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ABSTRACT

Rapid economic growth creates large differences in lifetime incomes across generations. This paper examines the intergenerational redistribution generated by subsidized access to appreciating public assets in rapidly growing economies. We show that providing incumbent generations with subsidized access to these assets before future growth is fully capitalized into market values gives them an early claim on subsequent economic growth, thereby redistributing resources from future to incumbent generations. In the context of housing privatization, subsequent capital gains on privatized housing enable homeowners to trade up, further amplifying housing demand, house prices, and intergenerational redistribution. We evaluate the early ownership and capital gains channels of asset-based redistribution in a quantitative equilibrium model calibrated to China's housing privatization. Relative to more standard pension-based redistribution, we show that asset-based redistribution delivers higher welfare for future cohorts while substantially reducing long-run fiscal burdens once economic growth unexpectedly slows.

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1 Introduction

Many emerging economies, including several East Asian economies, experienced prolonged episodes of rapid wage growth followed by an eventual slowdown. Such growth creates large differences in lifetime incomes across generations, as younger cohorts spend much of their working lives in a more productive economy than incumbent generations approaching retirement. Consequently, governments face the challenge of redistributing resources across cohorts whose lifetime earnings differ substantially because of economic transition.

The conventional policy instrument for intergenerational redistribution is fiscal policy through taxes and social security (Song et al., 2015). By promising generous pensions to incumbent generations, governments can transfer resources from future workers whose lifetime earnings are substantially higher. Such fiscal arrangements provide the natural benchmark for intergenerational redistribution because they explicitly link transfers received by current retirees to the earnings of future generations. Yet explicit fiscal redistribution becomes increasingly difficult to sustain once economic growth slows and populations age. Pension promises rely on future tax revenues that eventually weaken, while the number of beneficiaries continues to rise. Moreover, once established, generous pension commitments are politically costly to reverse. These considerations naturally raise the question of whether governments can redistribute across generations using policy instruments other than explicit fiscal transfers.

One class of policies that has received surprisingly little attention in this context is the subsidized sale of appreciating public assets. During periods of rapid industrialization and structural transformation, a number of emerging economies, such as Singapore, Korea, and China, subsidized purchases of public housing, land, or other appreciating public assets through a variety of institutional arrangements. Although these policies differed substantially in their implementation and immediate objectives, they shared a common economic feature: incumbent households acquired appreciating public assets before subsequent economic growth was fully capitalized into their prices, while the resulting capital gains were ultimately financed by future cohorts purchasing those assets at higher equilibrium prices. These experiences raise a natural question: what role can subsidized purchases of appreciating public assets play as an instrument for intergenerational redistribution during periods of rapid economic growth?

This paper argues that subsidized access to appreciating public assets constitutes an important instrument for intergenerational redistribution. By allowing incumbent households to acquire these assets before subsequent economic growth is capitalized into their market values, governments enable them to capture the resulting capital gains, which transfer resources from future generations to incumbent generations through higher future asset prices. In the context of housing privatization, this redistribution is further amplified as homeowners trade up to larger houses over the life cycle, fueling housing demand, house-price appreciation, and additional capital gains. Importantly, unlike explicit fiscal transfers, the extent of redistribution automatically adjusts to realized asset-price appreciation: faster economic growth generates larger capital gains, and hence greater intergenerational transfers, whereas slower growth naturally reduces redistribution without requiring subsequent policy reforms.

We formalize this argument in two complementary steps. We first develop a simple planner framework to show how subsidized purchases of appreciating public assets give initial cohorts an early ownership claim on subsequent asset appreciation. By allowing incumbent households, despite their initially low incomes, to purchase public housing at subsidized prices before subsequent economic growth is capitalized into housing values, the government gives them an early claim on future housing appreciation that can later be realized through resale. We show that when governments retain ownership of appreciating public assets but lack sufficient liquid fiscal resources to implement the first-best transfer to the initial cohort, subsidized selling prices provide an alternative instrument for intergenerational redistribution.

The simple model deliberately abstracts from an important equilibrium feedback. It takes the path of asset prices as given, whereas in practice housing prices respond to households' tenure and housing choices throughout the transition. By enabling incumbent households to acquire public housing early, purchase subsidies change the initial distribution of ownership and households' subsequent housing choices. As incomes rise, trade-up demand—from initial cohorts and, later, from subsequent cohorts—contributes to aggregate housing demand and equilibrium housing price appreciation. Subsidized purchases can therefore affect not only who receives future capital gains but also the equilibrium price path on which the magnitude of those gains depends.

To quantify this feedback, we develop a heterogeneous-agent overlapping-generations (OLG) model with housing where households make life-cycle tenure and housing choices under cohort-specific public housing policies. The framework allows us to quantify the magnitude and incidence of intergenerational redistribution generated by housing privatization and to compare its welfare consequences with those where redistribution operates through social security. We calibrate the policy parameters to China's housing privatization and discipline the remaining model parameters using household-level evidence on housing ownership across housing types, skill groups and cohorts, together with demographic, house-price, and other macroeconomic data.[1]

Our quantitative analysis delivers three main findings. First, subsidized asset purchases raise the welfare of the initial cohorts through both earlier access to home ownership and subsequent capital gains, with the relative importance of these channels varying substantially across different age groups in the initial cohorts. The capital gains channel remains quantitatively important even for older households because housing appreciation can be large relative to their remaining lifetime resources. Second, housing demand, including trade-ups over the life-cycle, plays an important role in determining equilibrium housing price appreciation. By changing the initial distribution of ownership and households' subsequent housing choices, the purchase subsidies to the initial cohorts affect the equilibrium housing price paths and, consequently, the capital gains accruing to the initial cohorts. It should be emphasized that the experiences of Singapore and South Korea further illustrate the broader relevance of these mechanisms; despite substantial differences in institutional design, both exhibit the same early-ownership and capital gains channels under alternative systems of subsidized housing acquisition and sale (Bardhan et al., 2003; Phang and Helble, 2016; Heo, 2012; Kim and Park, 2016).

Third, compared to an alternative pension reform that delivers similar welfare gains to incumbent generations, subsidized asset purchases generate higher welfare for future cohorts. This advantage arises because redistribution through appreciating public assets *automatically adjusts* with realized housing price appreciation as economic growth slows, whereas pension-based redistribution relies on fixed future obligations that become increasingly costly to finance as the tax base weakens.

Beyond the quantitative evaluation of China's housing reform, the paper makes two

[1] The Chinese housing privatization naturally maps into the model's policy parameters: the 1994 reform determines the eligibility of incumbent cohorts for subsidized purchases of public housing, while the 1998 reforms govern the elimination of new subsidized public-rental access and the introduction of mortgage finance.

broader contributions to the study of intergenerational redistribution. First, we introduce subsidized access to appreciating public assets as a distinct and novel policy instrument for intergenerational redistribution. Existing research has focused primarily on explicit fiscal instruments, including taxation, public debt, and social security, to reallocate resources across generations. Our analysis shows that governments can redistribute resources across generations through policies that subsidize the initial acquisition of appreciating public assets. This perspective helps explain why governments in rapidly growing emerging economies have frequently adopted policies that subsidize households' purchase of public housing or other appreciating public assets.

Second, we show that the extent of redistribution through asset price appreciation is endogenous. Existing studies typically treat asset-price movements as exogenous and examine their distributional consequences. By contrast, our analysis shows that subsidized asset purchases alter the initial distribution of ownership and subsequent housing choices, while aggregate housing demand, including life-cycle trade-up across cohorts, determines equilibrium housing price appreciation. The resulting intergenerational redistribution is therefore an endogenous equilibrium outcome.

Our paper is most closely related to the literature on redistribution induced by asset price changes. Glover et al. (2020) study how aggregate shocks redistribute welfare across generations through endogenous asset price movements in a quantitative overlapping-generations model, while Fagereng et al. (2025) develop a sufficient statistics framework to measure the welfare effects of asset price redistribution using Norwegian administrative data. Both papers study how asset price movements induced by large aggregate shocks redistribute wealth across households of different generations. In contrast, our paper examines the subsidized access to appreciating public assets as a policy instrument for intergenerational redistribution. Accordingly, policy affects redistribution through two channels: it determines who acquires appreciating assets before future growth is capitalized into prices, and it influences how much of that growth is ultimately capitalized into asset prices through homeowners' endogenous trade-up demand. Moreover, the durability of housing assets implies that subsidized asset purchases not only redistribute among incumbent cohorts, but also across cohorts yet to enter the economy.

More broadly, our paper contributes to the literature on intergenerational redistribution. Existing research has largely focused on redistribution through taxes, public debt, and social insurance.[2] Closely related to our paper, Song et al. (2015) study how alternative social security systems redistribute resources across generations in rapidly growing economies. Whereas this literature focuses on explicit fiscal transfers, we study the subsidized purchase of appreciating public assets as an alternative instrument for intergenerational redistribution. Whereas social security redistributes through explicit taxation on the labor income of future generations, subsidized asset purchases redistribute by granting incumbent generations preferential early ownership of appreciating assets, with subsequent capital gains carrying part of the redistribution across generations. Because redistribution is tied to the realized appreciation of asset prices rather than fixed pension promises, it automatically adjusts as economic growth slows, reducing the need for persistent fiscal commitments.

Finally, our paper contributes to the literature on housing privatization. Existing studies primarily examine the implications for the efficiency of housing allocations, wealth accumulation, housing demand, or the distribution of gains among incumbent households.[3] Rather than viewing housing privatization primarily as a housing-market reform, we reinterpret housing privatization as an instrument for intergenerational redistribution. This perspective highlights a previously overlooked role of housing reforms during episodes of rapid economic growth: they can serve as a mechanism for intergenerational redistribution, with both the housing price appreciation and the resulting redistribution endogenously determined through housing market equilibrium.

The remainder of the paper proceeds as follows. In Section 2 we develop a simple planner framework explaining why subsidized purchases of appreciating public assets can serve as an instrument for intergenerational redistribution; in Sections 3 and 4, we develop and calibrate a quantitative equilibrium model based on China's housing reforms, respectively; in Section 5 we quantify the redistributive effect of this policy, delineate the channels through which it operates, and discuss the broader relevance of the mechanism using the Singapore and South Korea experiences; in Section 6 we compare asset-based and pension-based redistribution from the perspective of cohorts who enter the economy after privatization, including both their welfare and the fiscal burdens they inherit; finally, in Section 7 we conclude.

[2] See, for example, Imrohoroglu and Zhao (2018b), Peterman and Sommer (2019) and Deng et al. (2023).

[3] See, among others, Wang (2011), Fang et al. (2010), Fang et al. (2016), Chen and Wen (2017) and Jiang et al. (2022) in the context of China's housing privatization.

2 A Simple Theory of Asset-Based Intergenerational Redistribution

This section develops a simple framework to illustrate how subsidized privatization of public housing can serve as an instrument of intergenerational redistribution. The economy begins with an initially poor cohort just before a temporary accelerated increase in wages. A social planner, therefore, has an incentive to redistribute resources toward this cohort. We first characterize the first-best allocation with cohort-specific lump-sum transfers and taxes. We then restrict the government's liquid fiscal resources and show how an endowment of public housing creates an alternative redistributive instrument. Appendix A contains the complete derivations and proofs of the propositions in this section.

2.1 Economic Environment

Households live for two periods. Cohort t values consumption and housing when young and only consumption when old. To capture rapid growth during economic transition, we assume that wages grow between periods 0 and 1 at a rate higher than that in the periods afterward, which grow at the constant rate g:

$$U_t = \log c_t^y + \phi \log h_t + \beta \log c_{t+1}^o, \qquad w_1 > (1+g)w_0, \quad w_t = w_1(1+g)^{t-1},\ t \geq 1, \tag{1}$$

where β is the discount factor for the household and ϕ is the utility weight on housing.

To highlight the direct effect of subsidized housing purchase as intergenerational redistribution, we abstract from the determination of house prices in this simple model, but we will discuss the feedback effects of house prices in the quantitative model in Section 3. Assume that housing is supplied perfectly elastically at prices $\{p_t\}$. Consequently, the user cost per unit of housing service is $q_t \equiv p_t - p_{t+1}/(1+r) > 0$, where r is the net risk-free interest rate. Thus, $q_t h_t$ is the user cost of housing services for cohort t.

2.2 First-Best Allocation and Lump-Sum Implementation

We first characterize the allocation chosen by the planner without taking a stand on how that allocation is implemented. We then ask what cohort-specific lump-sum transfers and taxes would decentralize the first best. Finally, we show that when the first-best transfer to the initial cohorts exceeds the government's liquid financial wealth, implementing the planner's allocation with lump-sum instruments requires taxing every future cohort.

Planner's First-Best Allocation. The planner enters period 0 with liquid financial wealth $A_0 > 0$ and can borrow or lend at the net rate r. With population growth rate n, feasible allocations satisfy

$$\sum_{t=0}^{\infty} \left(\frac{1+n}{1+r}\right)^t \left[c_t^y + q_t h_t + \frac{c_{t+1}^o}{1+r} - w_t\right] \leq A_0. \tag{2}$$

The planner chooses the entire sequence $\{c_t^y, c_{t+1}^o, h_t\}_{t\geq 0}$ to maximize:

$$\sum_{t=0}^{\infty} [\chi(1+n)]^t \left(\log c_t^y + \phi \log h_t + \beta \log c_{t+1}^o\right). \tag{3}$$

where $\chi > 0$ is the planner's relative welfare weight on successive cohorts. Assume $(1+n)\chi < 1$ and $(1+n)(1+g)/(1+r) < 1$, so that the welfare weights and the present value of wage income are summable. Under the restriction $\chi = (1+g)/(1+r)$ imposed below, these two conditions coincide. Let Λ denote the multiplier on the resource constraint. The planner's first-order conditions imply the first-best allocation

$$c_t^{y,FB} = \Lambda^{-1}\left[\chi(1+r)\right]^t, \qquad \frac{c_{t+1}^{o,FB}}{1+r} = \beta\Lambda^{-1}\left[\chi(1+r)\right]^t, \qquad q_t h_t^{FB} = \phi\Lambda^{-1}\left[\chi(1+r)\right]^t. \tag{4}$$

Thus, for each cohort, the planner allocates lifetime resources across young-age consumption, old-age consumption, and housing in fixed expenditure proportions. Across cohorts, desired lifetime expenditure grows at a rate $\chi(1+r)$ per period. Because the initial cohort has the unusually low wage w_0, whereas wage income experiences temporary faster growth, the planner optimally wants to shift resources to cohort 0 relative to what their own labor income can finance.

Implementing the First Best with Lump-Sum Transfers. Now suppose that the government can use cohort-specific lump-sum transfers, with a negative transfer interpreted as a lump-sum tax. A household in cohort t that receives T_t has a lifetime budget $c_t^y +$

$c^o_{t+1}/(1+r) + q_t h_t = w_t + T_t$. To reproduce the first-best allocation as in (4), the lifetime wealth of cohort t must equal the planner's desired total expenditure; hence, the required transfer to cohort t to implement the first-best allocation is

$$T_t^{FB} = (1+\phi+\beta)\Lambda^{-1}\left[\chi(1+r)\right]^t - w_t, \qquad t \geq 0. \tag{5}$$

The first argument on the right-hand side of Equation (5) captures the total desired life-time expenditure for cohort t, as implied by (4). The lump-sum transfer T_t^{FB} is then the amount required to decentralize that allocation for cohort t. The government's intertemporal budget implies

$$\sum_{t=1}^{\infty}\left(\frac{1+n}{1+r}\right)^t T_t^{FB} = A_0 - T_0^{FB}. \tag{6}$$

Thus, if the desired transfer to the initial cohort exceeds the government's liquid wealth, $T_0^{FB} > A_0$, the present value of transfers to future cohorts must be negative.

The Transfer Profile. To isolate redistribution associated with the initial wage gap rather than differences in long-run growth rates, impose $\chi = (1+g)/(1+r)$, which implies that the planner has no incentive for intergenerational redistribution among cohorts on the balanced-growth path. For $t \geq 1$, wages then grow at exactly the same rate as the planner's desired expenditure. It is useful to express each cohort's lump-sum transfer as a multiplier of the user cost of housing in the first-best allocation, or the so-called "transfer rate", which we denote as ς_t. Combining $w_t = w_1(1+g)^{t-1}$ with (4) and (5) gives

$$T_t^{FB} = \varsigma_t q_t h_t^{FB}, \qquad \varsigma_0 = \frac{1+\phi+\beta}{\phi} - \frac{w_0\Lambda}{\phi}, \qquad \varsigma_t = \varsigma \equiv \frac{1+\phi+\beta}{\phi} - \frac{w_1\Lambda}{(1+g)\phi}, \quad t \geq 1. \tag{7}$$

Thus, the transfer rate is constant for all cohorts born from period 1 onward. The initial cohort is different because it enters just before the economy moves onto the balanced-growth path. Since $w_1 > (1+g)w_0$, the planner assigns it a larger transfer rate. This implication is summarized in the following corollary.

Corollary 1. *Suppose $\chi = (1+g)/(1+r)$. Then the first-best lump-sum transfer rate is constant for all $t \geq 1$, $\varsigma_t = \varsigma$, and the initial cohort receives a strictly larger transfer rate: $\varsigma_0 > \varsigma_t$ for every $t \geq 1$.*

The intuition is straightforward. A utilitarian planner has no motive to redistribute across cohorts that all lie on the same balanced-growth path, so their desired transfers scale proportionally with their housing user costs. Cohort 0, however, is unusually poor relative to that path. The planner, therefore, shifts additional lifetime resources toward this cohort. Because the first-best instrument is a lump-sum transfer, this redistribution changes lifetime wealth without altering the relative price of housing and non-housing consumption, and hence does not distort the household's intratemporal allocation. The present-value condition (6) then pins down the sign of the common future multiplier ς: when $T_0^{FB} > A_0$, $\varsigma < 0$ and every future cohort is taxed; when $T_0^{FB} \leq A_0$, $\varsigma \geq 0$.

Proposition 2. *Suppose (1) holds and $\chi = (1+g)/(1+r)$. If $T_0^{FB} \leq A_0$, then $T_t^{FB} \geq 0$ for all $t \geq 1$. If $T_0^{FB} > A_0 > 0$, then $T_t^{FB} < 0$ for every $t \geq 1$. Thus, when the first-best transfer to the initial cohort exceeds the government's liquid financial wealth, implementing the planner's allocation with lump-sum instruments requires taxes on every future cohort.*

Proposition 2 implies that when $T_0^{FB} > A_0$, the planner still prefers the first-best allocation characterized above, but implementing it with unrestricted lump-sum transfers would require taxes on every future cohort. We now impose the intergenerational fiscal constraint that transfers to future cohorts cannot be negative. The constrained government therefore faces a shortfall in nondistortionary fiscal capacity. This creates a role for redistribution through assets already owned by the government.

2.3 Implementing the Transfer with Subsidized Asset Purchase

Suppose $T_0^{FB} > A_0 > 0$. Cash transfers alone are then insufficient to deliver the desired first-best transfer to the initial cohort. However, suppose that, in addition to limited liquid fiscal resources A_0, the government owns h^g units of public housing. We assume that public housing is committed to a housing-policy mandate, so its value is not freely available for general cash redistribution. The government can nevertheless transfer resources to eligible households by selling these assets below their market price. To characterize this possibility, let $p_0^g = (1-\eta_0)p_0$, with $\eta_0 \in [0,1)$, denote the subsidized purchase price. The per-unit subsidy is therefore $p_0 - p_0^g = \eta_0 p_0$. The initial household solves

$$\max_{c_0^y, c_1^o, h_0} \{\log c_0^y + \phi \log h_0 + \beta \log c_1^o\} \quad \text{s.t.} \quad c_0^y + \frac{c_1^o}{(1+r)} + (q_0 - \eta_0 p_0)h_0 = w_0 + A_0, \quad h_0 \leq h^g, \tag{8}$$

where $h_0 \leq h^g$ is the public-housing quantity constraint that a household is subject to when making housing decisions. Let T^H denote the transfer delivered by subsidized asset purchase for the initial cohort, $T^H \equiv \eta_0 p_0 h_0^{H*}$, where we use the superscript $H*$ to denote the allocation under subsidized privatization. This housing-linked transfer is the key new policy instrument. It allows the government to carry out redistribution beyond its limited liquid fiscal resources, but unlike a lump-sum cash transfer, it lowers the effective user cost of housing from q_0 to $q_0 - \eta_0 p_0$ and therefore changes relative prices. We now consider the following transfer profile

$$T^H = T_0^{FB} - A_0 > 0. \tag{9}$$

In other words, the effective total transfer to the initial cohort—the sum of the cash transfer A_0 and the transfer delivered through subsidized asset purchases, T^H—equals the first-best transfer T_0^{FB}, which we use as a benchmark transfer target. Holding the total transfer fixed provides a natural comparison with the first-best cash-transfer allocation: any welfare difference then reflects the distortion created by tying part of the transfer to housing rather than a difference in total resources. As Corollary 4 shows below, this distortion generally makes the initial cohort strictly worse off than under the first-best allocation, despite receiving the same total resources. Accordingly, under this particular transfer scheme, because the cash transfer to the initial cohort exhausts the government's liquid financial wealth, A_0, no liquid resources remain for cash transfers to future cohorts, and these transfers are therefore set to zero.[4]

Proposition 3. *Suppose $T_0^{FB} > A_0 > 0$, transfers to future cohorts are constrained to be nonnegative, and the market value of public housing is sufficient to cover the residual transfer, $T_0^{FB} - A_0 < p_0 h^g$. Under the housing-policy mandate described above, there exists a subsidized selling price $p_0^g = (1 - \eta_0)p_0 \in (0, p_0)$ that implements the residual transfer*

$$T^H = T_0^{FB} - A_0 > 0.$$

The required subsidy rate is given by Equation (A.16).

