

# The Effects of Partial Public Housing Privatization: Evidence from Hong Kong

Michael B. Wong\*

*MIT*

June 2022

## **Abstract**

Many governments sell public housing to sitting tenants but limit the resale and leasing of sold units. What is the impact of this partial privatization? I present quasi-experimental evidence that fifteen years after its introduction, Hong Kong's Tenants Purchase Scheme reduced household sizes in treated estates by 7 percent and increased household incomes by 23 percent. There was little reallocation of housing across households, however. These effects are instead driven by the relaxation of household-size-contingent income limits and unit allocation rules, which increased labor supply and altered household composition.

Keywords: public housing, privatization, resale restrictions, household composition, labor supply

JEL: H44, I38, R31

---

\*Email: mbwong@mit.edu. I am deeply indebted to my father Yue Chim Richard Wong, who devoted much of his life to the study of public housing in Hong Kong, and William Lui for assistance with the data. I thank David Autor and Parag Pathak for helpful comments. I gratefully acknowledge funding from the National Science Foundation and the Kuok Foundation.

# 1 Introduction

To reduce state involvement in housing allocation, many governments sell public rental housing to sitting tenants. For example, the Right-to-Buy program in the UK transferred ownership of over 2.8 million council houses to tenants between 1980 and the mid-2000s ([Disney and Luo 2017](#)). Ireland’s sale of council houses boosted its home ownership rate from 70.8 percent in 1971 to 79.3 percent in 1991.<sup>1</sup> Many economists support these programs because of evidence that housing provision through non-market mechanisms results in misallocation ([Gyourko and Linneman 1989](#); [Wong 1998](#); [Glaeser and Luttmer 2003](#); [Wang 2011](#)).<sup>2</sup>

However, subsidized sales of public housing often include restrictions on leasing and resale of sold units. In Hong Kong, for example, purchasing tenants must pay a hefty land premium before they can freely resell or lease their units.<sup>3</sup> This form of privatization is *partial* because it confers perpetual use rights to buyers, but not transfer and letting rights. Partial privatization may fail to reduce housing misallocation, since resale and leasing restrictions prevent households from moving. Furthermore, it may alter household composition and reduce availability of affordable housing to low-income renters by lifting means testing requirements.

In this paper, I quantify the impact of Hong Kong’s Tenants Purchase Scheme (TPS), which allowed 183,700 households to buy their public rental housing units but strongly limited the resale and leasing of sold units. Specifically, I leverage the program’s staggered roll-out across housing estates between 1998 and 2006 in a dynamic difference-in-differences design to estimate its effects on household sizes and household incomes. I construct a control group of non-TPS housing estates with similar construction years as TPS estates. I then use the interaction-weighted estimator proposed by [Sun and Abraham \(2020\)](#), which computes the mean of the

---

<sup>1</sup>Similar programs exist in Austria, Sweden, and Singapore. In Austria, social housing tenants can acquire a right-to-buy option by paying a capital contribution at the start of their tenancy. In Sweden, the conversion scheme allows tenants in public rental housing to establish a cooperative. In Singapore, the Home Ownership Scheme helps low-income residents buy public sale flats at subsidized prices on a 99-year lease term. See [Legislative Council Secretariat \(2020\)](#).

<sup>2</sup>The economic cost of public housing misallocation is potentially large, since public housing represents a large share of housing stock in the world. The OECD countries alone have more than 28 million public housing dwellings ([OECD 2021](#)). State-provided housing is also common throughout the developing world, particularly in Asia and sub-Saharan Africa ([Wang 2011](#)).

<sup>3</sup>In the UK, Right-to-Buy purchasers must repay the discount if reselling within the first five years of purchase.

cohort-specific average treatment effects on the treated estates, weighted by the shares of each treatment cohort. Outcomes are measured using restricted-access data from the Hong Kong Population Census.

The data confirm that TPS did not reallocate housing across households because of leasing and transfer restrictions. As of 2016, nearly 99 percent of households in sold TPS units were owner-occupiers who had not paid the land premium to the government and, as such, were legally prohibited from leasing out or reselling their units on the open market. Transfer of units with unpaid premium on the Home Ownership Scheme (HOS) Secondary Market was also very limited. Most purchasing households therefore did not move away for many years.

Nevertheless, TPS caused total population and average household size in treated estates to immediately fall, and average household income to immediately rise. The effects were large. Total population decreased by 5 percent within a few years, and eventually decreased by roughly 7 percent, or roughly 51,000, within two decades. Average household size declined by roughly 5 percent within two decades. Average household income rose by 7 percent within a few years, and was 23 percent higher 15 years later.

The effects are explained by the fact that purchasing tenants are no longer subject to the household-size-contingent income limits and unit allocation rules. In particular, public renters with incomes in excess of income limits must pay either 1.5 times rent or double rent. Furthermore, if the number of household members in a rental flat falls below the prevailing standard, the household must move to a smaller flat. Since these rules do not apply to purchasing households, TPS altered the residential and labor supply decisions of households and their constituent members. Consistent with this explanation, the share of households with incomes above the 1.5 times and double rent income limits dramatically increased, by 80 and 96 percent, respectively, within two decades. There is also evidence that households purchased TPS units in order to avoid these administrative rules.

Partial privatization therefore benefited well-off public renters, who were no longer subject to increased rent, and hurt the lower-income population, who faced reduced housing availability. Why? TPS disincentivized well-off tenants from moving up the housing ladder, so the available supply of low-end public housing fell. At the same time, TPS reduced the population in treated

estates. Since this population must be housed elsewhere, demand for low-end rental housing rose. This implies that TPS caused the low-income population to face both higher rents in the private sector and longer waiting times for public housing.

Despite their importance, evidence on the effects of public housing privatization programs is very limited, both in Hong Kong and elsewhere. While [Ho and Wong \(2006\)](#) present time-series evidence on the effects of TPS on property prices, this is the first study to credibly estimate the program's causal effects using its staggered rollout across estates. My finding is that partial privatization reduced average household sizes and raised average household incomes by eliminating household-size-contingent means testing requirements and unit allocation. The finding contrasts with [Wang \(2011, 2012\)](#), who show that the privatization of state employee housing in China reduced housing misallocation and relaxed credit constraints, and [Disney et al. \(2021\)](#), who show that UK's Right-to-Buy policy reduced crime.

This paper also relates to a broader literature on the effects of public housing. Prior studies show that there is significant misallocation of public housing in Hong Kong, as evidenced by increased commuting distances ([Lui and Suen 2011](#)), as well as over-consumption of housing by lower-income households and under-consumption by higher-income households ([Wong and Liu 1988](#)). Consistent with studies in other contexts (e.g., [Jacob and Ludwig 2012](#); [Dijk 2019](#)), my findings show that public housing in Hong Kong reduces labor supply. In addition, my evidence highlights an important effect ignored in existing studies: Means testing requirements and unit allocation rules substantially alters household composition in government-built estates.

Finally, this paper contributes to an active policy debate in Hong Kong, which faces the world's most severe housing affordability crisis.<sup>4</sup> Because of this crisis, there is renewed policy interest in relaunching TPS to boost homeownership.<sup>5</sup> This paper reveals that TPS benefited well-off public renters but reduced housing availability for the low-income population. Therefore, if TPS were relaunched without policy modifications, Hong Kong's already dire shortage of affordable housing will worsen.

---

<sup>4</sup>[Kwan \(2021\)](#) provide a ranking of cities according to affordability. Between 2004 and 2021, the real price of residential homes in Hong Kong rose by 239 percent, while real wages grew by only 7.1 percent, according to data from the Bank for International Settlements and the Hong Kong Census and Statistics Department.

<sup>5</sup>See [Legislative Council Secretariat \(2009\)](#), [GovHK \(2012\)](#) and [Our Hong Kong Foundation \(2017, 2019\)](#). The Hong Kong government suggests, however, that relaunching TPS will reduce the supply of public rental housing.

The paper proceeds as follows. Section 2 describes relevant background. Section 3 provides descriptive evidence. Section 4 presents the estimated effects of TPS. Section 5 concludes.