The transfer profile in Proposition 3 captures the redistributive role of subsidized privatization.

[4]Our purpose here is to illustrate how subsidized asset purchases provide an additional instrument for intergenerational redistribution when the government's capacity to make cash transfers is limited. We do not claim that this particular transfer profile is optimal within the restricted policy set.

When the government lacks enough liquid resources to implement the desired cash transfer, selling public housing below market value allows it to direct an additional positive transfer to the initial cohort. Appendix A.2 provides the detailed derivation underlying this implementation.

The fact that subsidized privatization expands redistributive capacity does not make it equivalent to a first-best cash transfer. When $T_0^{FB} > A_0$, the first-best allocation cannot be implemented through available cash transfers alone. A housing-linked transfer, instead, changes the effective price of housing and therefore generally distorts the initial cohort's allocation relative to the first-best cash-transfer benchmark. The resulting welfare comparison is summarized by the following corollary.

Corollary 4. *Under the conditions of Proposition 3, subsidized privatization generally yields a distorted allocation relative to the first-best cash-transfer benchmark. If the public-housing constraint is nonbinding, then*

$$U_0^{FB} > U_0^{H*}, \qquad h_0^{H*} > h_0^{FB}.$$

If the constraint binds, then $h_0^{H*} = h^g$ and

$$U_0^{FB} > U_0^{H*}$$

whenever $h^g \neq h_0^{FB}$. In particular, if $h^g < h_0^{FB}$, subsidized privatization leaves the initial cohort with less housing than under the first best.

The source of the distortion depends on whether the public-housing quantity constraint binds. When it is nonbinding, the purchase subsidy lowers the effective user cost of housing and induces the initial cohort to consume more housing and less non-housing consumption than under the first-best cash-transfer benchmark. When the quantity constraint binds, the household is restricted to h^g, and the allocation is distorted whenever this quantity differs from its first-best housing choice. In the case $h^g < h_0^{FB}$, the initial cohort consumes less housing than under the first best. This case provides a natural stylized counterpart to the quantitative model, where privatized public units are relatively small, and households may subsequently trade up to larger commercial housing.

The simple model therefore yields three results that motivate the quantitative analysis. First, implementing the first-best allocation with lump-sum instruments requires taxes on future cohorts when the initial cohort's desired transfer exceeds the government's liquid fiscal wealth. Second, subsidized sales of publicly owned housing provide an additional instrument for intergenerational redistribution when cash-transfer capacity is limited. Third, because this transfer is tied to housing purchases, it generally distorts the initial cohort's allocation relative to the first-best cash-transfer benchmark. The quantitative model builds on these insights by allowing subsidized public housing ownership, subsequent trade-up, and housing prices to be jointly determined in equilibrium.

3 The Quantitative Model

The simple model takes the asset price path as given and, therefore, abstracts from how housing choices, which are affected by housing purchase subsidies, will, in turn, affect subsequent asset price appreciation. The quantitative model endogenizes this feedback.[5] Subsidized privatization changes the initial distribution of homeownership, while households' subsequent tenure and housing-size choices, including life-cycle trade-up by both initial and later cohorts, shape aggregate housing demand and equilibrium house prices. The policy can therefore affect both the distribution of housing capital gains and the equilibrium price path that determines their magnitude.

To quantify this mechanism, we develop a multi-period overlapping-generations model with heterogeneous households, indivisible housing, mortgage down-payment constraints, and endogenous housing supply. The model has two key ingredients. First, it distinguishes smaller public housing units from larger commercial housing units. Combined with borrowing constraints, this distinction generates endogenous choices over renting, ownership, housing size, and trade-up over the life cycle, while endogenous housing supply allows these household choices to feed back into equilibrium prices.

Second, access to subsidized public housing is cohort specific. Initial cohorts that enter the economy before privatization may be eligible to purchase public housing at subsidized prices, while later cohorts lose access to subsidized purchases and, eventually, to subsidized public rental housing as well. These cohort-specific housing policies determine who obtains an early ownership claim on subsequent housing appreciation. As income growth becomes

[5] The quantitative model also allows for a richer fiscal structure: housing-policy subsidies are financed through the government's intertemporal budget, including initial liquid assets and labor-income taxation, rather than imposing the particular transfer profile considered in the simple model.

capitalized into housing values, the resulting capital gains are therefore distributed unevenly across generations, in particular, in favor of the initial generations that are relatively income poor, thus generating distinct welfare consequences across cohorts.

The remainder of this section proceeds as follows. We first describe household demographics, preferences, income risk, and pension income. We then specify the housing policy regime and describe the households' resulting tenure, housing-size, borrowing, and trade-up decisions over the life cycle. The production and government sectors complete the environment. We conclude by showing how households' housing choices and residential construction jointly determine housing market equilibrium. The complete definition of dynamic competitive equilibrium is relegated to Appendix B.

3.1 Households

Demographics. In each period, a continuum of households is born, and the newborn population grows at an exogenous rate $n_t \geq 0$.[6] Households live a maximum of J periods, where each period represents approximately five years in our quantitative exercises. They enter the economy as adults and work as workers until retirement age J_w. All households face a probability S_j of surviving up to age j, and they die at age J with certainty, where $S_j = \prod_{k=1}^{j} \psi_k$, and ψ_k is the conditional survival probability from age $k-1$ to age k. The fraction of households of age j at the calendar time t, denoted by $\mu_{t,j}$ is

$$\mu_{t,j} = \frac{\psi_j}{1+n_t}\mu_{t-1,j-1} \text{ for } j \in \{2, ..., J\}; \quad \mu_{t,1} = 1 - \sum_{j=2}^{J} \mu_{t,j}. \tag{10}$$

Preferences. All agents have identical preferences over an aggregate of consumption of goods, denoted by c, and housing services, denoted by s. For simplicity, households have perfect foresight about the aggregate transition once it begins, while continuing to face idiosyncratic income risk. For a household born in period $\tilde{t}$, his/her lifetime utility is:[7]

$$U_{\tilde{t}} = \mathbb{E} \sum_{j=1}^{J} \beta^{j-1} S_j \left\{ \log(c_{\tilde{t}+j-1,j}) + \phi \log(s_{\tilde{t}+j-1,j} - \underline{s}) + \iota \log(\mathbf{b}_{\tilde{t}+j-1,j} + \underline{\mathbf{b}}) \right\}. \tag{11}$$

[6] "Newborns" in our model correspond to twenty-one-year-olds who enter the labor market for the first time.

[7] $\tilde{t}+j-1$ in the subscript denotes the period when the cohort born in period $\tilde{t}$ is of age j.

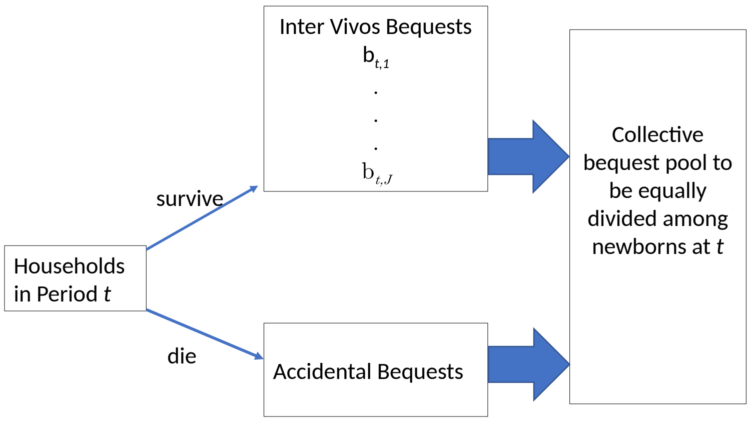

Figure 1: Inter-vivos Transfers and Accidental Bequests

In Equation (11), $\underline{s} > 0$ can be interpreted as the subsistence level of housing services; and $\iota \log(\mathbf{b}_{\tilde{t}+j-1,j} + \underline{\mathbf{b}})$ denotes the warm-glow utility from making inter vivos transfers in age j to children, where we follow De Nardi (2004) and De Nardi et al. (2010) and let $\underline{\mathbf{b}} > 0$ indicate that households will make positive inter vivos transfers only if their consumption level exceeds some threshold, suggesting that the inter vivos transfer is a luxury good. Note that agents can also leave accidental bequests at the time of their stochastic deaths, and we assume, to simplify the calculations, that they obtain no additional utility from leaving accidental bequests. The government will aggregate all inter vivos transfers and accidental bequests in the period t and evenly distribute them to newborns. Figure 1 depicts our modeling choice for bequests.

The total collectible intergenerational transfers to the newborn in period t can be expressed as

$$\sum_{j=1}^{J} \left[S_j \mathbf{b}_{t,j} N_{t,j} + (1 - S_j) N_{t,j} NW_{t,j} \right],$$

where $N_{t,j}$ is the size of the population of age j in period t, $NW_{t,j}$ is the average net worth of those who die at age j in period t. Their net worth varies among tenure status and asset positions and will be specified later.

Income Process. Household i's after-tax income in period t at age j, denoted by $y^i_{t,j}$, is given by:

$$y^i_{t,j} = \begin{cases} (1 - \tau^{ss}_t - \tau_t) w_t e^i_{t,j} & \text{if } j \leq J_w \\ b^i_{t,j} & \text{if } j > J_w, \end{cases} \tag{12}$$

where J_w is the pension eligibility age, w_t is the wage rate per unit of efficiency of labor supply; $e^i_{t,j}$ is i's efficiency units in period t at age j which is described below in Eq. (13); $b^i_{t,j}$ is the social security benefit (i.e., the pension) for a household i that is of age j in period t, which we describe in Eq. (15); τ_t and τ^{ss}_t are, respectively, the labor income tax rate and the social security tax rate in period t. τ^{ss}_t is determined to balance the government's intertemporal budget on social security, which we describe in Eq. (17).

The efficiency units of household i's labor supply in period t at age j is specified as:

$$e^i_{t,j} = \lambda^i \varepsilon_j z^i_t \epsilon^i_t, \tag{13}$$

where λ^i is a skill-specific component to capture the skill premium; ε_j is a life-cycle income profile that reflects, e.g., the experience effect; z^i_t is a persistent shock that follows an AR(1) process

$$\log(z^i_t) = \rho \log(z^i_{t-1}) + \nu^i_t, \tag{14}$$

where ν^i_t follows a standard normal distribution $N(0, \sigma_\nu)$; additionally, ϵ^i_t is a transitory shock drawn randomly from a log-normal distribution in each period. The stochastic income process, together with the borrowing constraint, allows us to generate heterogeneity among households in their timing, as well as their sizes, of housing purchases.

Social Security Benefits. The government pays social security benefits to retirees. For an individual household i that is of age $j > J_w$ in period t, the social security benefit in that period is determined as

$$b^i_{t,j} = \theta[(1 - \omega) y^i_{t-j+J_w, J_w} + \omega \bar{y}_{t-1}], \tag{15}$$

where $\theta > 0$ is the social security replacement rate at the time of retirement. J_w is the maximum working age, and $t - j + J_w$ is the last period the retiree would have worked at age J_w. Notice that a retiree's social security benefit, to a first-order approximation, is affected by the pensioner's own contribution to the system before he/she retires, as proxied by the term $y^i_{t-j+J_w,J_w}$, the before-tax wage earnings of the household i at its retirement age J_w, and the previous year's average wage among all workers, as proxied by $\bar{y}_{t-1}$, the average yearly earning of all workers in period $t-1$, which is given by

$$\bar{y}_{t-1} = \frac{\sum_{j=1}^{J_w} w_{t-1}\mu_{t-1,j} \int_i e^i_{t-1,j} di}{\sum_{j=1}^{J_w} \mu_{t-1,j}}. \tag{16}$$

$\omega \in (0,1)$ captures the relative weight on the economy-wide average wage and the household's own pre-retirement earnings. This specification accommodates pension systems with different degrees of earnings dependence and wage indexation. A larger ω links retiree benefits more closely to the earnings of current workers and therefore strengthens the intergenerational component of the pension system. To pin down the social security tax rate τ^{ss}_t in Eq. (12), we assume that τ^{ss}_t is constant over time and endogenously determined to balance the government's intertemporal pension budget, so that

$$\tau^{ss} \sum_{t=1}^{\infty} \frac{\sum_{j=1}^{J_w} w_t \mu_{t,j} \int_i e^i_{t,j} di}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{\sum_{j=J_w+1}^{J} \mu_{t,j} \int_i b^i_{t,j} di}{(1+r)^t}, \tag{17}$$

where the numerator on the right side is the total pension payments to retirees in period t and the numerator on the left side is the total labor income of all workers in period t.

3.2 Housing Policy Regime

Next, we specify the housing policy regime that determines the opportunity sets faced by households of different cohorts. The model represents public housing systems through cohort-specific rules that govern eligibility for subsidized purchase, the size of the purchase discount, access to subsidized public rental housing, and the timing of mortgage access. We distinguish three broad cohort groups. The *initial* cohorts are those already in the economy when privatization begins, and they may retain both subsidized rental access and the option to purchase their assigned public units; the *transitional* cohorts enter the economy after privatization begins and may retain access to subsidized public rental housing but do not have the option to purchase the public rental units; and the *post-transition* cohorts enter the economy after new access to subsidized public rental housing has ended, and they participate only in the commercial housing sector. These policy differences generate cohort-specific housing choice sets and therefore determine the incidence of housing privatization across generations. Section 4 maps them to China's housing reforms; however, the same structure can potentially accommodate other public housing systems by changing the eligibility, purchase discount, rental subsidy, and mortgage access schedules.

Pre-privatization State. Before period 1, the economy is in a pre-privatization steady state in which the relevant incumbent households occupy subsidized public rental housing. A public housing authority assigns a unit of size h_g^i to a household of permanent skill type λ^i, with h_g^i weakly increasing in skill type. Households pay an administratively determined rent. For tractability, we assume that the idiosyncratic income risk is perfectly insured in this initial steady state, and that the government budget is balanced. The equilibrium in this state determines the initial cross-sectional distribution when privatization begins in period 1. Appendix C specifies the corresponding household problem.

Housing Privatization. Public-housing privatization begins in period 1. From that period onward, households may rent a market unit $h_R \in \mathcal{H}_R = \{h_R^1, h_R^2, \ldots, h_R^{N_R}\}$ at market rent ρ_t, or purchase an owner-occupied market unit $h_O \in \mathcal{H}_O = \{h_O^1, h_O^2, \ldots, h_O^{N_O}\}$ at price p_t. For tractability, public rental units that remain in the rental sector are operated by competitive absentee rental intermediaries; the government can subsidize the rent paid by eligible households. A rental unit of size h provides housing service $s = h$; in contrast, an owner-occupied unit of size h provides housing services $s = \zeta h$, with $\zeta \geq 1$, while ownership entails maintenance costs $\delta_h p_t h$ and a proportional transaction cost $\tau_s p_t h$ upon sale.

Subsidized Purchase of Public Housing. Initial cohorts – households already in the economy before period 1 – can purchase the public unit they occupy at a subsidized price $p_t^g(j)$, where j denotes the age of the household in period t. They may also choose to continue to rent the same unit at a subsidized rent equal to a fraction ν of the market rent ρ_t, or move to a market rental unit or an owner-occupied commercial housing unit, where the last two options are not eligible for subsidies. Once an eligible household leaves its public unit for commercial housing, it permanently loses the option to purchase that public unit.

We parameterize the subsidized purchase price of the public unit as

$$p_t^g(j) = (1 - \eta_{t,j})p_t, \tag{18}$$

where $\eta_{t,j} \in [0, 1)$ is the policy-determined discount available to a household of age j in period t. The schedule $\{\eta_{t,j}\}$ can depend on the cohort, age, previous occupancy, or other eligibility criteria. Ineligible households do not have a purchase option. This formulation is sufficiently general to account for many country-specific discount rules; in Section 4 we specify the discount schedule used in our baseline calibration for China's housing privatization reform.

Withdrawal of Subsidized Public Rental Access. Let $T_R > 1$ denote the period in which new access to subsidized public rental housing ends. Cohorts that enter the economy at or after T_R, i.e., post-transitional cohorts, can no longer access the public rental sector. Cohorts that entered earlier may continue renting their assigned public units at the subsidized rate until they voluntarily leave, while subsidized purchase eligibility remains restricted to the initial cohorts. This cohort-specific withdrawal of public-housing access generates the housing choice sets that are central to the model.

Access to Mortgage Finance. Let T_M denote the period in which mortgage finance first becomes available to home buyers. From T_M onward, home buyers can partially finance their home purchases with mortgages, which are long term, subject to a fixed origination cost, and amortized over the buyer's remaining lifetime at the real mortgage rate r_m. At origination, the mortgage balance d is subject to a loan-to-value constraint governed by γ. For a household of age j with an outstanding balance d, the minimum per-period mortgage payment satisfies

$$m_j \geq m \equiv \frac{r_m(1 + r_m)^{J+1-j}}{(1 + r_m)^{J+1-j} - 1} d. \tag{19}$$

Accordingly, the principal evolves according to $d' = d(1 + r_m) - m_j$.

3.3 Household Housing and Tenure Decisions

At the beginning of each period, a household is in one of three tenure states: R_g, renting subsidized public housing; R_c, renting commercial housing; or O, owning a home. We denote this status by $I_t \in \{R_g, R_c, O\}$. Cohort-specific policy exposure determines the feasible

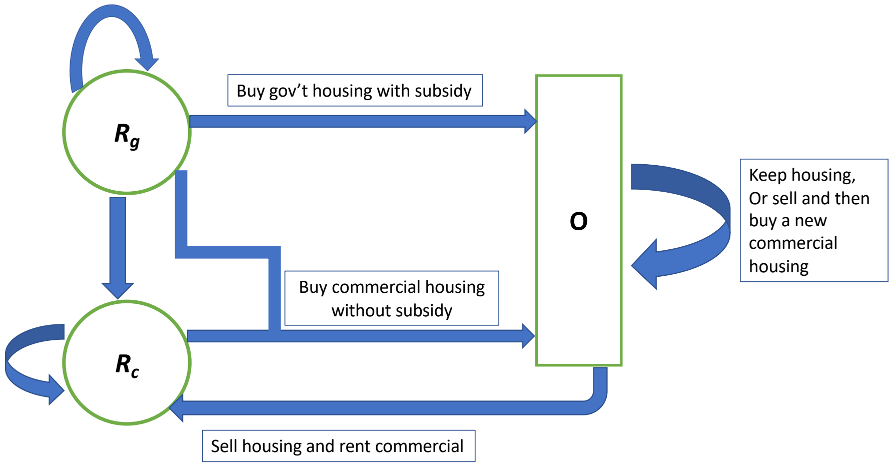

Figure 2: Housing Options for Initial Cohorts

transitions among these states. We summarize the choice sets for the three cohort groups below; and in Appendix C we formulate the household's recursive problems.

Initial Cohorts. The initial cohorts are already in the economy when privatization begins. A household that starts the period as a public renter ($I_t = R_g$) can continue renting its assigned public unit, or purchase that unit at the subsidized price $p_t^g(j)$, or move to a commercial rental unit, or purchase a commercial unit without a public-housing subsidy. Households that remain in their assigned public units take the housing size h_g^i as fixed and choose nondurable consumption and liquid savings. Households that move to commercial housing also choose the size of the house from $\mathcal{H}_R$ or $\mathcal{H}_O$. Before mortgage finance becomes available at T_M, purchases must be fully financed from the household's own resources; from T_M onward, buyers may also choose mortgage borrowing subject to the down-payment constraint.[8]

A household that is already a commercial renter ($I_t = R_c$) can rent or purchase only commercial housing. An owner ($I_t = O$), whether holding a privatized public unit or a market unit, can keep the current home, or sell it and purchase a market unit, or sell it and become a market renter. Upon sale, the household repays any outstanding mortgage balance and pays the transaction costs. Figure 2 summarizes these options.