## 2 Background

### 2.1 Public Rental Housing in Hong Kong

The purpose of Hong Kong’s public rental housing (PRH) program is to provide subsidised flats for qualifying low-income families that cannot afford private rental accommodation. Applicants are funnelled through a waiting-list system, which processes applications mainly on a first-come-first-served basis. Individual flats are then offered to applicants by random computer batching according to each applicant’s household size, flat allocation standards, and choice of district. Applicants receive up to three housing offers, which are given out one at a time. If all three offers are rejected, then the applicant must wait one year before reapplying. The average wait time for housed applicants was 2.0 years in 2011, but had risen to 5.5 years by 2019. In 1998, the year before the launch of TPS, 2.3 million Hong Kong residents lived in PRH units, roughly 38 percent of the total population.<sup>6</sup>

**Well-off Tenants Policy.** To target public housing provision to low-income families, the “Well-off Tenants Policy” was created to reallocate PRH units from households whose incomes have significantly risen to families that are more in need. This policy requires tenants who have lived in PRH flats for 10 years or more to declare the income and assets of all household members biennially. Households who report total monthly incomes in excess of household-size-contingent income limits are then required to pay either 1.5 times rent or double rent, and households who additionally have large net asset holdings are asked to move out. Because of this, the rent of PRH households rises discretely when their household incomes cross the income limits, resulting in a large notch in their budget set. To encourage truthful reporting, income and asset

---

<sup>6</sup>See [Housing Department \(2021\)](#) and [Legislative Council Secretariat \(2020\)](#). As of March 2019, public rental housing flats accounted for about 29 percent of the stock of permanent housing and housed about 31 percent of total households in Hong Kong ([Census and Statistics Department 2020](#); [Transport and Bureau 2019](#)).

declarations are randomly chosen for in-depth verification. Households with all members aged 60 or above are exempted from the policy.<sup>7</sup>

**Under-occupation.** To ensure equitable utilization of PRH units, the government also reallocates units if the size of a household significantly falls. Due to moving-out, death, marriage, or emigration of some household members, some households may end up enjoying more living space than is allowed under prevailing standards. To address under-occupation (UO), tenants are required to declare biennially their occupancy position. These declarations are verified through random flat visits. If the number of household members in a PRH flat is below the minimum number set by the HA for the flat, the household would be asked to move to a suitable flat. Under-occupation is a significant problem. As of March 2021, there were 79,380 UO households, roughly 10 percent of the total number of PRH households, of which 5,320 were considered prioritized UO cases. Between 2016 and 2020, the government resolved an average of about 2,200 prioritized UO cases each year.<sup>8</sup>

## 2.2 History of the Tenants Purchase Scheme

In 1998, the Hong Kong Housing Authority launched the Tenants Purchase Scheme (TPS), which allowed PRH tenants to buy the flats they lived in at a discounted price. The stated goal of the policy was to boost Hong Kong's homeownership rate to 70 percent within ten years' time. Between 1998 and 2006, units in 39 PRH estates, totalling 183,700 units and comprising roughly 27 percent of the total stock of PRH units, were made available for sale.

Strong incentives were put in place to encourage rapid sale. Almost all sitting tenants in the selected estates were offered the opportunity to purchase.<sup>9</sup> Tenants who do not wish to purchase

---

<sup>7</sup>See [Audit Commission \(2007\)](#) for more details. The Housing Subsidy Policy (HSP) and the Policy on Safeguarding Rational Allocation of Public Housing Resources (PSRA) were implemented in 1987 and 1996 respectively and are collectively referred to as "Well-off Tenants Policies". Under the PSRA, household income and net asset value are adopted as the two criteria for determining PRH households' eligibility to continue to receive subsidised public housing. Under section 26(1) of the Housing Ordinance, any person who knowingly makes any false statement are liable on conviction to a maximum fine of \$50,000 and to imprisonment for six months. Between 2003 and 2006, roughly 6 percent of households were found to have under-reported their incomes, of which 18 percent were prosecuted.

<sup>8</sup>See [Audit Commission \(2013\)](#) and [GovHK \(2021\)](#).

<sup>9</sup>The exceptions were those living in the following flats: 1) Housing for Senior Citizens and Small Household

can continue to rent and occupy their flats as before. The purchase price was set at replacement cost, but given a further discount of 60% on purchase within the first year, which is as low as 12% of market value.<sup>10</sup> To fund the purchase, the government agreed with a number of banks and financial institutions to provide mortgages of up to 100% of the balance of the purchase price of the flat for up to 25 years. Following the sale, the unit owner became responsible for maintenance and repairs, building management fees, as well as property taxes. By 2006, roughly 104,400 units had been purchased.

However, the government re-positioned housing policies in 2002 in response to the economic downturn and collapse of private-sector property prices following the Asian financial crisis. This included the dropping of the target for home ownership, and the withdrawal of Housing Authority from the property sale market as far as possible. In August 2005, the Housing Authority decided against expanding the sale of PRH flats to the remaining PRH estates. In Section 4, I leverage the staggered and incomplete roll-out of TPS across housing estates to identify the impact of the program.<sup>11</sup>

### **2.3 Restrictions on Resale and Leasing of TPS Units**

The TPS program granted permanent occupancy rights to purchasing households. As such, TPS flat owners were no longer subject to the Well-off Tenant Policy and under-occupancy unit allocation rules of PRH tenants. However, TPS flat owners were restricted from resale and letting on the open market until a premium equivalent to current value of the original discount is paid to the government. For this reason, most TPS owners did not enjoy the full benefits of private homeownership.

The resale restrictions were severe. In the first two years after the sale, a TPS flat owner can only sell the flat back to HA at the list price. Starting from the third year, flats can be sold in

---

Block; 2) Flats used for social welfare purposes; and 3) Flats with common entrance and communal facilities such as bathroom, kitchen and entrance.

<sup>10</sup>New tenants who purchase TPS flats enjoy a full credit if they buy within the first year and a halved credit in the second year. After the second year, no credit will be given. Purchasers will need to pay, apart from the price of the flat, the stamp duty, registration fees and legal costs. See [Housing Authority \(2014\)](#) for more details.

<sup>11</sup>In each of the first five phases of TPS launch, around 26,000 to 28,000 PRH flats in six selected estates were offered for sale. In the last phase, which comprised phase 6A and phase 6B, around 49,000 PRH flats in nine estates were offered for sale ([Legislative Council Secretariat 2020](#)).

the Home Ownership Scheme (HOS) Secondary Market to eligible purchasers without payment of a premium to the Housing Authority. After five years, flats may be sold in the open market subject to payment of a premium equivalent to the current value of the original discount.<sup>12</sup>

Letting of TPS units is also prohibited until the premium is paid. TPS owners letting units in breach of the Housing Ordinance are liable on conviction to a maximum fine of \$500,000 and to imprisonment for one year.

The premium became prohibitively expensive with soaring property prices, so very few TPS owners paid the premium. For example, there were 21,355 TPS units in the district of Tuen Mun, of which 14,383 were sold as of September 23, 2021. For these units, only 200 premiums were paid between 2005 and 2020. In other words, the number of premium payments per year was less than 0.1 percent of the stock of sold TPS units.<sup>13</sup> Consequently, most TPS owners could not resell or lease their units on the open market.

Transactions on the HOS Secondary Market were also rare. For TPS units in Tuen Mun, there were only 702 between the beginning of 2002 and October 2021. The number of transactions on the HOS Secondary Market per year was therefore less than 0.3 percent of the stock of sold TPS units.<sup>14</sup> This implies that most households who purchased PRH units continued to reside in the unit for many years thereafter.

---

<sup>12</sup>Within the third to fifth years from the date of first assignment, TPS flat owners can sell back their flats to Housing Authority at assessed market value less the original purchase discount. If HA declines to buy back the flats, however, TPS flat owners can sell, let or assign their flats in the open market. In addition, the Housing Authority may give consent to a request for change of ownership under special circumstances, such as divorce or separation, emigration or long-term working abroad, death, old age, bankruptcy, or terminal illness of owner. See [Housing Authority \(2014\)](#).