The choice between purchasing the assigned public unit and moving directly into market

[8]For tractability, we assume that a public rental unit vacated by an eligible household can be costlessly absorbed outside the household sector.

ownership reflects a size–price trade-off. The subsidized public unit is cheaper but has a predetermined size, whereas commercial housing offers a broader size choice at the market price. Higher-income households may therefore move directly into market ownership. Middle-income households may initially purchase the smaller subsidized public unit and later sell it to trade up as income and savings increase, and/or when the capital gains from housing price appreciations become substantial. Lower-income households may remain in subsidized public rental housing while accumulating resources for a future down payment. This endogenous progression from renting public units to subsidized ownership and then to larger commercial housing is the key trade-up channel in the model.

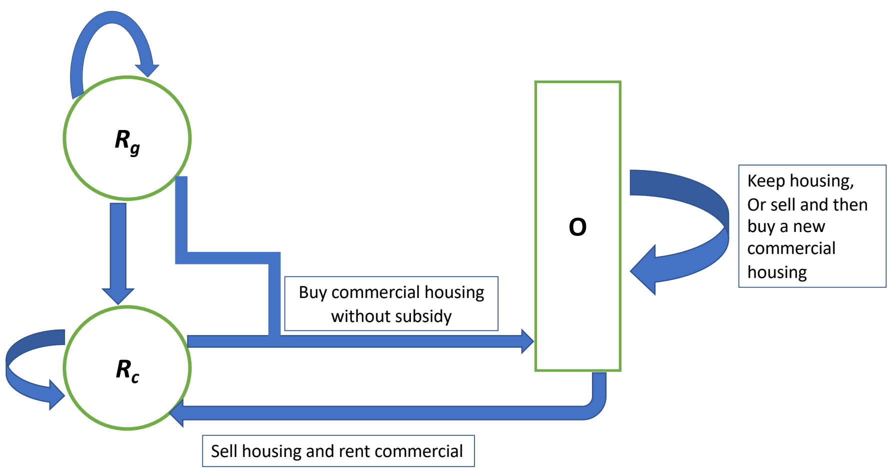

Figure 3: Housing Options for Transitional Cohorts

Transitional Cohorts. Transitional cohorts enter after privatization begins but before new access to subsidized public rental housing ends, that is, $1 \leq \tilde{t} < T_R$. They may enter or remain in subsidized public rental housing, but they are not eligible to purchase the public unit at a subsidized price. They may subsequently move to renting commercial units and, once sufficiently wealthy and mortgage-eligible, to buying commercial housing units. Figure 3 summarizes their housing options.

Post-Transitional Cohorts. Cohorts entering at or after T_R have no access to subsidized public rental or purchase programs and, therefore, choose only between renting and owning in the commercial housing sector. Ownership requires a down payment and, when mortgage finance is available, can be partially debt financed; its benefits include the housing-service flow from ownership and exposure to future house-price appreciation. Figure 4 summarizes their housing options.

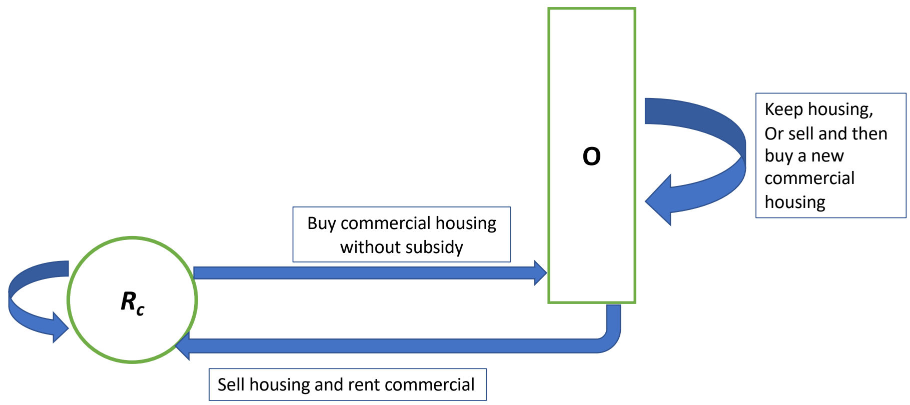

Figure 4: Housing Options for Post-transition Cohorts

3.4 Production

Following Kaplan et al. (2020), there are two production sectors in the economy: a final goods sector, which produces nondurable consumption (the numeraire good of the economy); and a residential construction sector, which produces new houses. Labor is perfectly mobile between the two sectors.

The consumption goods sector is competitive and operates under a constant returns-to-scale technology.

$$Y_t = \mathcal{A}_t N_{ct}, \tag{20}$$

where $\mathcal{A}_t$ denotes labor productivity and N_{ct} is the total units of labor services (in terms of efficiency units) used to produce consumption goods in period t. Therefore, the wage rate per efficiency unit of labor supply is given by

$$w_t = \mathcal{A}_t. \tag{21}$$

We assume that $\mathcal{A}_t$ evolves according to an exogenous process.

The residential construction sector sells newly built houses to both absentee rental companies and buyers of owner-occupied houses at a price p_t. Production requires new land L_t issued by the government and labor N_{ht} using constant returns to scale technology:

$$Y_{h,t} = (\mathcal{A}_t N_{ht})^{\alpha} L_t^{1-\alpha}, \alpha \in (0,1)\,. \tag{22}$$

Absentee rental companies lease apartments to households for rent ρ_t. Define the value of holding one apartment at time t as V_t, then the company maximizes

$$V_t = \max\{p_t, \rho_t + \frac{1}{1+r}(1-\delta_h)p_{t+1}\}.$$

Under perfect competition, free entry, and no arbitrage, the rental company must be indifferent between selling today and holding for rental plus resale. Therefore,

$$p_t = \rho_t + \frac{1-\delta_h}{1+r}p_{t+1}.$$

3.5 Government

In addition to balancing the intertemporal budget of the pension system, the government finances purchase discounts for eligible public-housing buyers and rental subsidies for eligible public-housing tenants. Because pension contributions are earmarked, the outlays related to the housing policy are financed through the government's initial liquid financial asset position at the beginning of period 1 and labor income taxation.[9] The resulting intertemporal budget constraint is as follows:

$$\begin{aligned} & A_0 + \sum_{t=1}^{\infty} \frac{1}{(1+r)^t} \tau w_t \sum_{j=1}^{J_w} \mu_{t,j} \int_i e_{t,j}^i di \\ & = \sum_{t=1}^{\infty} \frac{1}{(1+r)^t} \sum_{j=1}^{J} \left[\int \left[p_t - p_t^g(j)\right] h_g^i \mathbb{I}^{b_g}(x^R) d\mu_{t,j}^{R_g}(x^R) + \int (1-\nu)\rho_t h_g^i (1-\mathbb{I}^{b_g}(x^R)) d\mu_{t,j}^{R_g}(x^R) \right], \end{aligned} \tag{23}$$

In the above, we denote the vector of individual states for homeowners and renters by $x^O := \{y, z, h, d, i\}$ and $x^R := \{y, z, i\}$; $\mathbb{I}^{b_g}(x^R)$ is an indicator of whether an eligible public-housing renter with state x^R purchases the unit. $\mu_{t,j}^{R_g}(x^R)$ is the mass of subsidized public-housing renters with state variables x^R at the beginning of period t, before the purchase decision is made. The left-hand side of Equation (23) is the present value of government resources,

[9] This operational arrangement does not alter the status of these units as earmarked public assets, whose value is distinct from the government's liquid financial wealth A_0.

discounted to period 1, including the initial liquid financial asset position and labor income tax revenue.[10] The right-hand side is the present value of housing-policy outlays: the first term is the purchase discount on eligible public units, and the second is the subsidy on public rents. Hence, the policy transfers resources toward cohorts with preferential access to public housing and finances those transfers through the government's intertemporal fiscal resources.

3.6 Housing Market Equilibrium

The key equilibrium object of our mechanism is the commercial housing sector. Public units that remain in the subsidized rental sector are allocated outside the market and therefore do not enter the market-clearing condition unless households leave that sector. To describe aggregation, let $q \in \mathcal{Q} \equiv \{R_g, R_c, O_g, O_c\}$ index the housing states in the beginning of the period, where R_g and R_c are, respectively, the renters of public and commercial units, O_g denotes the owner of a privatized public unit, and O_c the owner of a market unit. This distinction is only for bookkeeping; both O_g and O_c belong to the owner state O described above. Let $\mu^q_{t,j}(x)$ denote the distribution of age-j households with state vector x in housing state q. Let $\mathbb{I}^{R_c}_t(x)$ indicate that a household chooses commercial rental housing, $\mathbb{I}^{B_c}_t(x)$ that it purchases a commercial house, and $\mathbb{I}^{S_g}_t(x)$ and $\mathbb{I}^{S_c}_t(x)$ that an owner sells a privatized public unit or a commercial unit, respectively. Finally, let $h^R_t(x)$ and $h^O_t(x)$ denote the sizes chosen for commercial rental and owner-occupied housing for households with state vector x. All of these policy functions depend on (p_t, ρ_t), which we suppress below to simplify the notation.

We first define the inherited commercial rental stock. In the absence of vacancies, the stock carried by competitive rental intermediaries from period $t-1$ is

$$H_{t-1} \equiv \sum_{j=1}^{J} \sum_{q \in \mathcal{Q}} \int h^R_{t-1}(x)\, \mathbb{I}^{R_c}_{t-1}(x)\, d\mu^q_{t-1,j}(x). \tag{24}$$

Thus, H_{t-1} is the stock of commercial rental housing inherited from the previous period.

The aggregate commercial-housing demand has three components. The first is housing used by commercial renters; the second is purchases of commercial housing by renters and existing owners, including trade-up purchases by owners of privatized public units; and the

[10] For simplicity, we assume that all government revenues from land sales are absorbed by contemporaneous government consumption and investment and therefore do not enter the intertemporal budget constraint. In practice, land sale revenues may finance infrastructure or other forms of public investment, which are outside the scope of the model.

third is replacement investment by owners who keep their current homes. Formally,

$$
\begin{aligned}
H_t^d(p_t,\rho_t) = & \underbrace{\sum_{j=1}^{J}\sum_{q\in\mathcal{Q}}\int h_t^R(x)\,\mathbb{I}_t^{R_c}(x)\,d\mu_{t,j}^q(x)}_{\text{market rental demand}} \\
& + \underbrace{\sum_{j=1}^{J}\sum_{q\in\mathcal{Q}}\int h_t^O(x)\,\mathbb{I}_t^{B_c}(x)\,d\mu_{t,j}^q(x)}_{\text{market purchase demand}} \\
& + \underbrace{\sum_{j=1}^{J}\left[\int \delta_h h_g^i\big(1-\mathbb{I}_t^{S_g}(x)\big)d\mu_{t,j}^{O_g}(x) + \int \delta_h h\big(1-\mathbb{I}_t^{S_c}(x)\big)d\mu_{t,j}^{O_c}(x)\right]}_{\text{maintenance and replacement demand}}. \qquad (25)
\end{aligned}
$$

The maintenance terms follow from household budget constraints: an owner who keeps a unit of size h spends $\delta_h p_t h$ on maintenance, which is interpreted as a replacement investment sufficient to compensate for physical depreciation.

Housing supplied to the market in period t comes from three sources: the undepreciated rental stock inherited from period $t-1$, units released by existing homeowners who sell, and newly constructed housing:

$$
H_t^s = (1-\delta_h)H_{t-1} + \sum_{j=1}^{J}\left[\int h_g^i\,\mathbb{I}_t^{S_g}(x)d\mu_{t,j}^{O_g}(x) + \int h\,\mathbb{I}_t^{S_c}(x)d\mu_{t,j}^{O_c}(x)\right] + Y_{h,t}, \qquad (26)
$$

where $Y_{h,t} = (\mathcal{A}_t N_{ht})^{\alpha} L_t^{1-\alpha}$ is new housing produced by the residential construction sector. Resales therefore reallocate existing owner-occupied units into the market, whereas $Y_{h,t}$ is the only source of newly produced housing.

The equilibrium house price p_t clears the market,

$$
H_t^d(p_t,\rho_t) = H_t^s, \qquad (27)
$$

while the rental rate is linked to the ownership price through the no-arbitrage condition of competitive rental intermediaries,

$$
p_t = \rho_t + \frac{1-\delta_h}{1+r}p_{t+1}. \qquad (28)
$$

This decomposition makes the trade-up channel transparent. When an owner of privatized public housing sells and purchases a larger commercial unit, the old unit enters resale supply through $\mathbb{I}_t^{S_g}$, while the larger replacement unit enters market demand through $\mathbb{I}_t^{B_c}$. The net increase in housing demand puts upward pressure on p_t, with the magnitude of the price response disciplined by new construction.

The quantitative framework isolates the two forces that determine the intergenerational redistribution of subsidized public housing purchases. Cohort-specific access to public housing determines which households acquire housing before subsequent economic growth is capitalized into market prices, while endogenous tenure and trade-up decisions determine how this initial allocation of ownership affects subsequent housing demand. Through housing market clearing, these household responses feed back into equilibrium housing prices and hence into the capital gains ultimately realized by different cohorts. The model therefore allows subsidized housing purchases to affect both the distribution and the equilibrium magnitude of housing capital gains.

We next take this framework to the data. In the benchmark quantitative application, we map the eligibility, subsidies, and mortgage-access policies of the model to China's housing market reform. We use the institutional timing of China's housing reforms together with its demographic, household, and housing market data to discipline the model and the strength of its key mechanisms. Appendix D summarizes the normalization used to express the growing economy in stationary units for computation.

4 Calibration

We calibrate the benchmark model to China's housing transition beginning in the 1990s. We organize the calibration into two groups. Section 4.1 describes parameters determined outside the model. Section 4.2 then describes the parameters jointly calibrated within the model to match the selected aggregate and cross-sectional moments. We conclude by assessing the model against several untargeted moments from the 2000 and 2005 population censuses.

4.1 Predetermined Model Parameters

We first set the parameters that are determined outside the model, using institutional features of China's housing transition, demographic evidence, estimates from the existing literature, and standard normalization choices. This includes mapping the housing-policy system in Section 3, namely the privatization date, cohort-specific purchase eligibility and discounts, subsidized rental access, and mortgage access, into the timing and generosity of China's reforms; and it also includes the parameters that govern the preferences, income-process, interest rates, etc. that we take from external sources, as well the exogenous productivity and population-growth paths. Table 1 summarizes these predetermined parameters.

Mapping the Housing Policy Regime to China. We anchor period 1 of the transition to 1994, when the State Council's *Decision on Deepening Urban Housing Reform* allowed incumbent employees in the state sector to purchase the public housing units they occupied at subsidized prices. The steady state before period 1 in Section 3.2 therefore represents China's pre-1994 urban housing system, in which the relevant incumbent households lived in public housing allocated through their work units. The initial cohorts in the model are households that were already in the economy at the beginning of 1994. In Chinese census data, privatized public house is commonly reported as "reform house"; we use that term below only when referring to the corresponding data category. Appendix E provides the institutional details that motivate this mapping.

Each model period represents approximately five years. We interpret period 1 as the 1994–1998 transition block and period 2 as beginning after the 1998 reforms. Policy changes occurring within a five-year block are assigned to the closest model period. This discretization is particularly relevant for the reforms introduced in 1998.

The July 1998 housing reform ended the creation of new work-unit housing for employees, while households already in the public-housing system could continue occupying their assigned units at subsidized rents until they moved out. We capture this change by setting $T_R = 2$: cohorts that enter the economy from period 2 onward have no new access to subsidized public rental housing, whereas households that entered during or before period 1 retain the public rental option until they leave the public housing sector. Mortgage finance was introduced at essentially the same stage of the transition. In April 1998, the People's Bank of China authorized commercial banks to issue residential mortgage loans and permitted loan-to-value ratios of up to 70 percent. We therefore set $T_M = 2$ and the minimum down-payment ratio at $\gamma = 0.30$ from T_M onward. Before T_M, housing purchases must be financed entirely from the household's own resources.

Only households already in the economy when privatization begins are eligible to purchase their assigned public units at subsidized prices. To map the discount $\eta_{t,j}$ in Equation (18) to the Chinese housing subsidy rule, we follow the formula based on seniority used in the previous quantitative specification. Specifically, for an eligible initial-cohort household of age j in the year 1994, we set:

$$\eta_{t,j} = \frac{\min\{j + 5 - t,\ J_w + 5\}}{J_w + 5} \times 65 \times 0.009, \tag{29}$$

where $j + 5 - t$ is a seniority index that is increasing in the household's age at the beginning of privatization and is therefore constant along a cohort's subsequent life cycle; capping it at $J_w + 5$ limits the credit to a full working life. The factor 65 represents the combined maximum effective working years of a husband and wife under the policy rule, and each credited year reduces the purchase price by 0.9 percent. The maximum purchase discount is therefore $65 \times 0.9\% = 58.5\%$, and it is reached only by households older than 60 in 1994; the discount declines linearly with age, to 22.5% for those aged 21–25 in 1994. This schedule gives larger subsidies to older incumbent cohorts with longer pre-1994 labor-market tenure, while households entering the economy in or after period 1 receive no subsidized purchase option. Eligible households that do not purchase their public unit may continue to rent it at the subsidized rate $\nu\rho_t$; we set $\nu = 0.20$, so public-housing tenants pay 20 percent of the market rent.

Demography and Income Process. Households enter the economy at age 21, and each model period corresponds to five years. We set the maximum lifetime at $J = 14$, corresponding to ages 21–90, and the working life at $J_w = 8$, corresponding to ages 21–60. The Age-specific survival probabilities, $\{S_j\}$, are taken from Imrohoroglu and Zhao (2018a). The top panel of Appendix Figure F.1 plots the path of population-growth n_t. In the initial steady state, population growth is set to 2.4 percent, the average growth rate of China's working-age population through 1995. Between 1995 and 2015, we use the United Nations series for working-age population growth. From 2016 to 2045, we use the projected growth rate of 0.088 percent and set population growth to zero thereafter.[11]

For the labor-efficiency process in Equation (13), we consider two types of skills, L and H, and normalize the low-skill component to $\lambda^L = 1$. The life-cycle profile ε_j is taken from He et al. (2017), who estimate it using data from the China Health and Nutrition Survey (CHNS). The persistent component z_t^i follows the AR(1) process in Equation (14); following He et al. (2017), we set the persistence parameter at $\rho = 0.84$ and the dispersion of persistent innovation at $\sigma_\nu = 0.055$, and discretize the process into a seven-state Markov chain using the Tauchen method. The transitory shock is log-normally distributed with dispersion $\sigma_\epsilon = 0.03$, following Fan et al. (2010). The high-skill component λ^H is instead jointly calibrated below because it is chosen to match the homeownership rate of skilled households.

Preferences, Housing, and Financial Parameters. Because each period of the model represents five years, we set the discount factor to $\beta = 0.59$, corresponding to an annual discount factor of 0.90. The five-year housing depreciation rate is set at $\delta_h = 0.226$, which corresponds to an annual depreciation rate of 5 percent based on OECD estimates for urban owner-occupied housing in China. The annual savings interest rate is set to $r = 0.02$, matching the real interest rate in 1994, and the mortgage rate is set to $r_m = 0.05$. We set the proportional seller transaction cost to $\tau_s = 0.12$, following Guren et al. (2021). The construction-technology parameter is set to $\alpha = 0.8$, implying a price elasticity of the new housing supply of 4, close to the average estimate for 35 major Chinese cities reported by Wang et al. (2012). The parameters governing the utility weight on housing, subsistence housing services, the inter vivos transfer motive, the owner-occupancy premium, and the sizes of public housing units are jointly calibrated and, therefore, discussed in Section 4.2.

Productivity and Government Policy. The pre-reform TFP growth rate is set at 4.2 percent, the average growth rate of urban wages over 1980–1993. During the transition, the TFP path $\{\mathcal{A}_t\}_{t=1}^{T}$ is chosen to match urban hourly wage growth: 10.8 percent during 1994–2010, 8.1 percent during 2010–2020, and 5.0 percent during 2021–2050. After 2050, we assume an annual TFP growth rate of 2 percent. The bottom panel of Appendix Figure F.1 plots the resulting TFP path. We normalize the initial level of TFP to $\mathcal{A}_1 = 1.3$ so that the average wage in 2005 is equal to one, and we accordingly normalize house prices. The

[11] China's demographic transition accelerated after 2010. The average growth rate of the working-age population fell from 1.73 percent during 2005–2010 to 0.66 percent during 2010–2015.

social-security replacement rate is set to $\theta = 0.6$, the replacement rate for retirees covered by the system during 1997–2011 as reported by Song et al. (2015). The government's initial liquid financial asset position is not predetermined; it is jointly calibrated below to match the average labor income tax rate.

4.2 Jointly Calibrated Model Parameters

We next choose the remaining parameters jointly so that the model matches a set of aggregate and cross-sectional moments from China's housing transition. The main household level data sources are the 2000 and 2005 population censuses, which report whether households rent or own privatized public housing (reported in the censuses as "reform house"). The targeted moments discipline household preferences, skill heterogeneity, the sizes of public housing, the government's initial fiscal position, and the housing supply response.

Household Preferences and Heterogeneity. We choose the high-skill component λ^H to match the homeownership rate of skilled households in 2000. The utility weight on housing services, ϕ, is chosen to match a share of housing-consumption expenditure of 20 percent, while the subsistence housing service parameter $\underline{s}$ is chosen to match a rental-demand price elasticity of -0.8, following Stephen et al. (1981). The parameters ι and $\underline{b}$ govern the strength and curvature of the inter vivos transfer motive and are calibrated to match the ratio of wealth at age 75 to wealth at age 50 and the median wealth-to-income ratio. Finally, the owner-occupancy service premium ζ is chosen to match the aggregate homeownership rate in the 2000 census.

Housing Sizes and Housing Supply. We choose the size of the smaller public housing unit, h_g^L, to match the 2005 housing price-to-income ratio reported by Fang et al. (2016). The size of the larger public unit, h_g^H, is chosen to match the population share of households owning privatized public housing in 2000. Owner-occupied commercial housing is available in six sizes: the two smallest sizes in commercial market coincide with the two public-housing sizes, while the largest market unit is five times the size of the smallest unit. Commercial rental housing is available in four sizes that correspond to the four smallest owner-occupied commercial units. Along the transition, the land-supply path L_t is chosen to match the observed evolution of house prices; Appendix Figure F.2 plots the calibrated land-supply

Table 1: Predetermined Model Parameters

Parameter	Description	Value	Source or target
J	Lifetime	14	Age 21–90
J_w	Working life	8	Age 21–60
δ_h	Five-year housing depreciation rate	0.226	OECD estimates (5% annual)
θ	Social-security replacement rate	0.6	Song et al. (2015)
β	Five-year discount factor	0.59	0.90 annual discount factor
ρ	Persistence of income shock	0.84	He et al. (2017)
σ_ν	Std. dev. of persistent shock	0.055	He et al. (2017)
σ_ϵ	Std. dev. of transitory shock	0.03	Fan et al. (2010)
$t = 1$	Privatization begins	1994	1994 housing reform
T_R	End of new public-rental access	2	1998 housing reform
T_M	Mortgage-market access	2	1998 mortgage reform
ν	Public-rent fraction	0.20	Housing policy
$\eta_{t,j}$	Purchase-discount schedule	Eq. (29)	Seniority-based rule
γ	Minimum down-payment ratio	0.3	70% maximum LTV after T_M
r	Saving interest rate	0.02	Real interest rate in 1994
r_m	Mortgage interest rate	0.05	Benchmark value
α	Construction labor share	0.8	Wang et al. (2012)
τ_s	Seller transaction cost	0.12	Guren et al. (2021)
$\{\mathcal{A}_t\}$	TFP path	Appendix Figure F.1	Urban wage growth, 1994–2050
$\{n_t\}$	Population growth path	Appendix Figure F.1	Working-age population growth, 1994–2050
$\{S_j\}$	Age-specific survival probabilities		Imrohoroglu and Zhao (2018a)
$\{\varepsilon_j\}$	Life-cycle income profile		He et al. (2017)
$\mathcal{A}_1$	Initial TFP level	1.3	Normalize average wage in 2005 to one

path together with the housing price series.

Government Assets. The government's initial liquid asset position A_0 is calibrated to match an average labor income tax rate of 10 percent. This target disciplines the fiscal resources available to finance the purchase discounts and public-rental subsidies described in Section 4.1.

Table 2 summarizes the jointly calibrated parameters, their target moments, and the corresponding model fit.

4.3 Model Fit and Untargeted Moments

Table 3 evaluates the model against cross-sectional homeownership moments by housing type, skill, and age. Only a small subset of these moments is directly targeted in the calibration: the aggregate homeownership rate, the share of households owning privatized public housing (i.e., reform houses), and the homeownership rate of high-skilled households in 2000. The remaining entries, including all 2005 moments and the age profiles of homeownership rates in both years, are untargeted. The table therefore provides a useful assessment of whether the calibrated model reproduces dimensions of household homeownership behavior that are not mechanically imposed by the calibration.

Housing Type. Panel A compares aggregate homeownership and its composition between privatized public and commercial housing. In 2000, the model closely matches the targeted aggregate homeownership rate, 71.0 percent compared with 69.7 percent in the data, and the targeted share owning privatized public housing, 48.0 percent compared with 51.3 percent. More importantly, the model continues to match the untargeted aggregate homeownership rate in 2005: 73.6 percent in the model versus 75.3 percent in the data. The model understates the 2005 share of households owning privatized public housing by about 3 percentage points and correspondingly overstates commercial homeownership. One possible reason is that some state-owned enterprises and nonprofit institutions continued to provide housing subsidies to employees beyond the main privatization episode, a margin not captured by the benchmark model. Even with this discrepancy in composition, the close fit of the aggregate ownership rate indicates that the model captures the overall transition into homeownership well. Appendix Figure E.1 provides complementary evidence on the dynamics

Table 2: Jointly Calibrated Model Parameters

Parameter	Description	Value	Target	Data	Model
ζ	Owner-occupancy service premium	1.65	Homeownership rate in 2000	0.697	0.710
ι	Strength of inter vivos transfer motive	0.85	Wealth ratio, age 75 to age 50	0.82	0.81
$\underline{b}$	Curvature of transfer motive	0.12	Median wealth-to-income ratio	0.634	0.60
ϕ	Weight on housing services	5.6	Rental expenditure share	0.20	0.20
$\underline{s}$	Subsistence housing service	0.17	Rental-demand price elasticity	-0.8	-0.8
h_g^L	Size of smaller public unit	9.1	House-price-to-income ratio	9.0	9.0
h_g^H	Size of larger public unit	12.7	Share owning privatized public housing in 2000	0.513	0.480
λ^H	Skill premium	1.49	Skilled-household ownership rate in 2000	0.749	0.762
A_0	Initial government liquid assets	5.3	Labor income tax rate	0.1	0.1
L_t	Land-supply path	Appendix Figure F.2	House-price dynamics		

of this composition: in the Chinese Urban Household Survey (UHS), the share of privatized public housing declines between 2002 and 2009, while the share of commercial housing rises, consistent with the model's transition from early ownership of privatized public units toward greater commercial housing ownership.

Skill. Panel B shows that the model also reproduces the cross-sectional ownership pattern by skill. In 2000, predicted homeownership rates are 64.7 percent for unskilled households and 76.2 percent for skilled households, compared with 67.2 and 74.9 percent in the data. In 2005, which is untargeted apart from parameters disciplined using other moments, the model continues to reproduce the higher homeownership rate of skilled households: 83.3 percent in the model versus 79.3 percent in the data. The model somewhat understates ownership among unskilled households in 2005, 65.3 percent compared with 73.8 percent, but preserves both the ranking across skill groups and the broad magnitude of ownership rates. This fit is important for our mechanism because skill heterogeneity affects both the size of assigned public housing units as well as households' incentives and ability to trade up into larger commercial units.

Age. Panel C provides a comparison of the simulated age-specific ownership rates with their data counterparts. Note, again, that none of the age-specific ownership rates is targeted. The model reproduces the broad hump-shaped life-cycle profile in both census years: homeownership is highest among middle-aged households and lower among the youngest and oldest groups. In 2000, the model predicts ownership rates of 60.3, 72.8, and 60.0 percent for ages 21–30, 31–60, and 61–90, compared with 57.0, 70.5, and 63.4 percent in the data. In 2005, the corresponding model values are 63.0, 73.8, and 65.8 percent, compared with 54.5, 77.7, and 73.6 percent in the data. Although the model overpredicts ownership among the youngest households and underpredicts it among the oldest in 2005, it captures the central life-cycle pattern without directly targeting these moments. This suggests that the combination of income growth, borrowing constraints, inter vivos transfers, accidental bequests, and endogenous tenure choices generates an empirically plausible age profile of homeownership.

Overall, the calibrated model reproduces the main cross-sectional patterns of housing ownership that are central to our mechanism, including differences across housing types,

Table 3: Model Fit: Homeownership by Housing Type, Skill, and Age

	2000		2005	
	Data	Model	Data	Model
Panel A. Homeownership by housing type				
Overall	0.697	0.710	0.753	0.736
Reform House	0.513	0.480	0.431	0.399
Commercial House	0.184	0.230	0.322	0.338
Panel B. Homeownership by skill group				
Overall	0.697	0.710	0.753	0.736
Unskilled	0.672	0.647	0.738	0.653
Skilled	0.749	0.762	0.793	0.833
Panel C. Homeownership by age				
21-30	0.570	0.603	0.545	0.630
31-60	0.705	0.728	0.777	0.738
61-90	0.634	0.600	0.736	0.658

Notes: Panel A reports aggregate homeownership and its composition between privatized public (i.e., reform) and commercial houses. The 2000 aggregate homeownership rate and the 2000 share owning reform houses are targeted moments in the calibration; the 2005 entries are untargeted. Panel B reports homeownership by skill group. The skilled-household ownership rate in 2000 is a calibration target, while the remaining entries are untargeted. Panel C reports homeownership by age group; all entries in this panel are untargeted.

skill groups, and ages. These cross-sectional fits provide discipline on the cohort-specific entry into homeownership and life-cycle housing adjustments that underpin the redistributive mechanism studied below.

5 Quantifying Intergenerational Redistribution through Subsidized Housing Purchases

This section quantifies how public house purchase subsidies redistribute resources toward the initial cohorts and distinguishes two conceptually distinct channels through which this redistribution arises. The first channel, the *early-ownership channel*, builds directly on the housing-linked transfer in the simple model: it captures the welfare gain from subsidized access to homeownership, holding the equilibrium house-price path fixed. The second channel, the *capital gains channel*, captures the additional redistribution generated by the endogenous appreciation of the housing assets acquired by the initial cohorts. Because house prices are determined by aggregate housing demand over the transition, including life-cycle trade-up across cohorts, the quantitative model endogenizes the housing price growth that is taken as given in the simple model.

Section 5.1 first documents the baseline patterns in homeownership, trade-up activity, and realized capital gains across the initial cohorts. Section 5.2 then compares the benchmark with a general-equilibrium no-subsidy economy and a price-imputation counterfactual to decompose the welfare gains of the initial cohorts into the early-ownership and capital-gain channels. Section 5.3 examines Singapore and South Korea to show how the same channels can operate under different forms of housing subsidy schemes.

5.1 The Mechanism: Early Ownership, Trade-Up Demand, and Capital Gains

In this subsection, we document the baseline outcomes underlying the redistribution mechanism. We begin with life-cycle ownership profiles across age groups within the initial cohorts, then examine the importance of trade-up purchases for the commercial housing demand and the financing of those purchases. We conclude by quantifying realized capital gains across age groups and over time. These benchmark patterns provide the basis for the counterfactual decomposition in Section 5.2.

Figure 5 plots the age profiles of the ownership of reform and commercial houses for four selected age groups of the initial cohorts. In the Chinese application, panels (a)–(d) correspond, respectively, to households born in 1965–1969, 1955–1959, 1945–1949, and 1935–1939.[12] Despite the lack of mortgage financing back in 1994 (mortgage financing did not become available until 1998), a substantial fraction of all four groups purchased their assigned public units early in the transition. For the younger initial cohorts, ownership of reform houses declines and commercial housing ownership rises, revealing a pronounced trade-up pattern. The oldest group behaves differently: for households born in 1935–1939, commercial housing ownership peaks at around age 65 and then begins to decline. These profiles show that the extent of subsequent trade-up differs substantially across age groups. However, they do not imply that the capital gains channel is small for older households since appreciation also raises the value of privatized public units that remain in their portfolios. Section 5.2 quantifies this age heterogeneity directly in welfare terms.

Figure 6 shows the quantitative importance of trade-up purchases for commercial housing demand during the transition. Trade-up purchases by owners of privatized public housing account for about 68% of the commercial housing demand in 2000 and 54% in 2005. Their contribution decreases to about 20% in 2010 and 17% in 2015 as first-time buyers and households from later cohorts become increasingly important. Thus, trade-up from privatized public housing is an important source of demand for commercial housing early in the transition, while the composition of demand for commercial housing broadens over time. By changing the initial distribution of ownership and the subsequent housing choices of the initial cohorts, the purchase subsidies provided to the initial cohorts affect this transition in demand, and thereby the equilibrium housing price path. Trade-up by later cohorts also contributes to commercial housing demand as the economy grows.[13]

Figure 7 provides evidence on how capital gains finance trade-up purchases. It plots the distribution of loan-to-value (LTV) ratios at origination for households in the initial cohort when they trade up from their reform housing to purchase a commercial house relative to that for first-time homebuyers. Since most first-time buyers borrow up to the LTV limit of

[12] For each group within the initial cohorts, the x-axis starts from its corresponding age in 1994 and extends to age 80.

[13] In this exercise, we count as trade-up transactions only households that sell privatized public housing and purchase commercial housing within the same model period; households that purchase commercial housing several periods after selling their previous home are not classified as trade-up buyers.

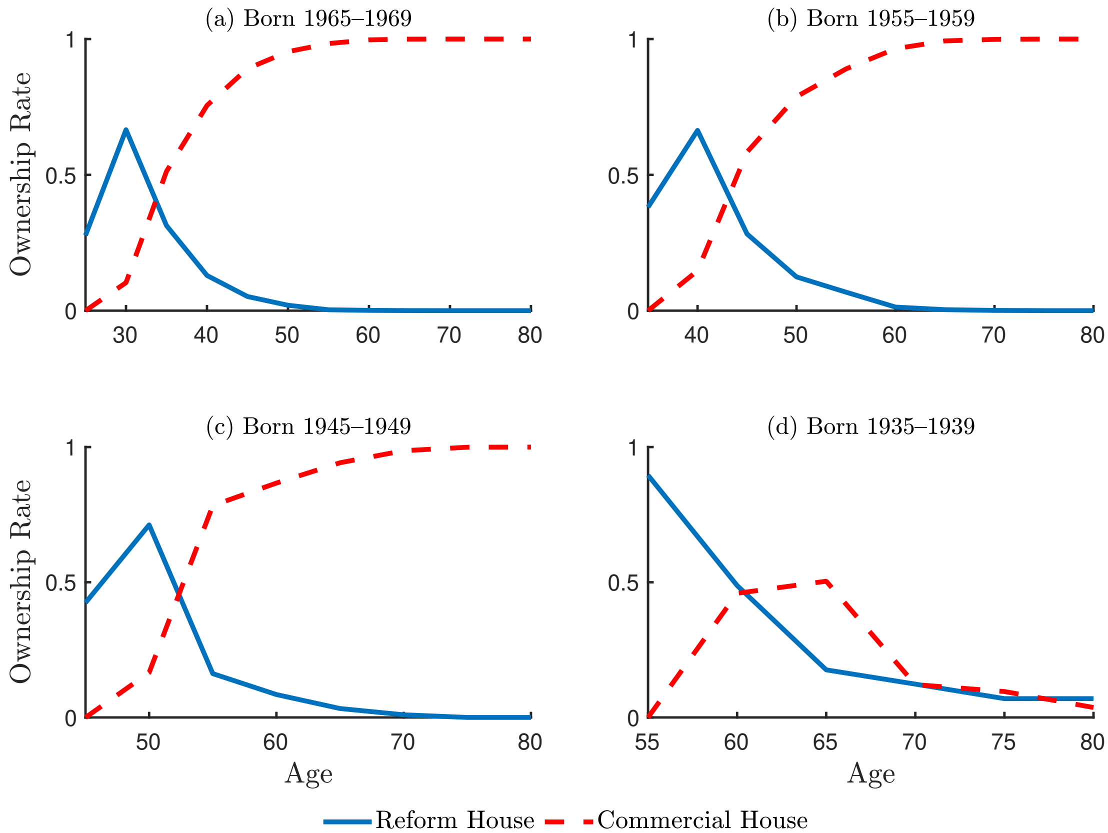

Figure 5: Home Ownership Rates, by Type of Houses, over the Life Cycle among Four Selected Age Groups of Initial Cohorts

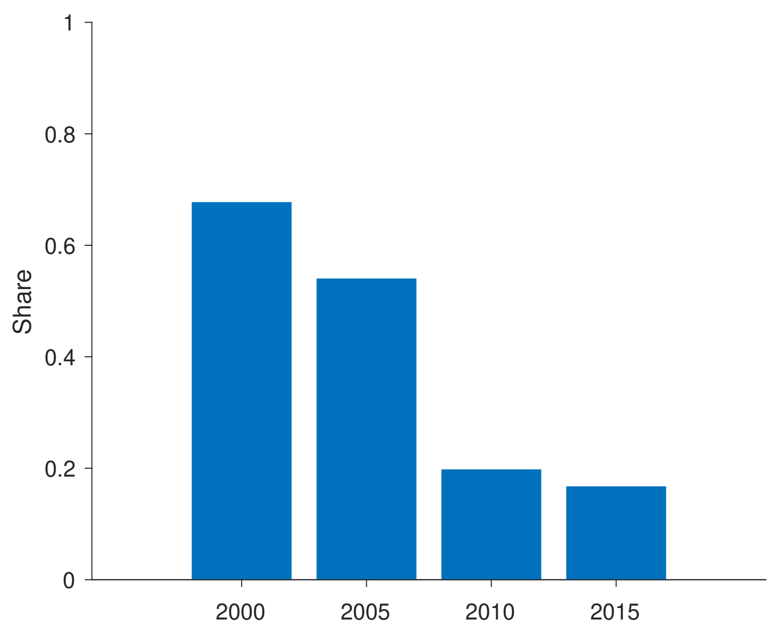

Figure 6: Importance of Trade-Up for the Demand for Commercial Housing Over Time

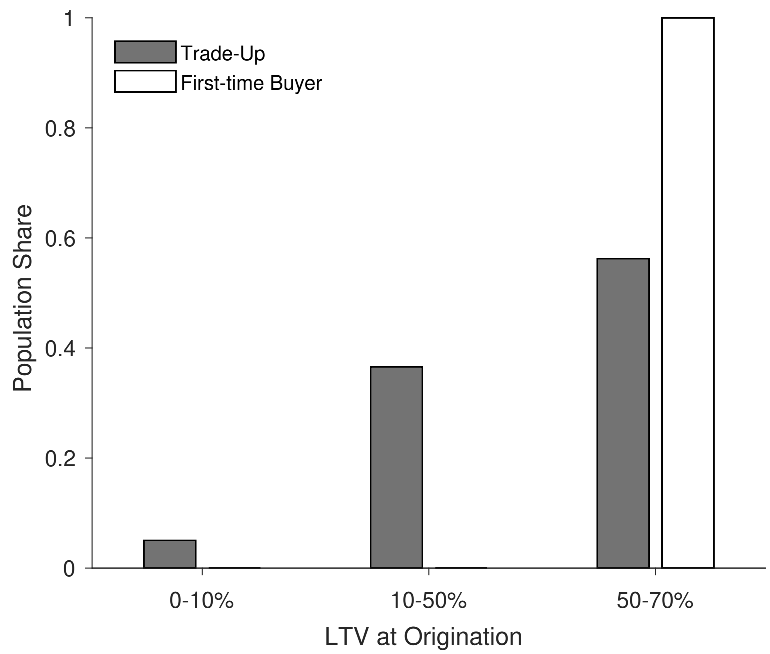

Figure 7: LTV Distributions for Trade-up and First-time Homebuyers

70%, their LTV ratios are all concentrated in the 50-70% range. In contrast, the trade-up buyers rely less heavily on mortgage debt: about 37 percent of them choose LTV ratios in the 10-50% bin, and about 5 percent take even smaller mortgages with LTV in the 0-10% bin. The proceeds from selling the privatized public unit they previously purchased with subsidies, including the realized capital gains, therefore help finance the down payment on the larger commercial unit. Appreciation can thus relax the financing constraint on upgrading, while trade-up contributes to aggregate market-housing demand and equilibrium price growth.