<sup>13</sup>See: <https://www.housingauthority.gov.hk/en/home-ownership/information-for-home-owners/premium-payment-arrangement/premium-statistics/index.html>

<sup>14</sup>See: <https://www.housingauthority.gov.hk/en/home-ownership/hos-secondary-market/transaction-records/index.html>



### 3 Data and Summary Statistics

#### 3.1 Hong Kong Population Census

To measure the effects of TPS on estate outcomes, I use restricted-access data from the Hong Kong Population Census and By-census, specifically, the 20% random samples in 2001, 2011 and the 10% random samples in 1996, 2006, 2016. These data provide information about each respondent's age, sex, household composition, employment, earnings, as well as an indicator for whether the respondent moved in last five years.<sup>15</sup> Furthermore, these data include identifiers for 136 public rental housing estates, including all 39 estates where residents became eligible to partake in TPS. This allows me to construct a panel of estates for analysis in Section 4.

#### 3.2 Trends in Ownership and Leasing in TPS Estates

Table 1 shows the trend in ownership and leasing composition of households in TPS estates. There are three findings. First, a large majority of units in TPS estates were sold immediately after the launch of TPS. By 2006, the share of households residing in sold TPS units had risen to 57.4 percent from zero in 1996. By 2016, the share further increased to 71.9 percent.

Second, households who purchased public rental units largely continued to reside in the unit for many years following the purchases. As shown in the middle four rows of Table 1, nearly 99 percent of sold TPS units were owner-occupied with their premium unpaid. Since the premium must be paid before a TPS owner could sell, let, assign, or otherwise alienate the unit on the open market, this implies that only a tiny proportion of sold TPS units were either rented out or resold on the open market. The number of transactions in HOS Secondary Market was also small, as previously shown in Section 2.3, therefore suggesting that most purchasing households did not move away for many years.

Third, the number of households residing in TPS estates fell from roughly 186,000 in 1996 to 177,000 in 2016. Since the number of units in these estates did not change during this time, this decline anticipates our finding below in Section 4 that the TPS reduced the population and

---

<sup>15</sup>Real income is deflated using 1996 dollars.

Table 1: Unit ownership of households in TPS estates over time

Year	1996	2001	2006	2011	2016
Share of HHs in unsold TPS units	100.0%	68.9%	42.6%	35.7%	28.1%
Share of HHs in sold TPS units	0.0%	31.1%	57.4%	64.3%	71.9%
TPS premium unpaid, Owner-occupied	0.0%	31.1%	55.6%	62.5%	70.9%
TPS premium unpaid, Rented	0.0%	0.0%	1.8%	1.4%	0.1%
TPS premium paid, Owner occupied	0.0%	0.0%	0.0%	0.3%	0.5%
TPS premium paid, Rented	0.0%	0.0%	0.0%	0.1%	0.4%
Number of households	185962	185641	181876	180022	177413

Notes: Table decomposes ownership status by household in TPS estates. Source: Hong Kong Population Census.

number of households in treated estates.

### 3.3 Who Became TPS Owners?

There is strong evidence that avoidance of household-size-contingent unit allocation rules and means testing requirements motivated many households to purchase TPS units.

Table 2 shows mean household characteristics in TPS estates in 2006, respectively for residents in sold and unsold TPS units. Larger and higher-income households, for whom these rules were more binding, were more likely to live in sold TPS units. By contrast, households whose members are all over 60 years old and therefore not subject to means testing requirements are less likely to live in sold TPS units. A government study in 2001 similarly reported that “the sale results of TPS flats were better among households who were paying additional rent, of larger size and with non-elderly members” (Housing Authority 2001). Yeung (2001) presents survey evidence that fear of paying extra rent was an important motivator for TPS purchases.

Another piece of evidence comes from the Official Proceedings of Hong Kong’s Legislative Council. On October 31, 2012, Council member Wong Kwok-kin made the following remark while lobbying the government to expand TPS:

Many well-off tenants want to buy their own flats through the TPS so as to avoid the trouble of paying double rent or undergoing random checking. However, many well-off tenants are not sitting tenants in the dozens of TPS estates. Therefore, I would like to ask the Secretary: Whether the authorities will study and consider the

Table 2: HH characteristics, sold and unsold units in TPS estates, 2006

	Sold units	Unsold units	Standardized difference
HH size	3.52 (1.3)	2.91 (1.36)	0.45
HH income	18668 (13157)	12853 (10304)	0.49
Working persons per HH	1.84 (1.16)	1.24 (1.09)	0.54
HH with all 60+ y. o.	0.06 (0.24)	0.15 (0.36)	-0.29
Single-person	0.06	0.18	-0.36
Nuclear family	0.76	0.71	0.12
Extended family	0.38	0.32	0.17
Non-family	0.08	0.07	0.02
HH size = 1	0.06	0.18	-0.36
HH size = 2	0.16	0.23	-0.16
HH size = 3	0.25	0.25	0.01
HH size = 4	0.32	0.24	0.18
HH size = 5	0.15	0.08	0.23
HH size = 6+	0.06	0.03	0.11
Number of HHs	101112	80764	

Notes: Table shows mean household characteristics in TPS estates in 2006, respectively for TPS buyers and non-buyers.

proposal of giving well-off tenants not living in the existing TPS estates the option to buy PRH flats if they have such a need? ([GovHK 2012](#))

If households bought TPS units to avoid household-size-contingent unit allocation rules and mean testing requirements, then economic theory predicts that some household members will move out and others will increase labor supply after buying TPS units. As we show in the next section, this is indeed the case.

## 4 Impact of the Tenants Purchase Scheme

This section shows that TPS reduced total population and average household size, but raised average household income in the treated estates. These findings are best explained by the fact that TPS relaxed household-size-contingent unit allocation rules and means testing requirements for purchasing incumbent households.

### 4.1 Empirical Strategy

To identify the effects of TPS on estate-level outcomes, I leverage the staggered and incomplete roll-out of the program across estates using dynamic difference-in-differences design.

The analysis sample includes all 39 treated estates and 43 control estates, chosen as follows. I take all public rental housing estates where residents did not become eligible for TPS. Since the estates chosen for TPS tend to be more recently built, I exclude all estates with any buildings constructed before 1980, to ensure that the control estates had similar building features and resident populations. I also exclude all estates with any buildings constructed after 1996, so that our estimates are not contaminated by influxes of new residents upon the completion of new construction.<sup>16</sup>

I then estimate the following equation:

$$y_{et} = \sum_{\tau \in \mathcal{T}} \beta_{\tau} (T_e \times 1_{t=t_e^*+\tau}) + \delta_e + \delta_t + \varepsilon_{et},$$

where  $e$  indexes estates,  $t \in \{1996, 2001, 2006, 2011, 2016\}$  is the Census year,  $y_{et}$  is an estate-level outcome variable,  $T_e$  indicates whether estate  $e$  was ever treated,  $t_e^*$  is the first Census year following treatment for estate  $e$ ,  $\tau \in \mathcal{T} \equiv \{-10, 0, 5, 10, 15\}$  indexes the year relative to  $t_e^*$ , and  $\delta_e$  and  $\delta_t$  denote estate and year fixed effects. This equation includes year fixed effects and thus controls for confounding city-wide changes in the housing market that contaminates previous estimates of the effects of the TPS program (e.g. [Ho and Wong 2006](#)).

---

<sup>16</sup>See Online Appendix Table [A1](#) and [A2](#). Building construction years are collated from four sources: (1) data.gov.hk; (2) Wikipedia; (3) website of the Housing Society; and (4) website of the Housing Authority.

Since the timing of TPS introduction was staggered across estates, my main specification uses the interaction-weighted estimator proposed by [Sun and Abraham \(2020\)](#), which computes an average of the cohort-specific average treatment effect on the treated estates, weighted by the shares of each cohort.<sup>17</sup> Standard errors clustered at the estate level are reported.

The  $\beta_\tau$  coefficients identify the causal effect of TPS under the assumption that the outcomes of treated estates would have evolved in parallel to those of control estates in the absence of treatment. It is possible to check for pre-treatment trends, since two pre-treatment Census years are available for the later cohort of treated estates. As shown below, the estimates consistently reveal an absence of pre-treatment trends.

The treatment and control estates are broadly similar in pre-treatment characteristics. Each estate houses roughly 4,500 households, or a population of roughly 18,000. Their average household incomes are highly similar (see Online Appendix Table A3). Furthermore, the pre-treatment characteristics of treated estates are highly similar across cohorts. However, treated estates have larger populations and larger average household sizes than control, suggesting that there remain systematic differences between the treated and control estates.

For robustness, I report cohort-specific estimates where observations are reweighted using entropy-balancing ([Hainmueller 2012](#)), with two goals in mind. First, reweighting the data so that that treated and control estates have the same pre-treatment average household size and average household income enables us to gauge whether observed pre-treatment differences in estate characteristics lead to selection bias. Second, cohort-specific estimates allow us to gauge whether the effects were similar across the cohorts. As reassuringly shown below, cohort-specific estimates using entropy-balancing weights are highly similar to the main estimates.

## 4.2 Impact on Household Composition

The estimates reveal that TPS altered household composition in treated estates. Total population and average household size both fell. The share of single-person households increased, while the share of extended-family households fell.

---

<sup>17</sup>This specification ensures that estimates are not contaminated by treatment effects from other periods when treatment is staggered ([Callaway and Sant’Anna 2020](#); [de Chaisemartin and D’Haultfœuille 2020](#)).

Figure 1 visualizes the effects of TPS on estate composition. Within each panel, the black series plots coefficients from the Sun-Abraham interaction-weighted estimator. The maroon and yellow series plots cohort-specific estimates using entropy-balancing weights, as described above. Year 0 denotes first observed Census year following treatment.

Panel (a) confirms that the share of households residing in sold TPS units immediately rose by 60 percent once residents became eligible to purchase TPS units in Year 0. As shown in the figure, this share eventually reached 79 percent higher than control in Year 15.

Panel (b) shows that total population in treated estates immediately declined by 5 log points. This effect was persistent and reached 7 log points lower than control in Year 15. Since the total population in TPS estates in 1996 was roughly 733,000, these estimates imply that the total population in TPS estates fell by roughly 51,000.

Panel (c) shows that the number of households in treated estates immediately and persistently declined by roughly 2-3 log points. This decline in the number of households suggests housing units became underutilized as a consequence of TPS sales. These estimates imply that the total number of households in TPS estates fell by roughly 4,000.

Panel (d) shows that average household size in treated estates immediately declined by 0.08, relative to a mean of 4.0 in the pre-treatment year of 1996. This decline widened over time, eventually reaching 0.21, or roughly 5 percent lower than control, in Year 15.

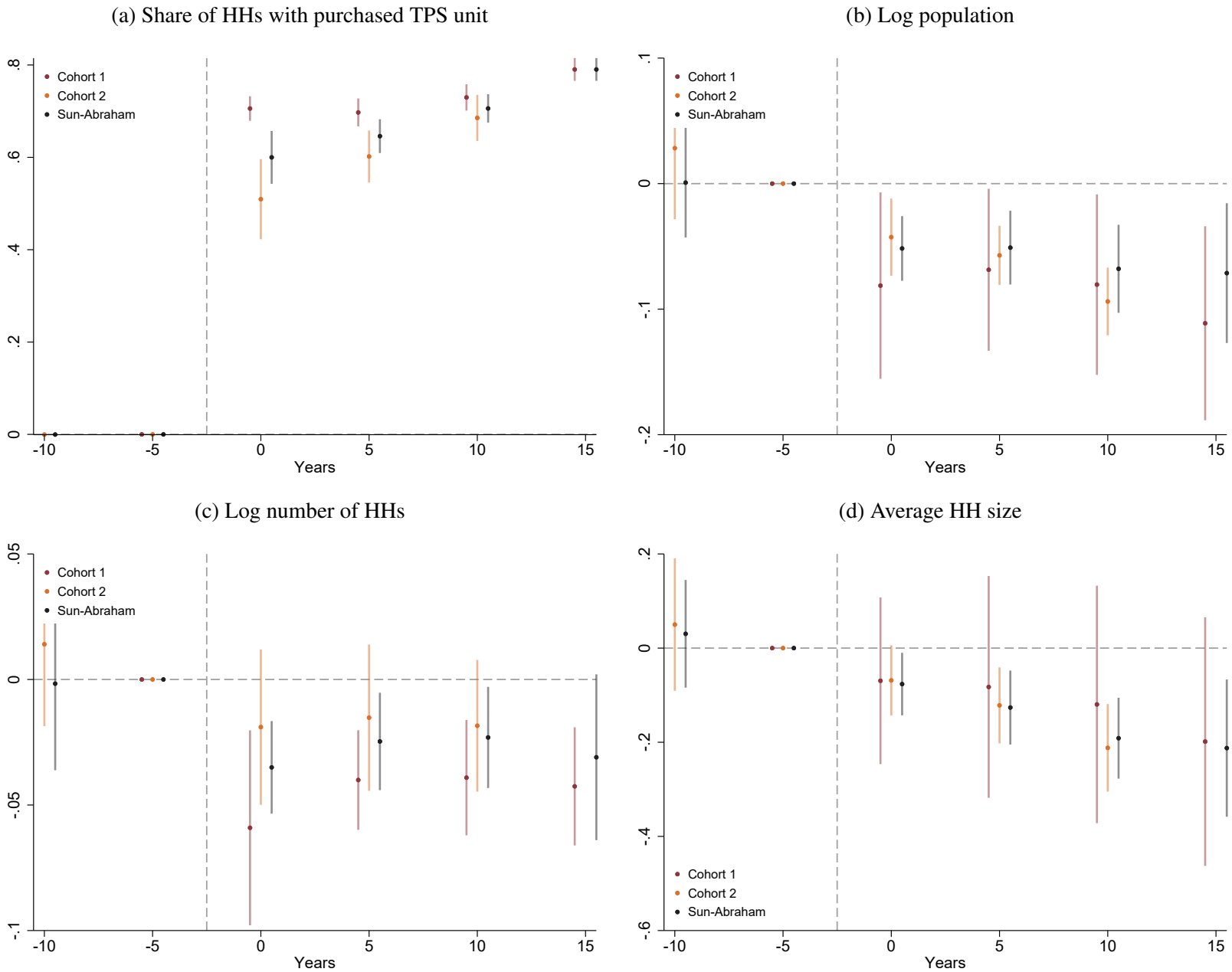
Online Appendix Figure A3 shows that the shares of households with one, two, or three members, while the shares of households with four, five, or six members fell. Furthermore, the share of extended-family households fell by 2.9 percentage points, while the share of single and nuclear family households rose by 0.8 and 1.7 percentage points, respectively.

These estimated effects are unlikely to be driven by pre-existing trends or selection of estates into treatment. In all of the above panels, we do not detect pre-treatment trends in Year -10. Furthermore, the cohort-specific estimates using entropy-balancing weights are highly similar to the Sun-Abraham estimates, even though they are less precise.<sup>18</sup>

---

<sup>18</sup>Online Appendix Table A6 tabulates the Sun-Abraham estimates. The first seven columns have already been discussed above. The final column shows that the share of households who moved in the last five years did not appear to have changed in treated estates as a consequence of TPS. However, these estimates are imprecise and therefore inconclusive.

Figure 1: Effect of TPS on estate composition



Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.

### 4.3 Impact on Household Income

While TPS reduced household sizes, average household incomes rose in treated estates. The share of households with incomes above the income limits dramatically increased.

Figure 2 visualizes the effect of TPS on estate household incomes. Panel (a) shows that average real household income in treated estates rose by 1132 dollars per month, or 7 percent relative to the 1996 mean in treated estates. Average real household income continued to diverge between treatment and control estates. By Year 15, average real monthly household income was 3712 dollars (or 23 percent) higher in treated estates.

Panel (b) shows that the average number of working members per household also rose. By Year 5, the average number of working members per household in treated estates increased by 0.2 (or 12 percent). This positive effect persisted until Year 15. Once again, these estimated effects do not appear to be driven by pre-existing trends or selection of estates into treatment.

Panel (c) shows the share of households above the 1.5X rent income limit rose sharply after treatment. By Year 0, the share of households above the 1.5X rent income limit increased by 3.2 percentage points, or 31 percent relative the 1996 mean in treated estates of 10.2 percent. This divergence further widened thereafter. By Year 15, the share of households above the 1.5X rent income limit was 8.1 percentage points (or 80 percent) higher than control.