Table 4: Realized Capital Gains Relative to Contemporaneous Average Wages

Age in 1994	2000	2005	2010	2015	2020	2025
21-25	5.68	6.26	6.38	5.73	5.09	4.44
26-30	5.86	6.36	6.45	5.78	5.12	4.46
31-35	6.04	6.47	6.51	5.82	5.15	4.48
36-40	6.22	6.58	6.58	5.86	5.18	4.51
41-45	6.40	6.69	6.64	5.91	5.21	4.53
46-50	6.58	6.80	6.71	5.95	5.24	4.55
51-55	6.76	6.90	6.77	6.00	5.27	4.58
56-60	6.94	7.01	6.84	6.04	5.30	4.60
>60	7.12	7.12	6.90	6.08	5.33	4.62

Table 4 quantifies the magnitude of the capital gains realized when the households in the initial cohort sell the reform houses they purchased in 1994 in later years, relative to the contemporaneous average wages in the year of the sale. On average, the realized capital gains are roughly four and a half to seven times the contemporaneous average wage and are largest if the sales take place between 2005 and 2010; the ratio started to decline after 2010 because wages began to rise faster than housing prices. Table 4 also shows that, conditional on selling in a given year, the capital gain rises with the households' age in 1994 when the housing privatization reform began, because the seniority-based purchase subsidy schedule (as in Equation 29) is more generous for households with longer pre-privatization labor-market tenure, with the cap in Equation (29) binding only for households older than 60 in 1994. These capital gains can remain important for older initial cohorts even though Figure 5 shows that they trade up less than younger cohorts. Once a household has acquired a privatized public unit, equilibrium housing price appreciation raises the value of that asset and can be realized either through resale or preserved through bequests. Because older households also have relatively little remaining labor market earnings, capital gains from the housing price appreciation can be large relative to their remaining lifetime resources. Section 5.2 directly quantifies this age-specific incidence of housing purchase subsidies in welfare terms.

5.2 Decomposing the Early-Ownership and Capital Gains Channels

We next conduct several counterfactual experiments to quantify the two channels identified above. We begin with a full general-equilibrium counterfactual in which the public-housing purchase subsidy is removed: the discount schedule $\eta_{t,j}$ in Equation (18) is set to zero; the initial cohorts in 1994 may still purchase their assigned public units, but at the full market price.[14] We recompute the entire transition equilibrium for this counterfactual economy, which we refer to as the *No Purchase Subsidy* economy, and denote its equilibrium house-price path by $\{p_t^{NS}\}$. Comparing this economy with the baseline shows how the purchase subsidies provided to the initial cohorts for their purchases of reform houses change their housing tenure and trade-up decisions, and through those decisions, equilibrium housing price dynamics.

Figure 8 shows the resulting housing price dynamics, where we use the 1994 housing price

[14] We also adjust the labor income tax rate τ in Equation (23) accordingly in this counterfactual. Since the government does not have to pay for the purchase subsidies to the initial cohorts, τ is reduced from 10% to 7.6% to balance Equation (23).

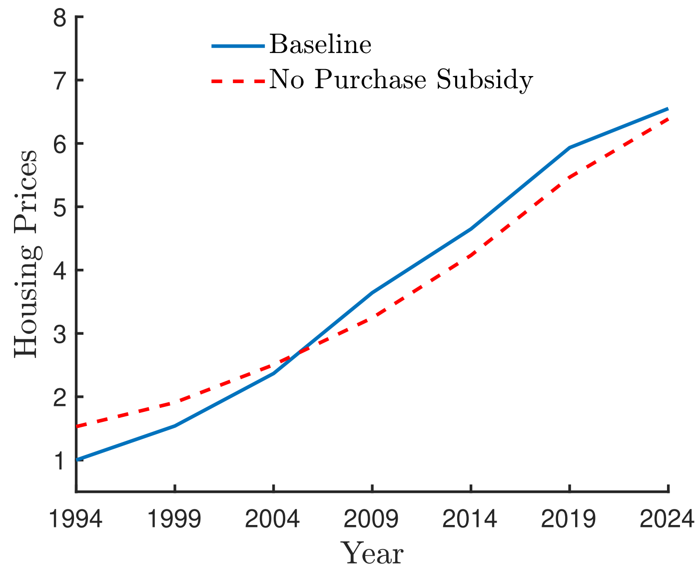

Figure 8: Housing Price Dynamics: Baseline Economy vs "*No Purchase Subsidy*" Counterfactual

Notes: "Baseline" denotes the baseline economy with the cohort-specific public-housing purchase subsidies (29); "No Purchase Subsidy" sets $\eta_{t,j} = 0$ while retaining the option for eligible initial cohorts to purchase their assigned public units at market prices. The 1994 housing price in the baseline economy is normalized to 1.

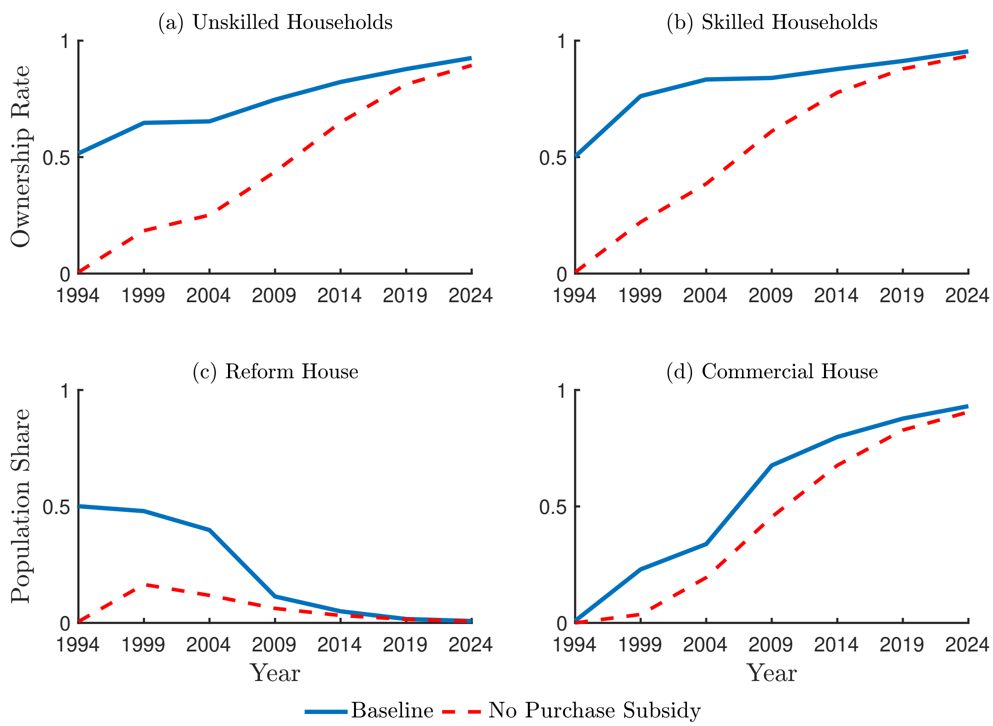

Figure 9: Homeownership Dynamics: Baseline vs. *No Purchase Subsidy* Counterfactual

Notes: Panels (a) and (b) report homeownership rates by skill group. Panels (c) and (d) report the population shares owning reform housing and commercial housing, respectively. "Baseline" and "No Purchase Subsidy" economies are the same as in Figure 8.

in the baseline economy to normalize all the other prices. In the early part of the transition, the equilibrium housing prices in the baseline economy are below those in the *No Purchase Subsidy* economy. Subsidized purchases initially move eligible households from renting their assigned public units into ownership of the same physical units, so they do not immediately create additional demand for commercial housing. In the absence of public housing purchase subsidies, some richer households will choose to purchase or rent commercial houses that are of larger sizes than their assigned public units, which tends to increase the overall demand for housing. Moreover, removing the subsidy reduces government outlays and raises disposable income through a lower labor-income tax, which tends to boost demand for commercial housing in the no-purchase-subsidy economy. The ranking of housing price levels subsequently reverses. As initial-cohort owners accumulate income and some trade up from their previous reform housing units to larger commercial housing, the demand for commercial housing strengthens. Consistent with the large trade-up shares documented in Figure 6, this transition helps push baseline housing prices above their no-purchase-subsidy counterparts. In the current calibration, the baseline housing prices are on average about 10 percent lower before the two paths cross in the mid-2000s, but about 10 percent higher during 2010–2014 and remain higher thereafter. Importantly, this implies that removing the purchase subsidies lowers average annual house-price growth over 2000–2015 from 7.3% to 5.4%. The difference between the two price paths reflects the general equilibrium effect of the purchase subsidies to the initial cohorts on housing tenure, wealth, and subsequent housing demand, against a background in which later cohorts also increasingly contribute to market demand and trade-up.

Figure 9 shows the corresponding effects on homeownership. The top two panels report homeownership by skill group. The purchase subsidies provided to the initial cohorts generate a substantially higher ownership rate early in the transition, when households have limited liquid wealth and mortgage finance is not yet available. The ownership gaps between the baseline and *No Purchase Subsidy* counterfactual narrow over time as households in the *No Purchase Subsidy* economy accumulate resources and eventually enter homeownership. This pattern isolates the first step of the mechanism: the public housing purchase subsidies bring forward the timing of homeownership for the initial cohorts.

The bottom two panels show how the composition of ownership evolves between reform housing and commercial housing. Before 2000, ownership of privatized public housing is substantially higher in the baseline, reflecting the affordability effect of the purchase subsidies that were only available to buyers of public units. Later, however, households in the baseline economy sell their reform housing more rapidly and move into commercial housing. Indeed, by the mid-2010s the share still holding reform housing has converged across the two economies, while commercial housing ownership remains higher in the benchmark throughout. This divergence identifies the trade-up margin: larger capital gains in the baseline, due to earlier homeownership, make it possible to sell the reform housing unit and use the capital gains to finance a larger commercial unit later. Together, Figures 8 and 9 show that the public housing purchase subsidies provided to the initial cohorts change both the timing of homeownership and the subsequent composition of housing demand, which in turn contributes to the difference in equilibrium housing price paths across the two economies.

To separate the welfare value of early ownership from the additional value created through the equilibrium housing price responses, we construct a second, *partial-equilibrium* counterfactual. This *price-imputation counterfactual* retains the baseline public housing purchase subsidies but feeds households the no-subsidy equilibrium price path $\{p_t^{NS}\}$. Because the price path is imposed rather than re-equilibrated, households retain subsidized access and the resulting early homeownership benefit but do not receive the additional appreciation associated with the subsidy-induced change in the equilibrium price path. The welfare gap between the baseline and the *price-imputation* counterfactual, therefore, isolates the policy-induced capital gains channel. By contrast, the gap between the *price-imputation* counterfactual and the equilibrium of *the No Purchase Subsidy* economy measures the early ownership channel: both face the same house-price path $\{p_t^{\mathrm{NS}}\}$, but only the former retains the public housing purchase subsidies that facilitate early homeownership.

To quantify welfare effects in this decomposition and in the policy comparisons that follow, we use consumption equivalent variation (CEV). For any counterfactual economy C relative to the baseline economy B, CEV is the uniform percentage change in expected consumption in each remaining period of life that makes a household indifferent between the two economies. A positive CEV indicates that the household is better off in the baseline economy.

Figure 10 reports this decomposition by age of the initial cohorts at the start of the housing privatization reform. It reveals a striking age pattern. The capital gains channel, which measures the welfare gap between the baseline economy and the price-imputation

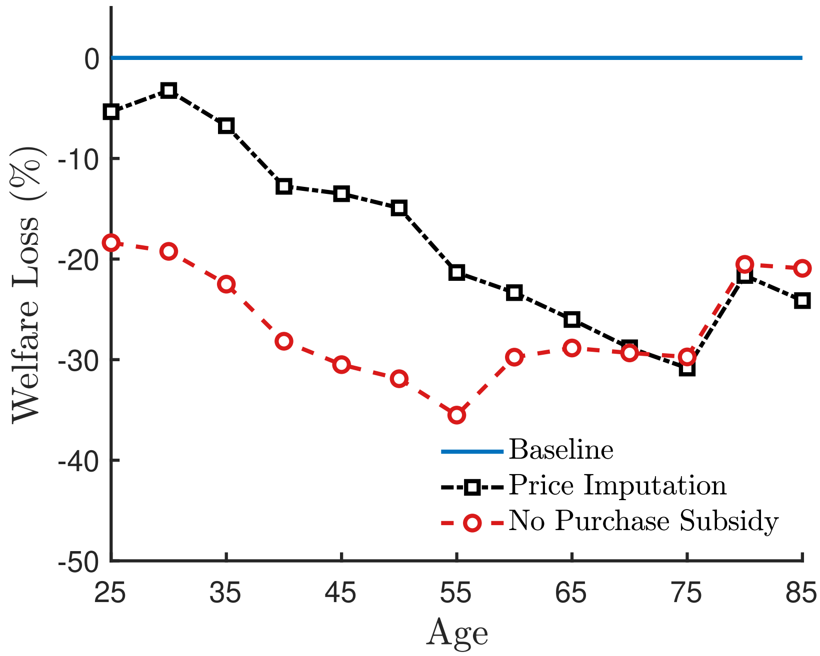

Figure 10: Decomposing the Welfare Effects of "Early Ownership" and "Capital Gains" Channels, by the Age of the Initial Cohorts in 1994

Notes: The baseline retains the public housing purchase subsidies schedule and endogenous equilibrium house prices. The *price-imputation* counterfactual retains the same discount schedule but imposes the equilibrium house-price path from the No Purchase Subsidy economy. The *No Purchase Subsidy* economy sets $\eta_{t,j} = 0$ and recomputes the transition in general equilibrium. A negative value indicates that the initial cohort is worse off under counterfactual than under the baseline asset-based redistribution.

counterfactual, generally becomes larger with age through roughly age 75 and remains substantially larger for older households than for younger households. This pattern highlights a central redistributive property of subsidized asset privatization. Older households have relatively little remaining labor-income horizon and therefore participate less in future economic growth through wages. Once they acquire public housing, however, future growth can be capitalized into the value of the asset they hold. The policy therefore allows incumbent older households to capture part of future economy-wide growth through housing wealth. Because these gains are large relative to their remaining human wealth and remaining lifetime consumption, their CEV value can be especially large. The bequest motive further preserves the value of appreciation at older ages, even when households have little incentive to consume more housing or to trade up themselves.

This result is consistent with the life-cycle ownership patterns in Figure 5. The oldest group shown there trades up less than the younger initial cohorts; its commercial housing ownership peaks around age 65 and then declines. Yet these households still hold privatized public units whose values move with equilibrium house prices. Table 4 reinforces the quantitative importance of this appreciation: conditional on selling, realized gains are large relative to contemporaneous wages and are larger for older households in a given year. The quantitative model, therefore, endogenizes and quantifies the price appreciation taken as given in the simple model. Subsidized access determines which initial households acquire an early ownership claim, while aggregate housing demand over the transition, including trade-up by both initial and later cohorts, determines how strongly that claim appreciates. Figures 5 and 10 show that this capital gains channel can remain especially important for older incumbent households because asset appreciation is large relative to their remaining lifetime resources.

Taken together, the results show that subsidized public-housing purchases redistribute toward the initial cohorts through two distinct but connected margins. The public housing purchase subsidies provided to the initial cohorts can bring forward their homeownership, while the ownership position created by the subsidies gives households a claim on subsequent housing price appreciation. The quantitative model endogenizes this second margin: the purchase subsidy changes early ownership and subsequent housing choices, while market-wide housing demand and life-cycle trade-up across cohorts determine the equilibrium price path. The resulting capital gains channel is particularly important for older incumbents because housing appreciation can be large relative to their remaining lifetime resources. Subsidized asset privatization, therefore, redistributes not only by lowering the acquisition price of an asset but also by allocating early claims on subsequent asset-price appreciation across generations.

5.3 External Validity: Singapore and South Korea

The two channels identified above do not depend on China's particular privatization design. What is essential is that selected households obtain housing on preferential terms before subsequent economic growth is fully capitalized into housing values, and that the housing asset later becomes sufficiently tradable for appreciation to accrue to its owners. The first condition creates the early ownership channel; the second gives those owners exposure to the capital gains channel. Singapore and South Korea provide useful external examples because both satisfy these conditions through their own housing policy regimes, albeit their substantial differences in the implementation of the housing subsidies.

Singapore implements this logic through its Housing & Development Board (HDB) system. Beginning in the 1960s, public housing was sold to eligible households at subsidized prices supported by state land policy, administratively determined pricing, and housing-finance arrangements tied closely to the Central Provident Fund (Phang, 1992, 2001; Phang and Helble, 2016). Eligibility and occupancy restrictions rationed access to these ownership opportunities, lowering the effective cost of entering homeownership for selected households. The second part of the mechanism emerged as the HDB resale market was progressively liberalized. From 1971 onward, eligible owners satisfying occupancy requirements were increasingly permitted to resell their flats at market prices, and later reforms further integrated the HDB resale and private housing markets (Phang and Helble, 2016; Tu and Wong, 2002). These changes allowed the appreciation of subsidized housing to become household wealth. Consistent with the capital gains channel in our model, Bardhan et al. (2003) characterize Singapore's housing system as a "property ladder" and show that increases in HDB resale prices stimulated purchases of private housing by relaxing the financing constraint of households upgrading from public to private units. Thus, preferential HDB acquisition generated an early ownership position, while subsequent resale-market appreciation raised the value of that position and helped finance later housing upgrades.

South Korea provides a different institutional route to the same two channels. The nationwide price-ceiling system introduced in 1977 limited the sale prices of newly constructed housing and, therefore, created a wedge between regulated acquisition prices and market values for successful applicants (Heo, 2012; Kim and Park, 2016). Because below-market prices generated excess demand, access was rationed through a housing-subscription system that gave priority according to characteristics such as prior homeownership, household composition, and subscription history (Kim, 2012; Kim and Park, 2016). The "Two Million Housing Drive" of 1988–1992 expanded supply through large-scale public development and further broadened access to housing produced under regulated land and pricing arrangements (Feather, 2019; Kim and Park, 2016). As price controls were subsequently relaxed and housing markets developed, households that had acquired units at regulated prices could realize the wedge between their acquisition cost and market value as capital gains (Heo, 2012; Kim and Park, 2016). In terms of our decomposition, the regulated issue price and rationed access generate the early-ownership channel, while subsequent market appreciation generates the capital gains channel.

The comparison between Singapore and South Korea clarifies what is essential to the mechanism. Singapore relied primarily on public provision, eligibility rules, subsidized pricing, and a gradually liberalized resale market, whereas Korea relied more heavily on price ceilings, rationing, public development, and regulated allocation. Yet both regimes created the same economic sequence: selected households obtained housing at a preferential effective purchase price, acquired an early claim on housing wealth, and subsequently benefited as rising incomes and aggregate housing demand were capitalized into market values. The specific source of later housing demand can vary across cohorts and over time; what matters for asset-based intergenerational redistribution is that preferential access determines who holds the asset before much of the subsequent appreciation occurs. These experiences, therefore, provide external evidence that both the early ownership and capital gains channels quantified in this section can operate under substantially different forms of subsidized housing acquisition. We next turn to the implications of asset-based redistribution for transitional and post-transitional cohorts relative to an alternative pension-based redistributive scheme.

6 Welfare and Fiscal Consequences for Later Cohorts

Sections 2 and 5 establish the logic of asset-based redistribution and quantify the early ownership and capital gains channels for the initial cohorts. A complete assessment of intergenerational redistribution, however, also requires asking how the policy affects cohorts that enter the economy after privatization and therefore do not receive subsidized access themselves. This section shifts attention to these transitional and post-transitional cohorts.

To evaluate the incidence on later cohorts, we compare the baseline asset-based redistribution policy with a counterfactual pay-as-you-go pension system that delivers the same average welfare as the initial cohorts receive in the baseline. Holding fixed the welfare gain of the initial cohorts makes the two systems comparable as alternative redistributive instruments. The key difference is how the transfer is carried forward. Under *asset-based* redistribution, the initial transfer is embodied in the ownership of an appreciating asset, and its subsequent incidence operates through equilibrium housing price dynamics and private intergenerational transfers through both inter vivos transfers and accidental bequests. Under *pension-based* redistribution, comparable benefits for the initial cohorts require a higher pension replacement rate and, therefore, larger social-security obligations financed by later workers. We first compare the welfare of transitional and post-transitional cohorts under the two systems and then examine how their fiscal consequences differ when economic growth slows.

6.1 Welfare of Transitional and Post-Transitional Cohorts

We construct the pension-based counterfactual by replacing the housing purchase subsidy with a more generous pay-as-you-go pension benefit. The pension replacement rate in this counterfactual is chosen so that the average welfare of the initial cohorts is the same as in the baseline economy with subsidized public-housing purchases. Importantly, however, the replacement rate, once chosen, is assumed to be *downward rigid*; that is, the higher benefit schedule also applies to subsequent cohorts. This experiment, therefore, holds fixed the welfare effect of the redistribution toward the initial cohorts while changing the instrument through which that redistribution is implemented.