Panel (d) shows a similar pattern for the share of households above the 2X rent cutoff. By Year 0, the share of households above the 1.5X rent increased by 0.9 percentage points (or 40 percent) in treated estates. By Year 15, the share of households above the 1.5X rent increased by 2.2 percentage points, roughly double the 1996 mean in treated estates. The fact that these effects are so large confirm that the relaxation of means testing had a significant impact on households.

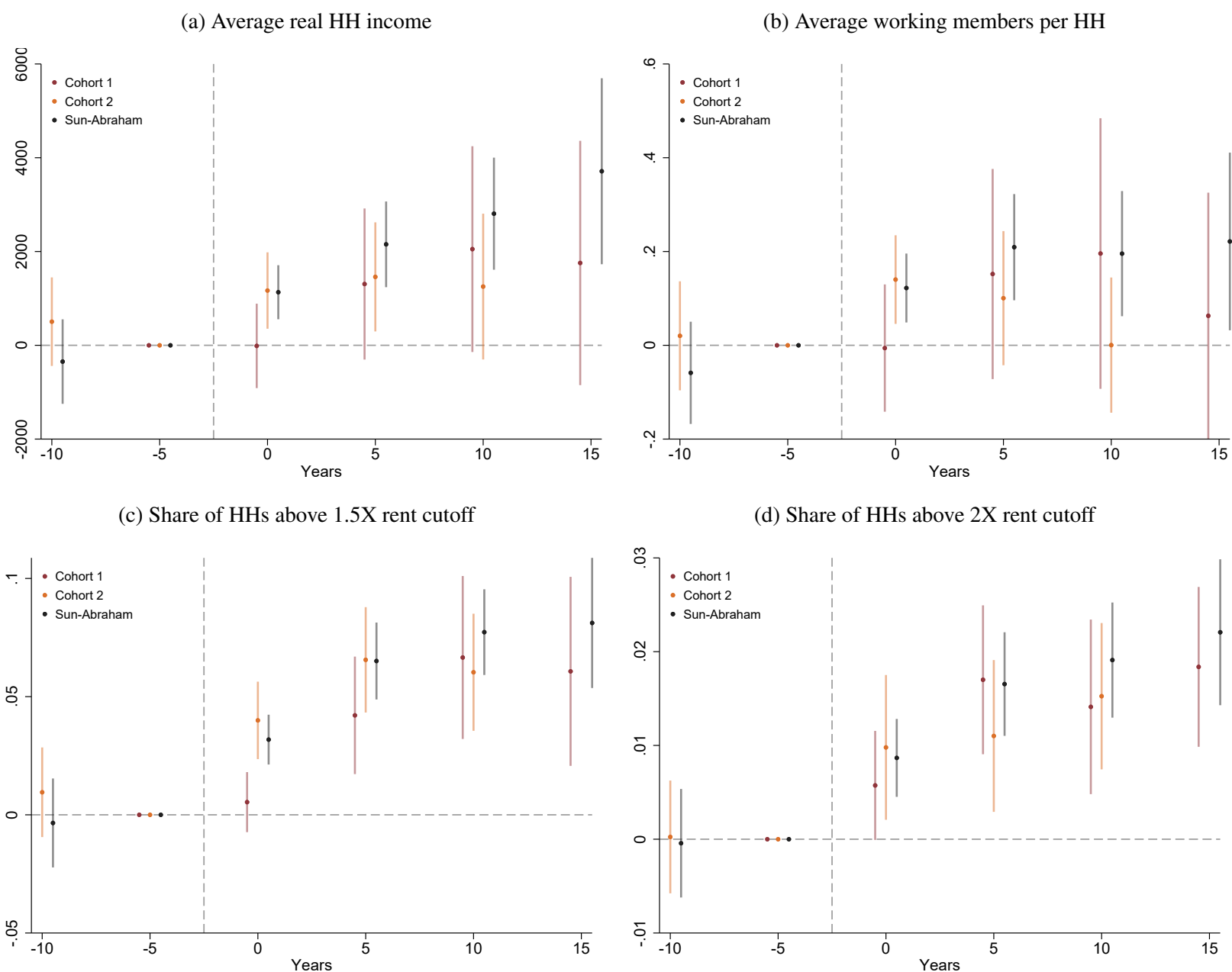
Figure 3 plots the effect of TPS on the share of households within household income bins.<sup>19</sup> The figure reveals that the share of households with incomes much lower than the 1.5X rent income limit dramatically fell in treated estates, while the share of households with incomes both above and slightly below the income limit increased. The lack of a differential response

---

<sup>19</sup>This exercise relates to a growing literature on bunching at tax kinks, tax notches, and wage floors (Saez 2010; Kleven and Waseem 2013; Kleven 2016; Cengiz et al. 2019; Blomquist et al. 2021).

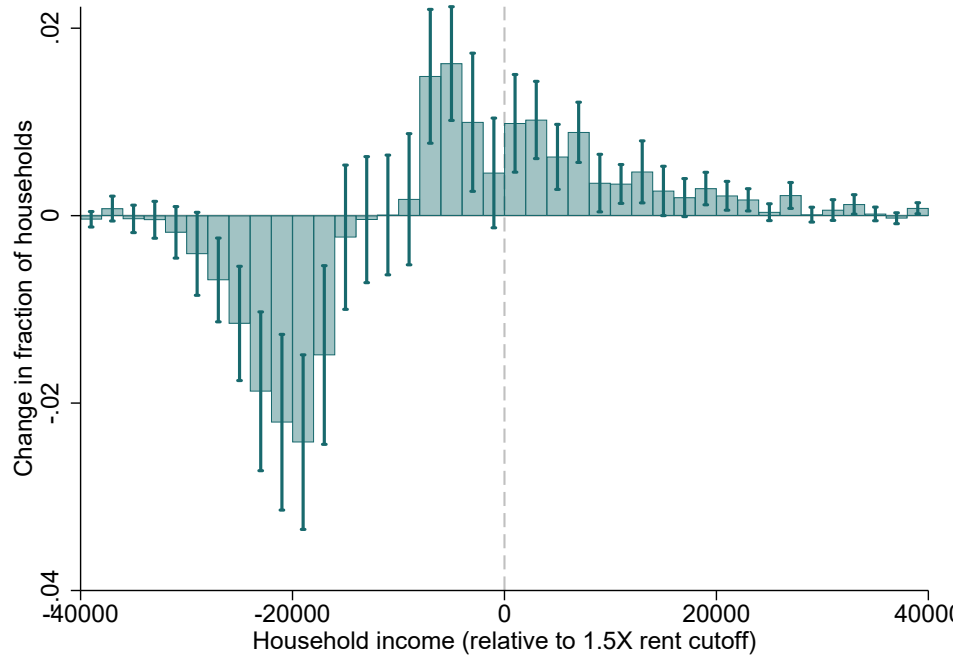


Figure 2: Effect of TPS on estate average HH income



Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample includes all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.

Figure 3: Effect of TPS on HH income distribution relative to 1.5X rent cutoff



Notes: Figure plots the effect of TPS on the share of households within a given household income bin relative to the 1.5X rent income limit in the second Census following treatment relative to that of the last Census year before treatment, estimated using the interaction-weighted estimator in Sun and Abraham (2020). Standard errors (clustered at the estate level) are shown in bars.

at the cutoff is consistent with the fact that public renter households did not appear to bunch around the income limit even before treatment, as shown in Online Appendix Figure A5. One possible reason is that optimization frictions prevented bunching just below the very large rent notch since it is difficult to coordinate among household members. Another possible reason is measurement error. Consistent with the latter, I observe bunching at round numbers in the data, especially for one-person households (see Online Appendix A5), which may obscure bunching.

#### 4.4 What Drove the Effects?

Why did TPS reduce average household sizes and total population in treated estates, but increase average household incomes? As previously shown, almost all TPS owners cannot resell or lease their units. However, TPS did relax household-size-contingent income testing and unit alloca-

tion rules for purchasing households. TPS can therefore alter household sizes and incomes through three channels. First, it could discourage high-income households from moving out. Second, it could alter household composition by encouraging low-income household members to move out and high-income household members to remain. Third, it could encourage household members to increase labor supply.

It is likely that all three channels operate. Consistent with reduced outflow of well-off households from treated estates, [Yeung \(2001\)](#) shows survey evidence that TPS reduced demand for HOS subsidized sale units. Consistent with reconfiguration of household composition, the previous estimates show that TPS reduced average household sizes, even as it increased average household income. Finally, evidence suggests that labor supply increased among continuing residents. By Year 10, the average income of women between ages 25-44 rose by 54 percent in treated estates (see Online Appendix Table [A7](#)). By contrast, the average income of men in the same age group only rose by 11 percent. The fact that average income increased much more for women than men is consistent with meta-analyses that show that female labor supply is much more elastic ([Evers, De Mooij and Van Vuuren 2008](#)). However, the data does not allow me to follow individuals or households over time, so I cannot conclusively distinguish between these channels.

## **4.5 Impact on the Broader Housing Market**

The effects of TPS on the broader housing market is best understood through the lens of a housing ladder model such as [Ortalo-Magné and Rady \(2006\)](#). At bottom of the ladder are a low-income population queuing to enter public rental housing. At top of the ladder are well-off tenants, who have accumulated sufficient wealth to leave public rental housing for higher-end housing such as HOS flats.

Seen through this framework, the results above imply that TPS reduced housing availability for the low-income population. First, TPS reduced movement of well-off tenants up the housing ladder because of relaxed unit allocation and income testing rules. The availability of public rental housing for the low-income population on the PRH waiting list therefore must have cor-

respondingly fallen. Second, TPS reduced total population in treated estates. This implies that new demand for housing at the bottom of the housing ladder was created, because those who moved out must be housed elsewhere.

Since TPS both increased the demand for and reduced the supply of lower-end housing in Hong Kong, the rents of lower-end private rental housing and the waiting times for public rental housing must have risen. An important policy implication follows. If Hong Kong relaunched TPS today without modification, as recently proposed by a number of think tanks and Legislative Council members, the housing shortage among Hong Kong's low-income population will likely worsen.

## 5 Conclusion

This paper contributes novel quasi-experimental evidence on the effects of partially privatizing public housing. Specifically, I analyze the impact of Hong Kong's Tenants Purchase Scheme, a large government program that allowed public renters to buy their housing units at discounted prices but imposed severe restrictions on resale and leasing. For causal identification, I use unique estate-level data from Hong Kong's Population Census and leverage the program's staggered rollout across housing estates between 1998 and 2006.

The estimates reveal that partial privatization substantially altered population and household composition, even though it did not significantly reallocate housing across households. Fifteen years after partial privatization, household sizes fell in treated public housing estates by 7 percent, while household incomes rose by 23 percent. These effects are attributable to the relaxation of household-size-contingent income testing and unit allocation rules for sitting tenants. Partial privatization therefore encouraged well-off tenants to stay in the treated estates, increase their labor supply, and reduce their household size, with negative consequences on the availability of affordable housing for the lower-income population.

The large effects of public housing programs on household size and composition, to my knowledge, has not been emphasized in the extant literature. Since means-testing and unit allocation rules are common around the world, it is likely that public housing programs have

similar effects elsewhere. For large-scale public housing programs like Hong Kong's, the effects on household composition may also have important follow-on effects on the broader housing market by altering both housing demand and supply.

## References

- Audit Commission. 2007. “Management of public rental housing tenancies.”. Chapter 5, Director of Audit Report No. 48.
- Audit Commission. 2013. “Allocation and utilisation of public rental housing flats.”. Chapter 3, Director of Audit Report No. 61.
- Blomquist, Sören, Whitney K. Newey, Anil Kumar and Che-Yuan Liang. 2021. “On Bunching and Identification of the Taxable Income Elasticity.” *Journal of Political Economy* 129(8):2320–2343.
- Callaway, Brantly and Pedro H. C. Sant’Anna. 2020. “Difference-in-Differences with multiple time periods.” *Journal of Econometrics* .
- Cengiz, Doruk, Arindrajit Dube, Attila Lindner and Ben Zipperer. 2019. “The Effect of Minimum Wages on Low-Wage Jobs\*.” *The Quarterly Journal of Economics* 134(3):1405–1454.
- Census and Statistics Department. 2020. “Population Estimates – Publications and Tables.”. Accessed from: <https://www.censtatd.gov.hk/hkstat/sub/sp150.jsp> on October 11, 2021.
- de Chaisemartin, Clément and Xavier D’Haultfœuille. 2020. “Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects.” *American Economic Review* 110(9):2964–96.
- Dijk, Winnie Van. 2019. “The socio-economic consequences of housing assistance.”. Working Paper.
- Disney, Richard F., John Gathergood, Stephen J. Machin and Matteo Sandi. 2021. “Does Homeownership Reduce Crime? A Radical Housing Reform from the UK.” *SSRN Electronic Journal* .
- Disney, Richard and Guannan Luo. 2017. “The Right to Buy public housing in Britain: A welfare analysis.” *Journal of Housing Economics* 35:51–68.
- Evers, Michiel, Ruud De Mooij and Daniel Van Vuuren. 2008. “The Wage Elasticity of Labour Supply: A Synthesis of Empirical Estimates.” *De Economist* 156:25–43.
- Glaeser, Edward L. and Erzo F. P. Luttmer. 2003. “The Misallocation of Housing Under Rent Control.” *American Economic Review* 93(4):1027–1046.
- GovHK. 2012. “Press Releases – LCQ3: Tenants Purchase Scheme. 31 October.”. Accessed from: <https://www.info.gov.hk/gia/general/201210/31/P201210310311.htm> on October 11, 2021.
- GovHK. 2021. “LCQ17: Transfer of under-occupation public rental housing households.”. Accessed at <https://www.info.gov.hk/gia/general/202106/09/P2021060900398.htm>, on October 10, 2021.