Table 5: Tax Rates under Asset-Based and Pension-Based Redistributive Policies

	Labor Income Tax Rate τ	Social Security Tax Rate τ^{ss}
Asset-Based (baseline)	0.100	0.231
Pension-Based (counterfactual)	0.076	0.340

Table 5 shows that the labor income and social security tax rates, τ in Equation (23) and τ^{ss} in Equation (17), differ substantially between the baseline asset-based redistribution policy and those under the pension-based redistribution counterfactual. In the pension-based counterfactual, the replacement rate required to match the average welfare of the initial cohorts in the baseline is $\theta = 0.82$, a substantial increase from the baseline replacement rate of $\theta = 0.60$; as a result, the social-security tax rate needs to increase from 0.231 in the baseline to 0.340 in the counterfactual. At the same time, the labor income tax rate is lower in the counterfactual because the government no longer subsidizes the public housing purchase in the counterfactual; in the calibrated economies, the labor income tax rate τ is 0.100 under the baseline asset-based policy and 0.076 under the pension-based counterfactual. Thus, replacing subsidized asset access with pension-based redistribution shifts the burden away from the general labor income tax and toward a substantially larger payroll contribution borne by future working cohorts. The two redistribution policies generate different housing

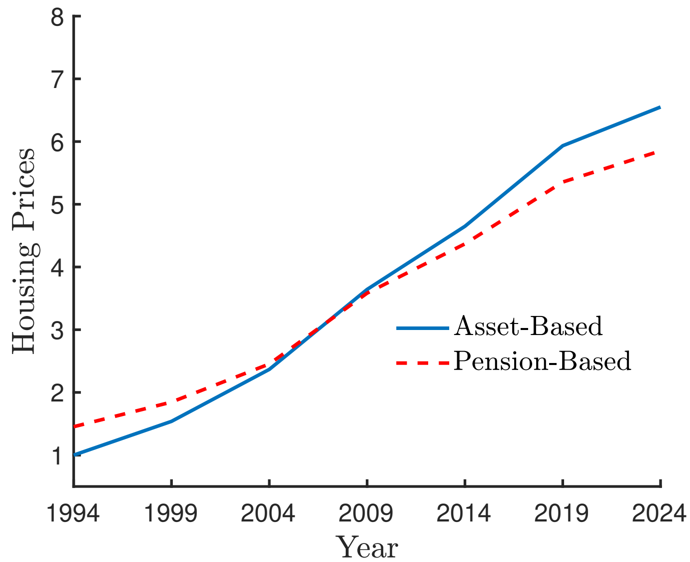

Figure 11: Housing Price Dynamics: Asset-Based vs. Pension-Based Redistribution

Notes: The figure reports the equilibrium housing price paths under the baseline asset-based policy and the pension-based counterfactual that delivers the same average welfare to the initial cohorts. The 1994 housing price in the baseline economy is normalized to 1.

market transitions. Figure 11 shows that the equilibrium housing price under the pension-based counterfactual would be substantially higher than that of the baseline asset-based policy (1.453 vs. 1 in 1994); however, subsequently, the pricing paths under the two policies converge around 2009; by 2024, the housing price under the baseline asset-based policy would be about 12 percent higher (6.551 vs. 5.852).

Figure 12 shows the corresponding homeownership dynamics under the two policy regimes. Because the public housing purchase subsidy can be used immediately by the initial cohorts, it brings forward homeownership; in contrast, higher pension replacements for the initial cohorts under the pension-based redistribution policy are realized primarily after retirement. Aggregate homeownership therefore rises earlier under the asset-based policy. Ownership of commercial housing is also higher throughout much of the transition, reflecting the combined effects of earlier entry into ownership, subsequent housing adjustments, and the equilibrium price path.

The central question is how these differences affect the transitional and post-transitional cohorts that enter after privatization, by skill type. Figure 13 reports welfare (measured by CEV) under the baseline asset-based policy relative to the pension-based counterfactual for cohorts entering the economy from 1994 onward. It shows that these transitional and

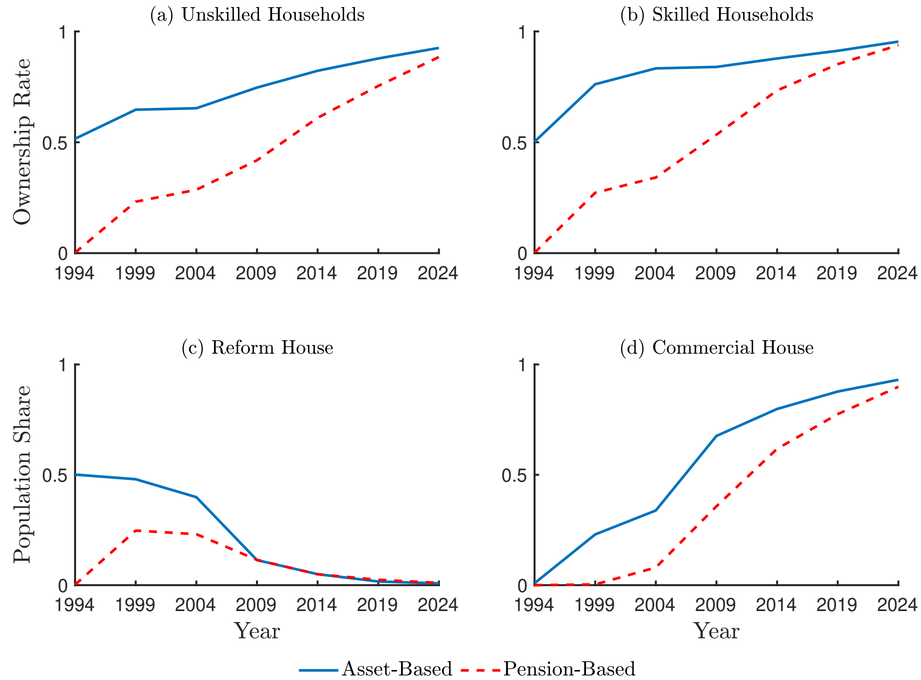

Figure 12: Homeownership Dynamics: Asset-Based vs. Pension-Based Redistribution

Notes: Panels (a) and (b) report homeownership rates by skill group. Panels (c) and (d) report the population shares owning privatized public housing and commercial housing, respectively.

post-transitional cohorts, regardless of skill type, are both better off under the asset-based policy than under the pension-based counterfactual. The welfare advantage of asset-based redistribution is largest for the cohorts entering in the 1990s and early 2000s, and it becomes substantially smaller for cohorts who entered the economy from around 2010 onward. Thus, the benefits of asset-based redistribution are not confined to the initial cohorts that receive subsidized access; they can extend to later cohorts through the housing price equilibrium and intergenerational transfer consequences of the policy.

Figure 14 further decomposes this welfare difference through several intermediate counterfactual experiments. The first counterfactual (CF1 in Figure 14) replaces the baseline equilibrium housing price path with the price path from the pension-based counterfactual. This reduces the welfare advantage by roughly 7–13 percentage points for the earlier transitional and post-transitional cohorts. The result reflects the timing of the housing price path: these cohorts enter the housing market when prices under the asset-based policy are relatively low and can subsequently benefit from appreciation after becoming owners. It should not be interpreted as implying that higher house prices are uniformly beneficial to later cohorts; rather, welfare depends on the timing of purchase, subsequent ownership exposure, and the

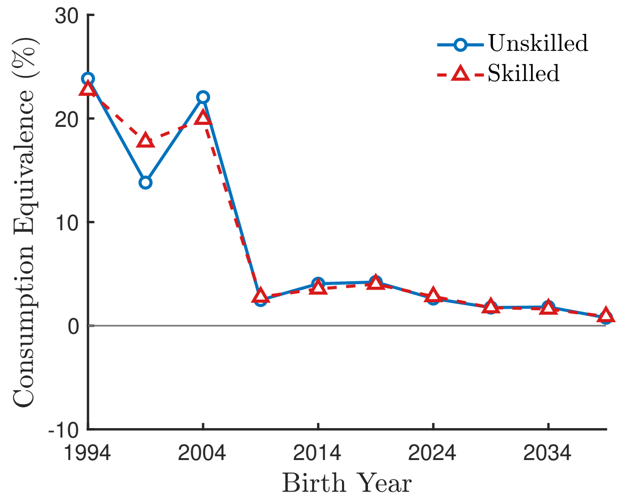

Figure 13: Welfare Effects on Transitional- and Post-Transitional Cohorts: Asset-Based vs. Pension-Based Redistribution

Notes: The figure reports welfare under the baseline asset-based policy relative to the pension-based counterfactual, measured by CEV. Cohorts are indexed by the model period in which they enter the economy (labeled "birth year" on the horizontal axis), i.e., the period in which they turn 21. A positive value indicates that the cohort is better off under the asset-based redistribution.

accompanying equilibrium transition.

The second counterfactual (CF2 in Figure 14) additionally removes the purchase discount granted to the initial cohorts. Doing so sharply reduces the welfare advantage for the cohorts who enter the economy after late 1990s, even though they never receive that discount directly. The reason is that the housing purchase subsidies to the initial cohorts raise their housing wealth, which indirectly benefits subsequent cohorts via inter vivos transfers and accidental bequests. Asset-based redistribution can consequently transmit resources to later generations through *private* balance sheets after the original public transfer has taken place. The third counterfactual (CF3 in Figure 14) additionally imposes the pension-based tax structure. Although the pension counterfactual carries a lower labor-income tax rate, its substantially higher social-security tax rate reduces the lifetime disposable income for working cohorts; on net, the tax structure further lowers welfare, especially for unskilled households, whose lifetime resources are more sensitive to payroll taxation.

Taken together, these results highlight a dimension of subsidized asset privatization that is largely absent from the simple model and from the initial-cohort analysis in Section 5. A transfer to the initial cohorts delivered through subsidizing the purchase of public assets can continue to affect later cohorts without promising them the same explicit public benefit: the

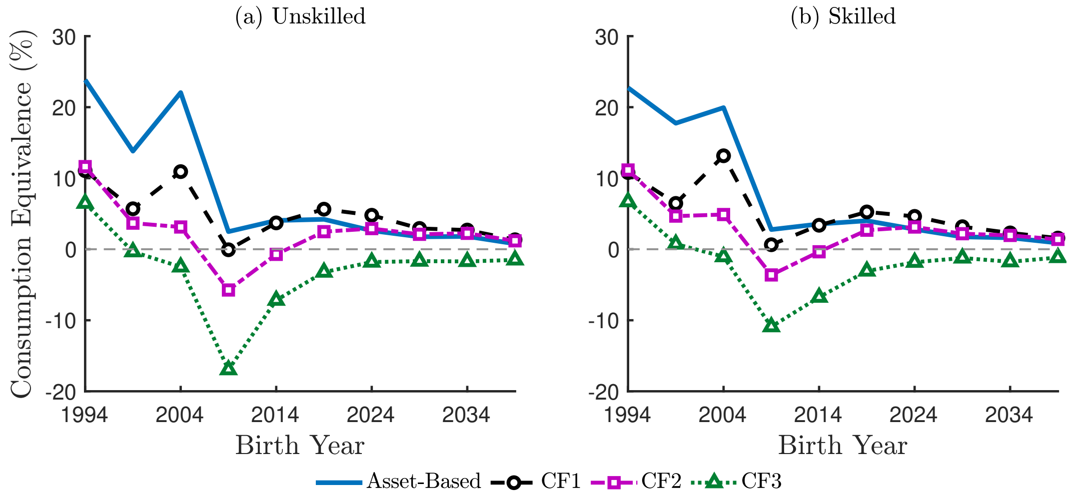

Figure 14: Decomposition of the Welfare Difference for Later Cohorts

Notes: "CF1" imposes the pension-based equilibrium housing price path; "CF2" additionally removes the public housing purchase subsidies to the initial cohorts; and "CF3" additionally imposes the labor-income and social-security tax rates under pension-based redistribution policy as in Table 5.

asset-price path shapes when they enter homeownership and the returns they subsequently earn, while the wealth accumulated by the initial cohorts can be transmitted privately through inter vivos transfers and accidental bequests. By contrast, a pension system that provides the same welfare to the initial cohorts carries the higher statutory benefit schedule forward and finances it through larger social-security contributions from later workers. In the calibrated economy, this difference makes asset-based redistribution more favorable to transitional and post-transitional cohorts than pension-based redistribution.

6.2 Fiscal Resilience under Slower Growth

The distinction between asset-based and pension-based redistribution becomes even sharper when economic growth slows. The transfer generated by subsidized asset ownership is *partly state contingent*: weaker income growth lowers housing demand and asset-price appreciation, thereby reducing the capital gains through which redistribution occurs. Pension benefits, by contrast, are tied to a replacement-rate promise that is difficult to reduce once granted. A slowdown therefore weakens the tax base while leaving the pension-based economy with a larger explicit benefit commitment.

We evaluate this difference by examining the effects under the asset-based and pension-based redistribution regimes when unanticipated slowdowns in wage (or productivity) growth begin on alternative dates. Table 6 compares the fiscal consequences under the asset-based policy and the pension-based counterfactual; the corresponding wage growth paths are reported in Appendix Figure F.3. Both systems experience weaker labor-income and social-security revenues when wage growth slows, and both can run fiscal deficits when tax rates are held at their original levels. The difference is that the pension-based counterfactual enters the slowdown with the substantially higher replacement rate required to compensate the initial cohorts.

The fiscal difference is quantitatively large. In all cases of unexpected slowdown, the ratio of total deficit to tax income is significantly smaller under the asset-based policy than under the pension-based policy. For example, if the unexpected growth slowdown were to start in 2015, the ratio of the total government deficit to tax revenue is 24.9% under asset-based redistribution and 54.2% under pension-based redistribution. The asset-based economy does incur the up-front fiscal cost of subsidized public-housing purchases and rents, and its labor-income tax is correspondingly higher in the benchmark transition. But it does not require the same persistent increase in pension promises. When growth disappoints, weaker asset-price appreciation automatically limits part of the transfer generated through capital gains, whereas the higher pension replacement rate continues to create obligations against a smaller tax base. This state contingency is the main fiscal reason that asset-based redistribution can impose a smaller burden on transitional and post-transitional cohorts when long-run growth turns out to be lower than expected.

Overall, the comparison shows that alternative instruments delivering the same welfare gain to the initial cohorts can have very different implications for the cohorts that follow. Asset-based redistribution is front-loaded through subsidized access to an appreciating asset, while its subsequent incidence is transmitted through equilibrium asset prices and private intergenerational transfers. Pension-based redistribution instead creates an explicit claim on future labor income that must be financed by subsequent workers. In the calibrated economy, the former structure is more favorable to transitional and post-transitional cohorts: they benefit from the dynamics of housing prices and the private-transfer consequences of the initial asset allocation while facing a smaller persistent fiscal obligation. The contrast becomes particularly important when growth slows because the capital gains generated by the asset-based scheme adjust with realized asset-price appreciation, whereas pension promises continue to burden a weaker future tax base. Thus, the choice of redistributive instrument

Table 6: Government Budget under Asset-Based and Pension-Based Redistribution

	No slowdown		Slowdown in 2005		Slowdown in 2010		Slowdown in 2015	
	Asset	Pension	Asset	Pension	Asset	Pension	Asset	Pension
Tot subsidy	3.016	0.399	1.767	0.153	1.770	0.150	1.770	0.150
Tax income	6.753	4.138	3.687	2.809	4.616	3.516	5.662	4.313
Pension deficit	0.000	0.000	0.736	2.526	0.552	2.228	0.313	1.512
Total deficit	-0.000	-0.002	3.803	4.858	2.694	3.849	1.408	2.337
Total deficit/Tax income	-0.000	-0.000	1.031	1.730	0.584	1.095	0.249	0.542

Notes: The table reports housing-policy subsidies, tax revenue, the pension deficit, the total government deficit, and the ratio of the total deficit to tax revenue in the no-slowdown benchmark and under slowdowns beginning in 2005, 2010, and 2015. "Asset" denotes the baseline asset-based policy and "Pension" the pension-based counterfactual.

matters not only for how much is transferred to the initial cohorts but also for how the costs and benefits of that transfer propagate across later generations.

7 Conclusion

Rapid economic growth creates an intergenerational distribution problem: cohorts that enter later enjoy higher lifetime labor income than incumbent cohorts that experience only part of the transition. This paper shows that subsidized access to appreciating public assets provides a distinct instrument for sharing those gains across generations. When the government is limited in its liquid fiscal resources at the beginning of the economic takeoff, preferential access to public assets can give incumbent households an early ownership claim on future economic growth. Unlike conventional fiscal redistribution, this mechanism operates through the allocation and subsequent valuation of assets. Because ownership and household choices feed back into equilibrium asset prices, asset-based redistribution can affect both who receives future capital gains and their equilibrium magnitude. This perspective shifts the study of asset-price redistribution from the incidence of given price movements to the allocation of asset ownership itself as an instrument of intergenerational policy.

We execute this idea in two steps. A simple planner framework shows that when the government has limited capacity to make unrestricted transfers but owns earmarked public assets, subsidized sales can serve as an alternative instrument for intergenerational redistribution. The quantitative analysis delivers three main findings. Subsidized asset purchases benefit the initial cohorts through both earlier ownership and subsequent capital gains, with the relative importance of these channels varying across different age groups. By changing the distribution of ownership and subsequent housing demand, the policy also influences the equilibrium housing price appreciation and, hence, the magnitude of these gains. Relative to redistribution through social security, asset-based redistribution generates higher welfare for many later cohorts and is more fiscally resilient when economic growth unexpectedly slows.

An important direction for future research is to study how asset privatization interacts with regional and within-cohort inequality. Because public assets are location specific, similar subsidies can generate very different wealth gains across regions when productivity growth, migration, land supply, and housing demand produce different paths of asset appreciation;

large windfalls may accrue to incumbent owners in high-growth cities while later entrants face higher acquisition costs. Within a cohort, eligibility and the ability to exercise a purchase option may differ by employment status, income, liquid wealth, credit access, and family resources, so poorer eligible households may be unable to acquire the asset while better-positioned households capture larger appreciation gains. These disparities can persist through inter vivos transfers and bequests, turning a policy designed to redistribute across generations into a source of long-run inequality across regions and families. Extending the framework to incorporate spatial heterogeneity, heterogeneous access to subsidized assets, and richer intergenerational wealth transmission would allow future work to quantify these additional distributional consequences.

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Online Appendix (Not For Publication)

This Online Appendix is organized to follow the order in which the material is first invoked in the main text. Appendix A provides the technical derivations and proofs for the simple model. Appendix B defines the dynamic competitive equilibrium and describes the computational algorithm, and Appendix C states the household optimization problems underlying that equilibrium. Appendix D summarizes the detrending procedure used to express the quantitative model in stationary units. Appendix E provides the institutional details used to map the housing-policy regime into the Chinese quantitative application and documents the transition in housing composition. Appendix F collects the remaining supplementary quantitative figures referenced in the main text.

A Technical Details of the Simple Model

This appendix collects the technical details omitted from Section 2. Appendix A.1 derives the first-order conditions and intermediate equations used in the main text. Appendix A.2 then provides the proofs of Corollary 1, Propositions 2 and 3, and Corollary 4.

A.1 First-Order Conditions and Intermediate Derivations

Planner's first-best allocation. Let Λ be the multiplier on the planner's resource constraint (2). The first-order conditions associated with (3) are

$$\frac{1}{c_t^y} = \Lambda\left(\frac{1}{\chi(1+r)}\right)^t, \qquad \frac{\beta}{c_{t+1}^o} = \frac{\Lambda}{(1+r)}\left(\frac{1}{\chi(1+r)}\right)^t,$$
$$\frac{\phi}{h_t} = \Lambda q_t\left(\frac{1}{\chi(1+r)}\right)^t. \tag{A.1}$$

Solving these conditions yields

$$c_t^{y,FB} = \Lambda^{-1}(\chi(1+r))^t, \qquad c_{t+1}^{o,FB} = \beta(1+r)\Lambda^{-1}(\chi(1+r))^t,$$
$$q_t h_t^{FB} = \phi\Lambda^{-1}(\chi(1+r))^t, \tag{A.2}$$

which yields Equation (4) in the main text. Substitution into the resource constraint gives

$$(1+\phi+\beta)\Lambda^{-1}\mathcal{G} = A_0 + \sum_{t=0}^{\infty}\left(\frac{1+n}{(1+r)}\right)^t w_t, \qquad \mathcal{G} \equiv \frac{1}{1-(1+n)\chi}. \tag{A.3}$$

Lump-sum implementation. A household receiving a cohort-specific lump-sum transfer T_t has lifetime wealth $w_t + T_t$. Its optimal expenditure shares imply that reproducing the planner's allocation requires

$$w_t + T_t^{FB} = (1+\phi+\beta)\Lambda^{-1}(\chi(1+r))^t,$$

which gives Equation (5). Summing the resulting transfer sequence and using (A.3) yields

$$\sum_{t=0}^{\infty}\left(\frac{1+n}{(1+r)}\right)^t T_t^{FB} = A_0, \tag{A.4}$$

and hence Equation (6).

To derive the transfer profile in Equation (7), first note that at $t = 0$, (A.2) gives $q_0 h_0^{FB} = \phi\Lambda^{-1}$. Hence

$$\frac{T_0^{FB}}{q_0 h_0^{FB}} = \frac{1+\phi+\beta}{\phi} - \frac{w_0\Lambda}{\phi} \equiv \varsigma_0. \tag{A.5}$$

For $t \geq 1$, use $w_t = w_1(1+g)^{t-1}$ and impose $\chi = (1+g)/(1+r)$. Since (A.2) implies $q_t h_t^{FB} = \phi\Lambda^{-1}(1+g)^t$, substitution into (5) gives

$$\frac{T_t^{FB}}{q_t h_t^{FB}} = \frac{1+\phi+\beta}{\phi} - \frac{w_1\Lambda}{(1+g)\phi} \equiv \varsigma, \qquad t \geq 1. \tag{A.6}$$

Equations (A.5)–(A.6) yield Equation (7) in the main text.

Household demand under subsidized privatization. Let $W_0 \equiv w_0 + A_0$. In either case, the housing-linked transfer is defined as

$$T^H = \eta_0 p_0 h_0^{H*}(\eta_0). \tag{A.7}$$

When the public-housing quantity constraint is nonbinding, the first-order conditions of

(8) imply

$$c_0^{y,H*} = \frac{W_0}{1+\phi+\beta}, \qquad \frac{c_1^{o,H*}}{1+r} = \frac{\beta W_0}{1+\phi+\beta}, \qquad (q_0 - \eta_0 p_0) h_0^{H*} = \frac{\phi W_0}{1+\phi+\beta}. \tag{A.8}$$

Therefore

$$h_0^{H*}(\eta_0) = \frac{\phi W_0}{(1+\phi+\beta)(q_0 - \eta_0 p_0)}, \tag{A.9}$$

Adding the subsidy value to effective housing expenditure gives

$$q_0 h_0^{H*} = \frac{\phi W_0}{1+\phi+\beta} + T^H. \tag{A.10}$$

Imposing $T^H = T_0^{FB} - A_0$ yields

$$h_0^{H*} = \frac{T_0^{FB} - A_0 + \frac{\phi}{1+\phi+\beta} W_0}{q_0}. \tag{A.11}$$

The non-bindingness of the public housing constraint requires that

$$h^g \geq h_0^{H*} = \frac{T_0^{FB} + \frac{\phi}{1+\phi+\beta} w_0 - \frac{1+\beta}{1+\phi+\beta} A_0}{q_0} \tag{A.12}$$

The corresponding subsidy is

$$\eta_0 = \frac{q_0 (T_0^{FB} - A_0)}{p_0 \left(T_0^{FB} - A_0 + \frac{\phi}{1+\phi+\beta} W_0 \right)}, \qquad p_0^g = (1 - \eta_0) p_0. \tag{A.13}$$

Finally, since $w_0 + T_0^{FB} = W_0 + T^H$ and the first-best housing expenditure is $q_0 h_0^{FB} = \phi(W_0 + T^H)/(1+\phi+\beta)$, we obtain

$$q_0 (h_0^{H*} - h_0^{FB}) = \frac{1+\beta}{1+\phi+\beta} T^H = \frac{1+\beta}{1+\phi+\beta} (T_0^{FB} - A_0) > 0. \tag{A.14}$$

These expressions characterize the case in which the quantity constraint is nonbinding.

We next consider the case in which (A.12) does not hold and the quantity constraint binds. As a result, $h_0^{H*} = h^g$. Imposing $T^H = T_0^{FB} - A_0$ in (A.7) therefore gives

$$\eta_0 = \frac{T_0^{FB} - A_0}{p_0 h^g}, \qquad p_0^g = (1 - \eta_0) p_0. \tag{A.15}$$

Hence, the subsidized purchase price follows $p_0^g = (1 - \eta_0)p_0$, where

$$\eta_0 = \begin{cases} \dfrac{q_0(T_0^{FB} - A_0)}{p_0\left(T_0^{FB} - A_0 + \frac{\phi}{1+\phi+\beta}W_0\right)} & \text{if (A.12) holds,} \\[2em] \dfrac{T_0^{FB} - A_0}{p_0 h^g} & \text{otherwise.} \end{cases} \tag{A.16}$$

A.2 Proofs of the Main Results

Proof of Corollary 1. Under $\chi = (1+g)/(1+r)$, Equation (7) gives $\varsigma_t = \varsigma$ for every $t \geq 1$. Moreover,

$$\varsigma_0 - \varsigma = \frac{\Lambda}{\phi}\left(\frac{w_1}{1+g} - w_0\right) > 0,$$

where the inequality follows directly from $w_1 > (1+g)w_0$. Hence $\varsigma_0 > \varsigma_t$ for every $t \geq 1$. □

Proof of Proposition 2. Under $\chi = (1+g)/(1+r)$, Equation (A.6) shows that every future transfer can be written as $T_t^{FB} = \varsigma q_t h_t^{FB}$ with the same multiplier ς. Because $q_t h_t^{FB} > 0$, all T_t^{FB} for $t \geq 1$ have the same sign. From the government's present-value budget,

$$\sum_{t=1}^{\infty}\left(\frac{1+n}{(1+r)}\right)^t T_t^{FB} = A_0 - T_0^{FB}.$$

If $T_0^{FB} > A_0$, the right-hand side is negative; since all future transfers have the same sign, $\varsigma < 0$ and therefore $T_t^{FB} < 0$ for every $t \geq 1$. If $T_0^{FB} \leq A_0$, the right-hand side is nonnegative, so $\varsigma \geq 0$ and $T_t^{FB} \geq 0$ for every $t \geq 1$. □

Proof of Proposition 3. Let

$$T^H \equiv T_0^{FB} - A_0 > 0$$

denote the residual transfer to the initial cohort that cannot be financed with the government's liquid resources. Under the transfer scheme considered in Proposition 3, no cash transfer is made to future cohorts, and the residual transfer to cohort 0 is delivered through the subsidized purchase of public housing.

We consider separately whether the public-housing quantity constraint binds.

Case 1: the constraint is slack. If Equation (A.12) holds, the household's optimal housing demand is given by Equation (A.9). Combining this demand with

$$T^H = \eta_0 p_0 h_0^{H*}$$

and imposing $T^H = T_0^{FB} - A_0$ gives

$$\eta_0 = \frac{q_0(T_0^{FB} - A_0)}{p_0\left(T_0^{FB} - A_0 + \frac{\phi}{1+\phi+\beta} W_0\right)}, \qquad W_0 \equiv w_0 + A_0,$$

which is the first branch of Equation (A.16). Moreover,

$$\frac{\eta_0 p_0}{q_0} = \frac{T^H}{T^H + \frac{\phi}{1+\phi+\beta} W_0} < 1,$$

so the effective user cost $q_0 - \eta_0 p_0$ remains positive.

Case 2: the constraint binds. If Equation (A.12) does not hold, the unconstrained candidate in (A.11) exceeds h^g, so the public-housing quantity constraint binds and

$$h_0^{H*} = h^g.$$

The housing-linked transfer is therefore

$$T^H = \eta_0 p_0 h^g.$$

Imposing $T^H = T_0^{FB} - A_0$ gives

$$\eta_0 = \frac{T_0^{FB} - A_0}{p_0 h^g},$$

which is the second branch of Equation (A.16). Provided $T_0^{FB} - A_0 < p_0 h^g$, this subsidy satisfies $0 < \eta_0 < 1$ and hence $0 < p_0^g < p_0$.

Thus, in either case, a subsidy rate given by Equation (A.16) delivers the residual transfer $T^H = T_0^{FB} - A_0$ to the initial cohort. $\square$

Proof of Corollary 4. Let

$$D \equiv 1 + \phi + \beta, \qquad W_0 \equiv w_0 + A_0, \qquad T^H \equiv T_0^{FB} - A_0 > 0.$$

Since $A_0 + T^H = T_0^{FB}$, the total lifetime resources associated with the first-best transfer target are

$$Y_0 \equiv w_0 + T_0^{FB} = W_0 + T^H.$$

We again distinguish the two cases.

Case 1: the quantity constraint is nonbinding. Equations (A.8)–(A.14) imply

$$c_0^{y,H*} = \frac{W_0}{D}, \qquad c_1^{o,H*} = \frac{\beta(1+r)W_0}{D},$$

and

$$q_0 h_0^{H*} = \frac{\phi W_0}{D} + T^H.$$

By contrast, under the first-best cash transfer,

$$c_0^{y,FB} = \frac{Y_0}{D}, \qquad c_1^{o,FB} = \frac{\beta(1+r)Y_0}{D}, \qquad q_0 h_0^{FB} = \frac{\phi Y_0}{D}.$$

Hence

$$q_0(h_0^{H*} - h_0^{FB}) = \frac{1+\beta}{D} T^H > 0,$$

while

$$c_0^{y,H*} < c_0^{y,FB}, \qquad c_1^{o,H*} < c_1^{o,FB}.$$

Because the first-best allocation uniquely maximizes household utility subject to lifetime resources Y_0, whereas the subsidized privatization allocation differs from it, strict concavity implies

$$U_0^{FB} > U_0^{H*}.$$

Case 2: the quantity constraint binds. In this case

$$h_0^{H*} = h^g$$

and, from Proposition 3,

$$T^H = \eta_0 p_0 h^g.$$

The household budget can therefore be written as

$$c_0^y + \frac{c_1^o}{1+r} = W_0 - (q_0 - \eta_0 p_0)h^g = Y_0 - q_0 h^g.$$

Conditional on $h_0 = h^g$, optimal allocation between young- and old-age consumption gives

$$c_0^{y,H*} = \frac{Y_0 - q_0 h^g}{1+\beta}, \qquad c_1^{o,H*} = \frac{\beta(1+r)(Y_0 - q_0 h^g)}{1+\beta}.$$

The first-best household allocation solves the same lifetime-resource problem,

$$c_0^y + \frac{c_1^o}{1+r} + q_0 h_0 = Y_0,$$

but with housing freely chosen. Its unique optimal housing quantity is

$$h_0^{FB} = \frac{\phi Y_0}{D q_0}.$$

Therefore the binding privatization allocation coincides with the first-best allocation only in the knife-edge case $h^g = h_0^{FB}$. For any $h^g \neq h_0^{FB}$, strict concavity implies

$$U_0^{FB} > U_0^{H*}.$$

In particular, when $h^g < h_0^{FB}$,

$$h_0^{H*} = h^g < h_0^{FB},$$

so the quantity constraint forces the initial household to consume less housing than under the first best. This case provides a natural bridge to the quantitative model, in which privatized public units are relatively small and households may subsequently trade up to larger commercial housing. □

B Equilibrium Definition and Computational Algorithm

B.1 Dynamic Competitive Equilibrium

Given government policies $\langle r_m, \theta, \nu, \gamma, \omega, p_t^g(j) \rangle$ and a sequence of aggregate variables $\langle \mathcal{A}_t, L_t, n_t \rangle_{t=1}^{\infty}$, a dynamic competitive equilibrium consists of quantities $\langle N_{ct}^*, N_{ht}^*, L_{h,t}^* \rangle$, prices $\langle p_t^*, \rho_t^*, w_t^*, p_{Lt}^* \rangle$, tax policies $\langle \tau, \tau^{ss} \rangle$, household value functions $\mathbb{V} \equiv \langle V_t^{R_g}, V_t^{R_c}, V_t^{B_g}, V_t^{B_c}, V_t^{O_g}, V_t^{O_c} \rangle$ and associated policy functions $\mathbb{P}^*$, and beginning-of-period distributions $\boldsymbol{\mu}_t \equiv \langle \mu_t^{R_g}, \mu_t^{R_c}, \mu_t^{O_g}, \mu_t^{O_c} \rangle$ such that:

1. Given prices and government policies, $\mathbb{P}^*$ solves the household problems in Appendix C, and $\mathbb{V}$ is consistent with those policy functions and the evolution of household states.
2. Given $\langle \mathcal{A}_t, L_t \rangle$ and prices $\langle p_t^*, \rho_t^*, w_t^*, p_{Lt}^* \rangle$, construction firms choose N_{ht}^* and $L_{h,t}^*$ optimally.
3. The labor market clears at $w_t^* = \mathcal{A}_t$, with $N_{ct}^* + N_{ht}^* = N_t$.
4. The land market clears, $L_{h,t}^* = L_t$.
5. The house price p_t^* clears the market-housing sector according to Equation (27), and the rental rate ρ_t^* satisfies the no-arbitrage condition in Equation (28).
6. The social-security tax τ^{ss} satisfies the intertemporal pension budget, while the labor-income tax τ and the government's initial liquid asset position satisfy Equation (23).
7. The distributions $\boldsymbol{\mu}_t$ evolve consistently with income shocks, survival, aging, and the endogenous household policy rules.

B.2 Computational Algorithm

The computation has two stages: a pre-privatization steady state that provides the initial cross-sectional distribution, and a transition from privatization to a terminal steady state. Appendix D describes the normalization used to remove deterministic growth trends.

Pre-privatization steady state. Given the policy parameters and the initial wage, interest rate, and public-rental arrangement, we solve households' life-cycle problems, aggregate their decisions, and update the initial bequest until the household distribution is stationary. The remaining initial equilibrium objects are chosen so that the government budget is satisfied and the assigned public-housing stock is consistent with the initial housing allocation. This stationary distribution is the state from which privatization begins in period 1.

Transition path. Let T be sufficiently large that the economy is arbitrarily close to the terminal steady state. Given the paths of exogenous productivity, population growth, land supply, and the housing-policy schedules, the transition is computed as follows:

1. Solve the terminal steady state and initialize guesses for the transition path of house prices $\{p_t\}_{t=1}^T$ and the labor-income tax τ.

2. Given prices and policies, solve household value and policy functions backward from T to period 1.

3. Starting from the pre-privatization distribution, simulate household decisions and the distribution of states forward. Inter vivos transfers and bequests are assigned according to the household rules in the model.

4. Aggregate market-housing demand and supply in each period. Update $\{p_t\}_{t=1}^T$ until the housing market clears period by period.

5. Aggregate tax revenue, public-housing subsidies, and pension payments. Update τ until the government's intertemporal budget constraint is satisfied.

6. Check convergence to the terminal steady state. If the terminal condition is not sufficiently accurate, increase T and repeat the preceding steps.

Terminal steady state. In the terminal steady state, residential investment replaces depreciated housing, $I = \delta_h H$, while house prices, rents, construction, and the housing stock jointly satisfy firms' optimality conditions and the market-clearing conditions stated above.

C Household Optimization in the Quantitative Model

C.1 Pre-privatization State

Before privatization begins, the economy is in the pre-privatization steady state described in Section 3.2. Households occupy assigned public housing units of skill-specific size h_g^i and are therefore in state R_g. For tractability, idiosyncratic earnings risk is perfectly insured in this state, so households of the same age and permanent skill type have the same resources. Because the assigned public-housing size is not a choice, households choose nonhousing consumption c, inter vivos transfers $\mathbf{b}$, and saving in risk-free assets a' after paying the subsidized public rent $\nu\rho_t h_g^i$.

For a household of skill type i and age j in this state, the problem is:

$$V_0^{R_g}\left(\lambda^i, j, y, t\right) = \max_{\{c,a',\mathbf{b}\}} u\left(c, h_g^i, \mathbf{b}\right) + \beta\psi_{j+1}\mathbb{E}\left[V_0^{R_g}\left(\lambda^i, j+1, y', t+1\right)\right], \tag{C.1}$$

$$\text{s.t.} \quad c + \mathbf{b} + a' + \nu\rho_t h_g^i = y, \tag{C.2}$$

$$y' = \begin{cases} (1-\tau_0^{ss})\lambda^i w_{t+1}\varepsilon_{j+1} + a'(1+r) & \text{for } j \leq J_w \\ b_{t+1,j+1}^i + a'(1+r) & \text{for } j > J_w \end{cases} \tag{C.3}$$

The pre-privatization steady state has stationary detrended aggregates and a time-invariant cross-sectional distribution of household states. It provides the initial distribution for the transition beginning in period 1.

C.2 Housing Choices after Privatization

After privatization begins, households can be renters of subsidized public housing (R_g), renters of commercial housing (R_c), owners of privatized public housing (O_g), or owners of commercial housing (O_c). The recursive problems below correspond to these housing states and use the same terminology as the main text.

As described in Section 3.6, the vector of individual states for renters and homeowners is denoted by $\mathbf{x}_t^R := (\lambda^i, h_t, j, y_t, z_t^i, t)$ and $\mathbf{x}_t^O := (\lambda^i, h_t, j, y_t, d_t, z_t^i, t)$, respectively.

As described in Section 3.2, public-rental eligibility is cohort specific. Eligible households pay the subsidized rent $\nu\rho_t$ on their assigned public unit. An R_g household may remain in subsidized public rental housing or move to commercial housing. An initial-cohort household that still retains its purchase option may also buy its assigned public unit at the subsidized price $p_t^g(j)$; for a transitional-cohort public renter, this purchase option is omitted. The transfer $\mathcal{T}_{t+1}$ guarantees the subsistence levels of nonhousing consumption and rental housing services:

$$\mathcal{T}_t(y) = \max\{0, \rho_t h_R^1 + \underline{c} - y\},$$

where h_R^1 is the smallest market-rental option.

Specifically, the value function of a type-R_g renter of state variable $\mathbf{x}_t^R = (\lambda^i, h_g^i, j, y_t, z_t^i, t)$ at the beginning of period t can be expressed as

$$
\begin{aligned}
V_t^{R_g}(\lambda^i, j, h_g^i, y, z) = & \max_{\{c,a',\mathbf{b}\}} u(c, h_g^i, \mathbf{b}) \\
& + \beta\psi_{j+1}\mathbb{E}\Bigg[\max\Bigg\{ V_{t+1}^{R_g}\left(\lambda^i, j+1, h_g^i, y', z'\right), V_{t+1}^{B_g}\left(\lambda^i, j+1, h_g^i, y', z'\right), \\
& \qquad V_{t+1}^{R_c}\left(\lambda^i, j+1, y', z'\right), V_{t+1}^{B_c}\left(\lambda^i, j+1, y', z'\right)\Bigg\}\Bigg]
\end{aligned}
$$

$$
\text{s.t.} \quad c + \mathbf{b} + a' + \nu\rho_t h_g^i = y
$$

$$
y' = \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a'(1+r) + \mathcal{T}_{t+1} & \text{for } j \le J_w \\ b_{t+1,j+1}^i + a'(1+r) + \mathcal{T}_{t+1} & \text{for } j > J_w \end{cases}
$$

$$
a' \ge 0
$$

Unlike subsidized public-housing renters, market renters can choose housing sizes from the option set $\mathcal{H}_R$. They do not receive a rental subsidy, and once they leave the subsidized public-rental sector, they cannot return to it. Thus, at the beginning of the next period, they choose between continuing to be a market renter, that is, staying as type-R_c, and buying a commercial housing unit and obtaining value $V_{t+1}^{B_c}$. The value function of households who are market renters, i.e., the type-R_c households, can be expressed as

$$
V_t^{R_c}(i, j, y, z) = \max_{\{c,a',h_R\in\mathcal{H}_R,\mathbf{b}\}} u(c, h_R, \mathbf{b}) + \beta\psi_{j+1}\mathbb{E}\left[\max\left\{ V_{t+1}^{R_c}\left(y', z', j+1\right), V_{t+1}^{B_c}\left(i, j+1, y', z'\right)\right\}\right]
$$

$$
\text{s.t.} \quad c + \mathbf{b} + a' + \rho_t h_R = y
$$

$$
y' = \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a(1+r) + \mathcal{T}_{t+1} & \text{for } j \le J_w \\ b_{t+1,j+1}^i + a'(1+r) + \mathcal{T}_{t+1} & \text{for } j > J_w \end{cases}
$$

$$
a' \ge 0
$$

We next characterize households that purchase either an assigned public unit or a commercial housing unit at the beginning of the period. For an eligible initial-cohort household that purchases its assigned public unit, the optimization problem is

$$
\begin{aligned}
V_t^{B_g}(i,j,y,z) = \max_{c,a',d',\mathbf{b}} u(c,\zeta h_g^i,\mathbf{b}) + \beta\psi_{j+1}\mathbb{E}\Bigg[\max\Bigg\{ & V_{t+1}^{O_g}(i,j+1,y',z',\zeta h_g^i,d',), \\
& V_{t+1}^{R_c}(i,j+1,y'_{\text{sell}},z'), V_{t+1}^{B_c}(i,j+1,y'_{\text{sell}},z')\Bigg\}\Bigg] \\
\text{s.t.} \quad c + \mathbf{b} + a' + p_t^g(j)h_g^i &= y + d' \\
y' &= \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a'(1+r) & \text{for } j \leq J_w \\ b_{t+1,j+1}^i + a'(1+r) & \text{for } j > J_w \end{cases} \\
y'_{\text{sell}} &= y' + (1-\tau_s)p_{t+1}h_g^i - d'(1+r_m) + \mathcal{T}_{t+1} \\
d' &\leq (1-\gamma)p_t^g(j)h_g^i \\
a' &\geq 0
\end{aligned}
$$

An eligible buyer of the assigned public unit pays the subsidized price $p_t^g(j)$ as given by Eq. 18. Households can take out mortgages and borrow up to a fraction $(1-\gamma)$ of the purchase price. At the beginning of the next period, a household may choose to remain the owner of the house (O_g), or sell the house and become either a renter (R_c) or a buyer (O_c) of a commercial housing unit. Note that once a household sells the privatized public housing unit, it fetches the market price, which gives rise to a potential capital gain from the difference between the subsidized purchase price and the sale price.