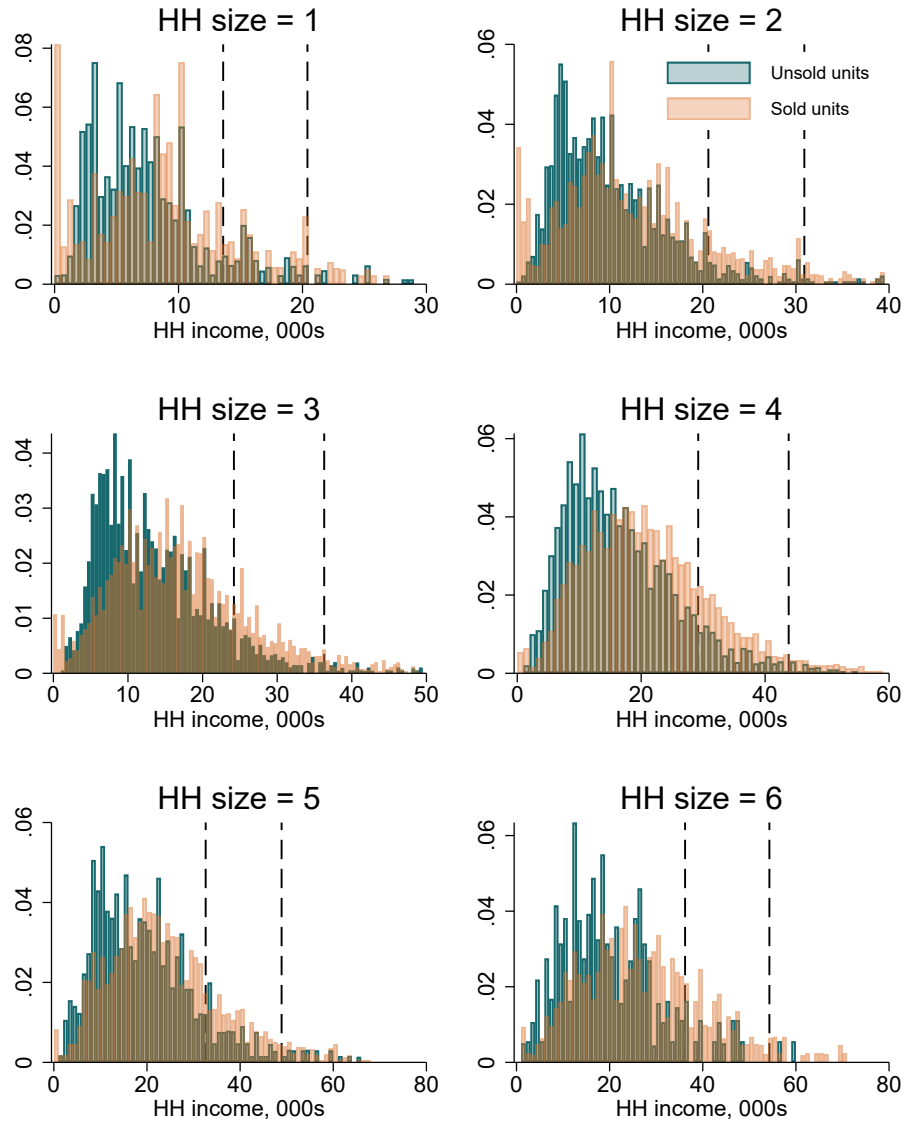
- Gyourko, Joseph and Peter Linneman. 1989. "Equity and efficiency aspects of rent control: An empirical study of New York City." *Journal of Urban Economics* 26(1):54–74.
- Hainmueller, Jens. 2012. "Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies." *Political Analysis* 20(1):25–46.
- Ho, Lok Sang and Gary Wai-Chung Wong. 2006. "Privatization of Public Housing: Did it Cause the 1998 Recession in Hong Kong?" *Contemporary Economic Policy* 24(2):262–273.
- Housing Authority. 2001. "Memorandum for the Home Ownership Committee: Statistical Analysis on Tenants Purchase Scheme." Paper No. HOC 38/2001.
- Housing Authority. 2014. "Buying a Flat under the Tenants Purchase Scheme: Frequently Asked Questions." Accessed at [https://www.housingauthority.gov.hk/en/common/pdf/home-ownership/buying-a-flat-under-tps/FAQ-4.3Buying\\_a\\_Flat\\_underTPS-EN.pdf](https://www.housingauthority.gov.hk/en/common/pdf/home-ownership/buying-a-flat-under-tps/FAQ-4.3Buying_a_Flat_underTPS-EN.pdf) on October 10, 2021.
- Housing Department. 2021. *Information Booklet on General Housing Policies*. Accessed at <https://www.housingauthority.gov.hk/en/about-us/policy-focus/policies-on-public-housing/index.html> on October 10, 2021.
- Jacob, Brian A and Jens Ludwig. 2012. "The Effects of Housing Assistance on Labor Supply: Evidence from a Voucher Lottery." *American Economic Review* 102(1):272–304.
- Kleven, Henrik J. and Mazhar Waseem. 2013. "Using Notches to Uncover Optimization Frictions and Structural Elasticities: Theory and Evidence from Pakistan\*." *The Quarterly Journal of Economics* 128(2):669–723.
- Kleven, Henrik Jacobsen. 2016. "Bunching." *Annual Review of Economics* 8(1):435–464.
- Kwan, Shawna. 2021. "Hong Kong Homes Ranked Least Affordable for 11th Year." *Bloomberg*. Accessed at <https://www.bloomberg.com/news/articles/2021-02-23/hong-kong-homes-ranked-world-s-least-affordable-for-11th-year> on October 11, 2021.
- Legislative Council Secretariat. 2009. "Background brief on the proposal to re-launch the Home Ownership Scheme and Tenants Purchase Scheme." Paper submitted to the Panel on Housing of the Legislative Council for information on 2 February 2009. LC Paper No. CB(1)669/08-09(04).
- Legislative Council Secretariat. 2020. "Tenants purchase schemes in selected places." Accessed from <https://www.legco.gov.hk/research-publications/english/1920in06-tenants-purchase-schemes-in-selected-places-20200316-e.pdf> on October 11, 2021.
- Lui, Hon-Kwong and Wing Suen. 2011. "The effects of public housing on internal mobility in Hong Kong." *Journal of Housing Economics* 20(1):15–29.

- OECD. 2021. “OECD Affordable Housing Database.”. Retrieved from <https://www.oecd.org/housing/data/affordable-housing-database/>.
- Ortalo-Magné, François and Sven Rady. 2006. “Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints.” *The Review of Economic Studies* 73(2):459–485.
- Our Hong Kong Foundation. 2017. “Land and Housing Policy Research Series 3: Housing Policy Reform to Narrow Wealth Gap – Urgent Formation of Land to Improve People’s Livelihood.”. Accessed from: [https://www.ourhkfoundation.org.hk/sites/default/files/media/pdf/ohkf\\_land\\_and\\_housing\\_2017\\_en\\_17102017.pdf](https://www.ourhkfoundation.org.hk/sites/default/files/media/pdf/ohkf_land_and_housing_2017_en_17102017.pdf) on October 11, 2021.
- Our Hong Kong Foundation. 2019. “Vision of Universal Affordable Housing in Hong Kong – Policy Recommendation Outline.”. Accessed from: [https://ourhkfoundation.org.hk/sites/default/files/media/pdf/OHKF\\_Housing\\_Proposal\\_ExeSum\\_20191011\\_EN\\_web.pdf](https://ourhkfoundation.org.hk/sites/default/files/media/pdf/OHKF_Housing_Proposal_ExeSum_20191011_EN_web.pdf) on October 11, 2021.
- Saez, Emmanuel. 2010. “Do Taxpayers Bunch at Kink Points?” *American Economic Journal: Economic Policy* 2(3):180–212.
- Sun, Liyang and Sarah Abraham. 2020. “Estimating dynamic treatment effects in event studies with heterogeneous treatment effects.” *Journal of Econometrics* .
- Transport and Housing Bureau. 2019. “Housing in Figures 2019.”. Accessed from: <https://www.thb.gov.hk/eng/psp/publications/housing/HIF2019.pdf> on October 11, 2021.
- Wang, Shing-Yi. 2011. “State Misallocation and Housing Prices: Theory and Evidence from China.” *American Economic Review* 101(5):2081–2107.
- Wang, Shing-Yi. 2012. “Credit Constraints, Job Mobility, and Entrepreneurship: Evidence from a Property Reform in China.” *The Review of Economics and Statistics* 94(2):532–551.
- Wong, Yue-Chim and Pak-Wai Liu. 1988. “The distribution of benefits among public housing tenants in Hong Kong and related policy issues.” *Journal of Urban Economics* 23(1):1–20.
- Wong, Yue Chim Richard. 1998. *On Privatizing Public Housing*. City University of Hong Kong Press.
- Yeung, Fai Yip. 2001. “A study of the impact of the tenants purchase scheme (TPS) on the Hong Kong housing markets.”. Lingnan University Master Thesis.