The problem for a market-housing buyer differs from that for a buyer of an assigned public unit in two respects. First, commercial housing is purchased at the market price rather than at a subsidized public-housing price. Second, buyers choose among the available market-housing sizes ($\mathcal{H}_O$).

$$
\begin{aligned}
V_t^{B_c}(i,j,y,z) = \max_{c,a',d',h_o\in\mathcal{H}_O,\mathbf{b}} u(c,\zeta h_o,\mathbf{b}) + \beta\psi_{j+1}\mathbb{E}\Bigg[\max\Bigg\{ & V_{t+1}^{O_c}(i,j+1,y',z',h_o,d'),\\
& V_{t+1}^{R_c}(i,j+1,y'_{\text{sell}},z'), V_{t+1}^{B_c}(i,j+1,y'_{\text{sell}},z')\Bigg\}\Bigg]
\end{aligned}
$$

$$
\begin{aligned}
\text{s.t.}\quad & c + \mathbf{b} + a' + p_t h_o = y + d'\\
y' = & \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a'(1+r) & \text{for } j \le J_w\\ b^i_{t+1,j+1} + a'(1+r) & \text{for } j > J_w \end{cases}\\
{y_{\text{sell}}}' = & \ y' + (1-\tau_s)p_{t+1}h_o - d'(1+r_m) + \mathcal{T}_{t+1}\\
d' \le & \ (1-\gamma)p_t h_o\\
a' \ge & \ 0
\end{aligned}
$$

The optimization problem for an owner of privatized public housing is:

$$
\begin{aligned}
& V_t^{O_g}(i,j,y,z,h_g^i,d) = \max_{c,a',m,\mathbf{b}} u(c,\zeta h_g^i,\mathbf{b})\\
& + \beta\psi_{j+1}\mathbb{E}\Big[\max\left\{V_{t+1}^{O_g}(i,j+1,y',z',h_g^i,d'), V_{t+1}^{R_c}(i,j+1,y'_{\text{sell}},z'), V_{t+1}^{B_c}(i,j+1,y'_{\text{sell}},z')\right\}\Big]\\
& \text{s.t.}\quad c + \mathbf{b} + a' + \delta_h p_t h_g^i + m = y\\
& m \ge \frac{r_m(1+r_m)^{J+1-j}}{(1+r_m)^{J+1-j}-1} d\\
& d' = d(1+r_m) - m\\
& y' = \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a'(1+r) & \text{for } j \le J_w\\ b^i_{t+1,j+1} + a'(1+r) & \text{for } j > J_w \end{cases}\\
& y'_{\text{sell}} = y' + (1-\tau_s)p_{t+1}h_g^i - d'(1+r_m) + \mathcal{T}_{t+1}.\\
& a' \ge 0
\end{aligned}
$$

Similarly, the value function for an owner of commercial housing is:

$$V_t^{O_c}(i,j,y,z,h_o,d) = \max_{c,a',m,\mathbf{b}} u(c,\zeta h_o,\mathbf{b})$$

$$+\beta\psi_{j+1}\mathbb{E}\Big[\max\left\{V_{t+1}^{O_c}(i,j+1,y',z',h_o,d'),V_{t+1}^{R_c}(i,j+1,y'_{\text{sell}},z'),V_{t+1}^{B_c}(i,j+1,y'_{\text{sell}},z')\right\}\Big]$$

$$\text{s.t.}\quad c+\mathbf{b}+m+a'+\delta_h p_t h_o = y$$

$$m \geq \frac{r_m(1+r_m)^{J+1-j}}{(1+r_m)^{J+1-j}-1}d$$

$$d' = d(1+r_m)-m$$

$$y' = \begin{cases} (1-\tau^{ss}-\tau)\lambda^i w_{t+1}\varepsilon_{j+1}z' + a'(1+r) & \text{for } j \leq J_w \\ b^i_{t+1,j+1} + a'(1+r) & \text{for } j > J_w \end{cases}$$

$$y'_{\text{sell}} = y' + (1-\tau_s)p_{t+1}h_o - d'(1+r_m) + \mathcal{T}_{t+1}.$$

$$a' \geq 0$$

D Detrending the Quantitative Model

The pre-privatization steady state and the terminal steady state generally have different deterministic growth rates for productivity and population. We therefore detrend the pre-privatization steady state separately and then express the transition path relative to the terminal growth trend.

D.1 Transition Path and Terminal Steady State

Let g and n denote the terminal steady-state growth rates of wages and population. Let g_I, g_p, and g_h denote the corresponding growth rates of residential investment, house prices, and individual housing quantities. The construction technology and housing-market accounting imply

$$\begin{aligned} 1+g_I &= [(1+g)(1+n)]^{\alpha}, & 1+g_p &= [(1+g)(1+n)]^{1-\alpha}, \\ 1+g_h &= \frac{1+g_I}{1+n}, & 1+g &= (1+g_h)(1+g_p). \end{aligned} \tag{D.1}$$

Individual variables fall into two groups. Consumption, financial assets, inter vivos transfers, and cash-on-hand scale with the wage trend, whereas housing quantities and housing services scale with the individual housing trend:

$$
\begin{aligned}
\widehat{x}_{t,j} &= x_{t,j}(1+g)^{T+j-t-1}, && x \in \{c, a, b, y\}, \\
\widehat{x}_{t,j} &= x_{t,j}(1+g_h)^{T+j-t-1}, && x \in \{h, s\}.
\end{aligned} \tag{D.2}
$$

Aggregate variables can likewise be grouped by their balanced-growth trends:

$$
\begin{aligned}
\widehat{x}_t &= x_t(1+g)^{T-t}, && x \in \{w, \mathcal{A}\}, \\
\widehat{x}_t &= x_t(1+n)^{T-t}, && x \in \{N_c, N_h\}, \\
\widehat{x}_t &= x_t(1+g_p)^{T-t}, && x \in \{p, p^g(j), \rho\}, \\
\widehat{x}_t &= x_t(1+g_I)^{T-t}, && x \in \{I, H\}, \\
\widehat{Y}_t &= Y_t[(1+g)(1+n)]^{T-t}, && \widehat{L}_t = L_t.
\end{aligned} \tag{D.3}
$$

The subsidized public rent $\nu\rho_t$ inherits the same trend as ρ_t. These transformations are sufficient to express the household, firm, government, and market-clearing conditions in stationary units; therefore, we do not reproduce the full system equation by equation.

D.2 Pre-privatization Steady State

Let g_0 and n_0 denote wage and population growth in the pre-privatization steady state, and let g_{I0}, g_{p0}, and g_{h0} denote the associated trends in residential investment, house prices, and individual housing quantities. Analogously,

$$
\begin{aligned}
1+g_{I0} &= [(1+g_0)(1+n_0)]^{\alpha}, && 1+g_{p0} = [(1+g_0)(1+n_0)]^{1-\alpha}, \\
1+g_{h0} &= \frac{1+g_{I0}}{1+n_0}, && 1+g_0 = (1+g_{h0})(1+g_{p0}).
\end{aligned} \tag{D.4}
$$

The individual variables are detrended by

$$
\begin{aligned}
\widehat{x}_{t,j} &= x_{t,j}(1+g_0)^{-t}, && x \in \{c, a, b, y\}, \\
\widehat{x}_{t,j} &= x_{t,j}(1+g_{h0})^{-t}, && x \in \{h, s\},
\end{aligned} \tag{D.5}
$$

while the aggregate variables satisfy

$$
\begin{aligned}
&\widehat{x}_t = x_t(1+g_0)^{-t}, && x \in \{w, \mathcal{A}\}, \\
&\widehat{x}_t = x_t(1+n_0)^{-t}, && x \in \{N_c, N_h\}, \\
&\widehat{x}_t = x_t(1+g_{p0})^{-t}, && x \in \{p, \rho\}, \\
&\widehat{x}_t = x_t(1+g_{I0})^{-t}, && x \in \{I, H\}, \\
&\widehat{x}_t = x_t[(1+g_0)(1+n_0)]^{-t}, && x \in \{C, Y\}, \\
&\widehat{L}_t = L_t. && \qquad \text{(D.6)}
\end{aligned}
$$

After solving this steady state, we recover levels and re-trend the initial distribution using the terminal trend factors before computing the transition path.

E Institutional Background for the Chinese Quantitative Application

This appendix collects the institutional facts that are directly used to map the housing-policy regime in Section 3.2 into the Chinese quantitative application. The relevant features are the allocation of public housing before privatization, the subsidized sale of occupied public units to incumbent households, the withdrawal of new work-unit housing provision, the introduction of mortgage finance, and the subsequent transition from privatized public housing to commercial housing. We omit broader historical details that do not enter the model or the calibration.

E.1 Public Housing before Privatization

Before the large-scale privatization of the 1990s, urban housing provision was closely tied to the work-unit system. Employers acquired or developed housing and allocated units to their employees at rents substantially below market levels. The size and location of assigned units depended in part on household characteristics and length of service (Fang et al., 2016). These features motivate the pre-privatization steady state in the quantitative model, in which incumbent households occupy assigned public units of skill-specific size and pay subsidized rents rather than choosing freely from the commercial housing stock.

E.2 Subsidized Purchase and the 1998 Policy Shift

The July 1994 State Council decision on urban housing reform allowed employees in the state sector to purchase the public units they occupied at subsidized prices. A central pricing concept was the "cost price," which was administratively determined to be below the market price and adjusted upward over time. An alternative "standard price" conveyed only partial property rights and was intended to be temporary. Using the 2000 census, Fang et al. (2010) report substantial discounts relative to market prices in major cities. This institutional structure motivates the model's restriction of subsidized purchase eligibility to the initial cohorts and the cohort- and age-dependent purchase discount $\eta_{t,j}$.

A second policy change occurred in 1998. The State Council ended the practice of work units developing or purchasing new housing for employees, shifting new entrants toward the market sector. At roughly the same time, mortgage finance became broadly available: the People's Bank of China authorized commercial banks to make residential mortgage loans and permitted loan-to-value ratios of up to 70 percent. In the quantitative model, these reforms are represented by the end of new subsidized public-rental access at T_R and the introduction of mortgage finance at T_M, with a minimum down-payment ratio of $\gamma = 0.30$.

E.3 Transition Toward Commercial Housing

The post-privatization evolution of housing tenure also motivates the distinction between smaller privatized public units and commercial housing in the quantitative model. Using the Chinese Household Income Project, Sato et al. (2013) report that ownership of privatized public housing rose sharply during the initial privatization phase, while market-housing ownership remained much smaller. As the market sector subsequently expanded, the share of households in privatized public housing declined, while market-housing ownership increased. This pattern is consistent with a transition in which privatized public housing serves as an initial ownership position from which some households later move into commercial housing.

The size differential between assigned public housing and preferred commercial housing is also supported by household evidence. Using the China Health and Nutrition Survey, Wang (2011) finds that households living in state-owned housing before the reform consumed substantially fewer housing services than they would have chosen in the private market. This evidence motivates the model's smaller public-housing units and creates scope for life-cycle

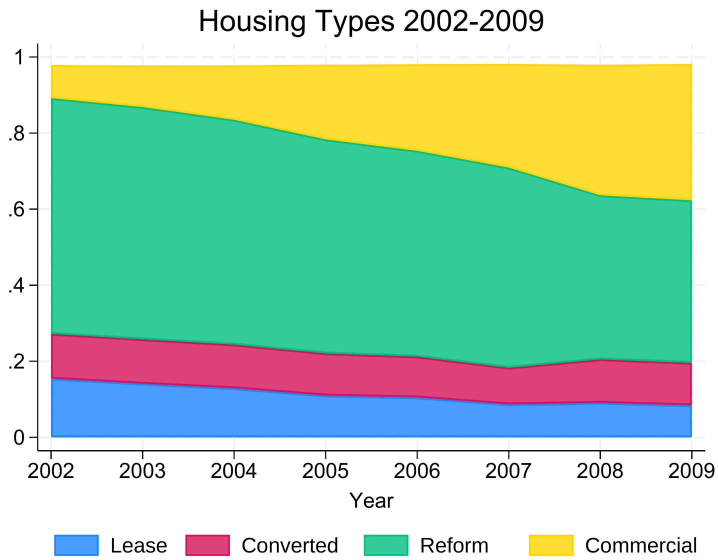

Figure E.1: Housing Composition in China: 2002–2009

Notes: The figure is constructed from various years of China Urban Household Survey. "Reform" housing corresponds to privatized public housing in the terminology of the main text; "commercial" housing refers to housing built by commercial developers; "converted" housing refers to housing stock in urban fringe that was converted into urban area; and "lease" stands for rental housing.

upgrading once households obtain access to the market sector. Together, these institutional features discipline the two margins central to the quantitative mechanism: subsidized access determines which incumbent households obtain an early ownership position, while subsequent market participation allows that position to be revalued and, when households choose to move, to be used to finance larger commercial housing.

F More Quantitative Results

This appendix collects supplementary quantitative figures referenced in the main text. Appendix Figures F.1 and F.2 report the exogenous demographic and productivity paths, as well as the calibrated land-supply and house-price paths used in the quantitative analysis. Appendix Figure F.3 reports the alternative paths of wage rates used in the fiscal-resilience exercises of Section 6.

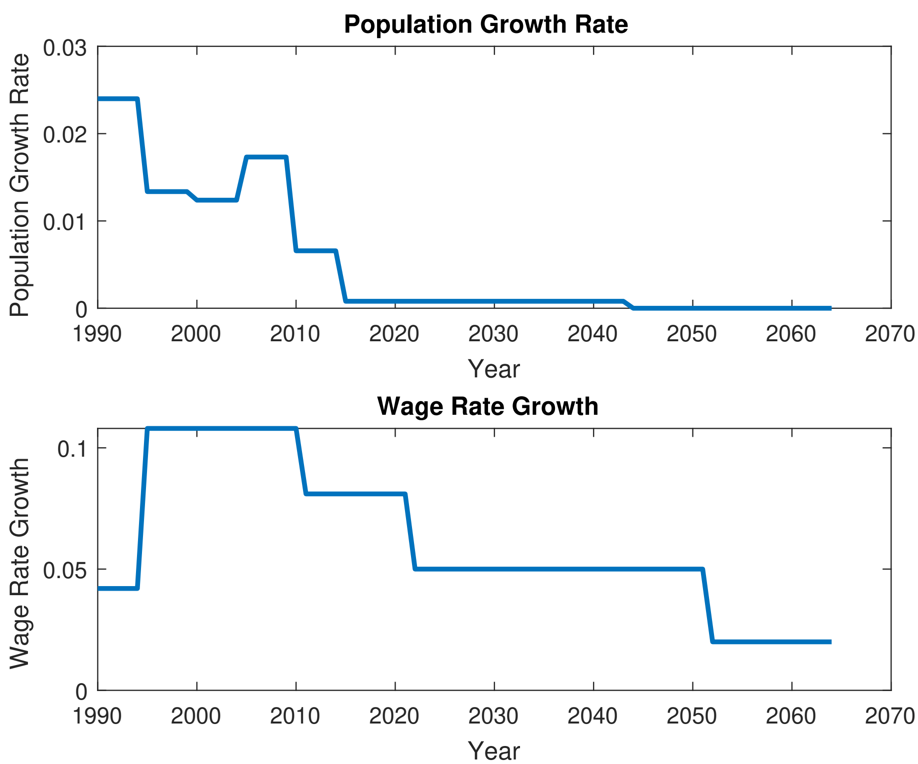

Figure F.1: Dynamics of Wage and Population during Economic Transition

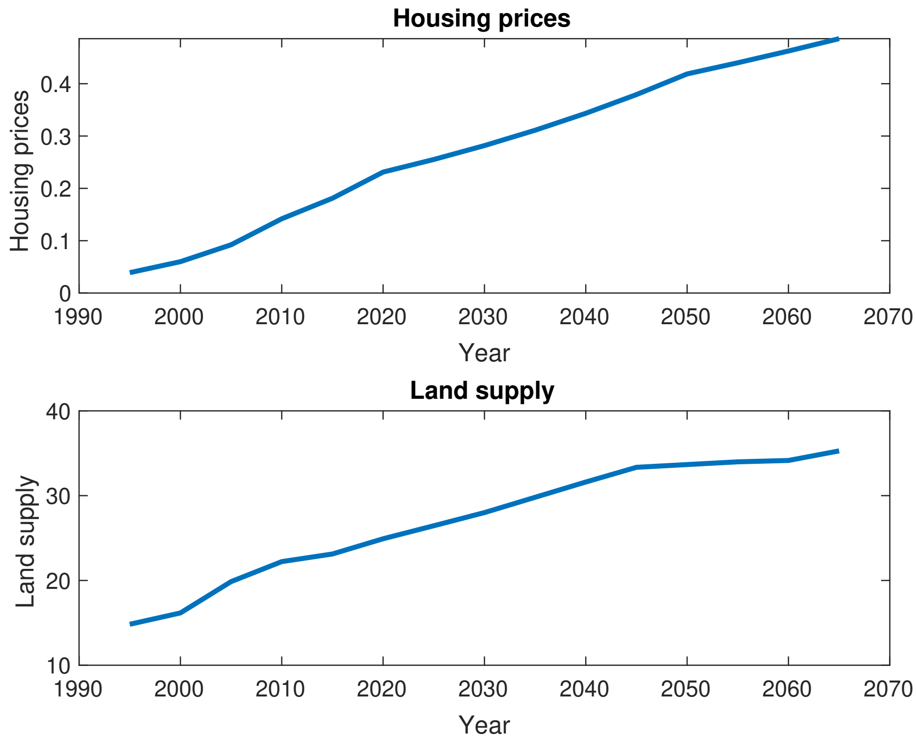

Figure F.2: Calibrated Land Supply and Housing Price Dynamics

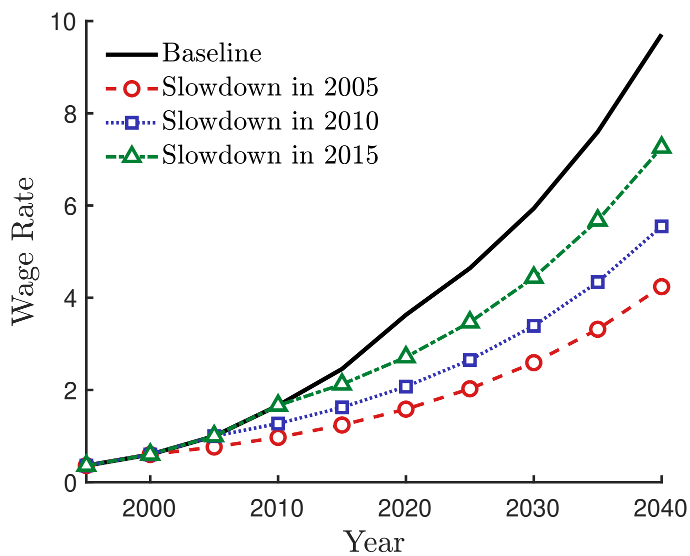

Figure F.3: Wage Growth Paths under Alternative Slowdown Scenarios

Notes: Wage rate, corresponding to w_t in Equation 21, is normalized to 1 in 2005. The baseline (expected) wage rate grows at 10.80% per year from 1995 to 2010, 8.10% per year over 2010–2020, and 5.00% per year from 2020 to 2040, for an average of 7.59% per year over the whole 1995–2040 window. Each slowdown scenario follows this baseline until its shock date, i.e., the 2000–2005 block for the "Slowdown in 2005" case, the 2005–2010 block for "Slowdown in 2010", and the 2010–2015 block for "Slowdown in 2015", at which point wage growth drops immediately and permanently to 5.00% per year, giving overall averages of 5.63%, 6.26% and 6.90% per year, respectively.