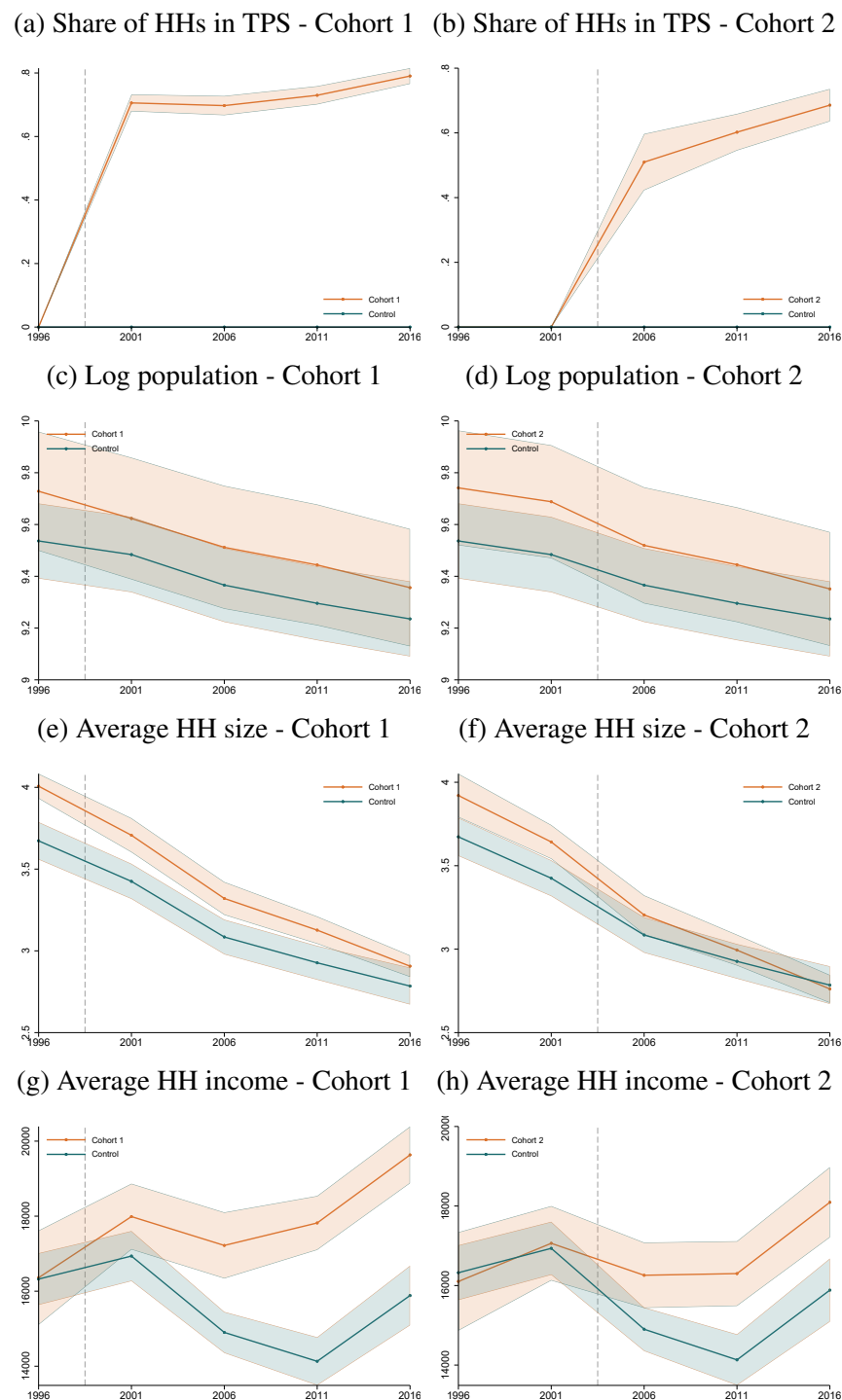
## Online Appendix

Figure A1: HH income distribution by household size, sold vs unsold units, 2006



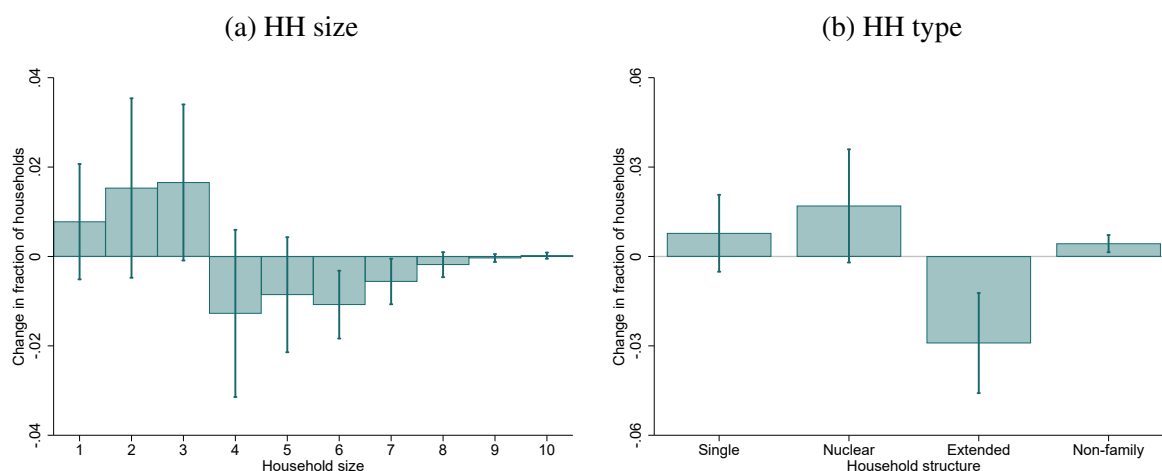
Notes: Figure plots the distribution of household income in TPS estates in 2006 by household size, respectively for sold and unsold units. The 1.5X and 2X rent income limits are plotted in dashed vertical lines. Households with all members above age 60 are excluded.

Figure A2: Trends in housing estate outcomes, treated vs weighted control estates



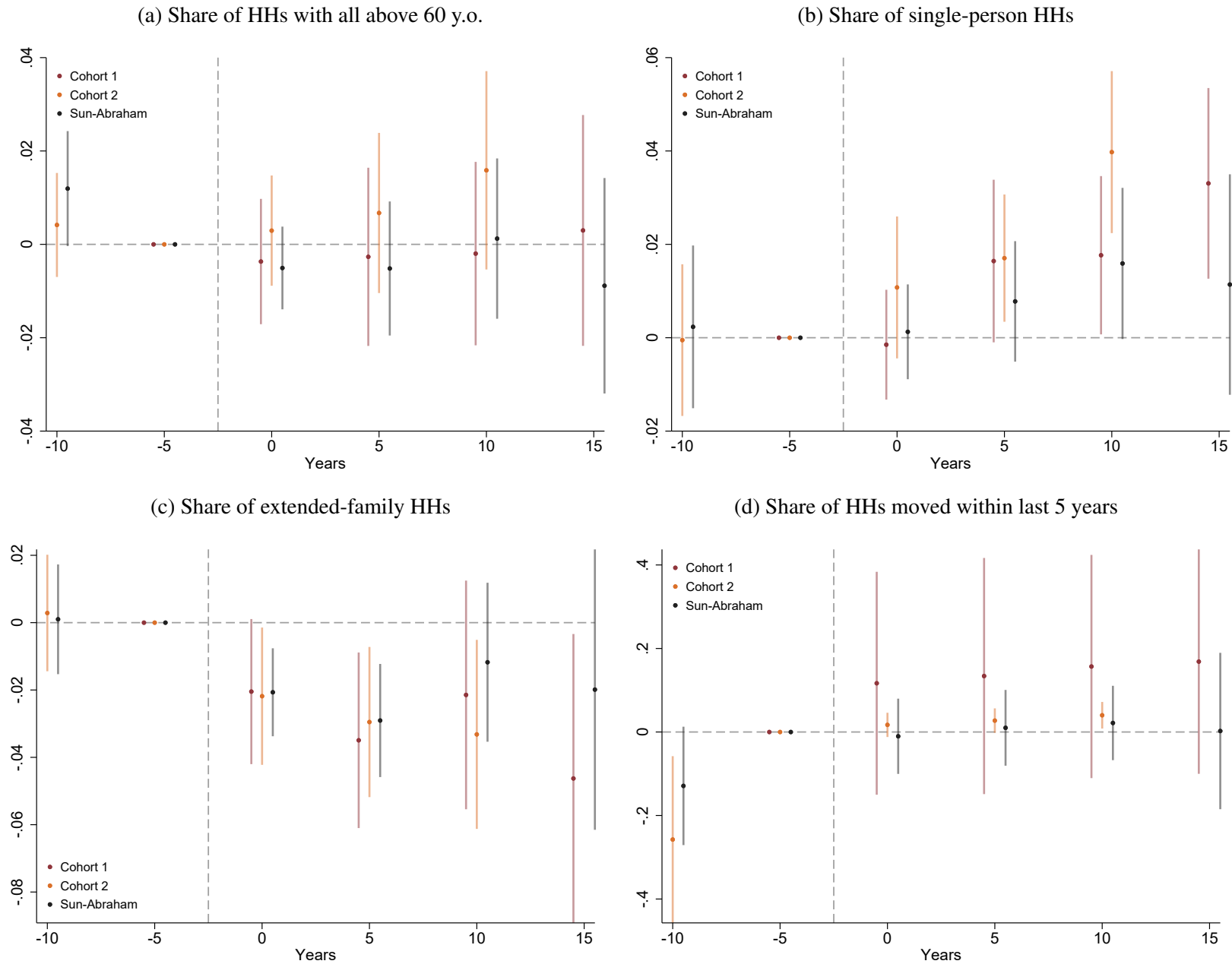
Notes: Each panel shows the trend in mean estate characteristics, separately for the two treated cohorts and their respective controls, whose means are computed with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample includes all estates where all buildings were built after 1979 and before 1996. Standard errors are shown in the shade area.

Figure A3: Effect of TPS on distribution of household types



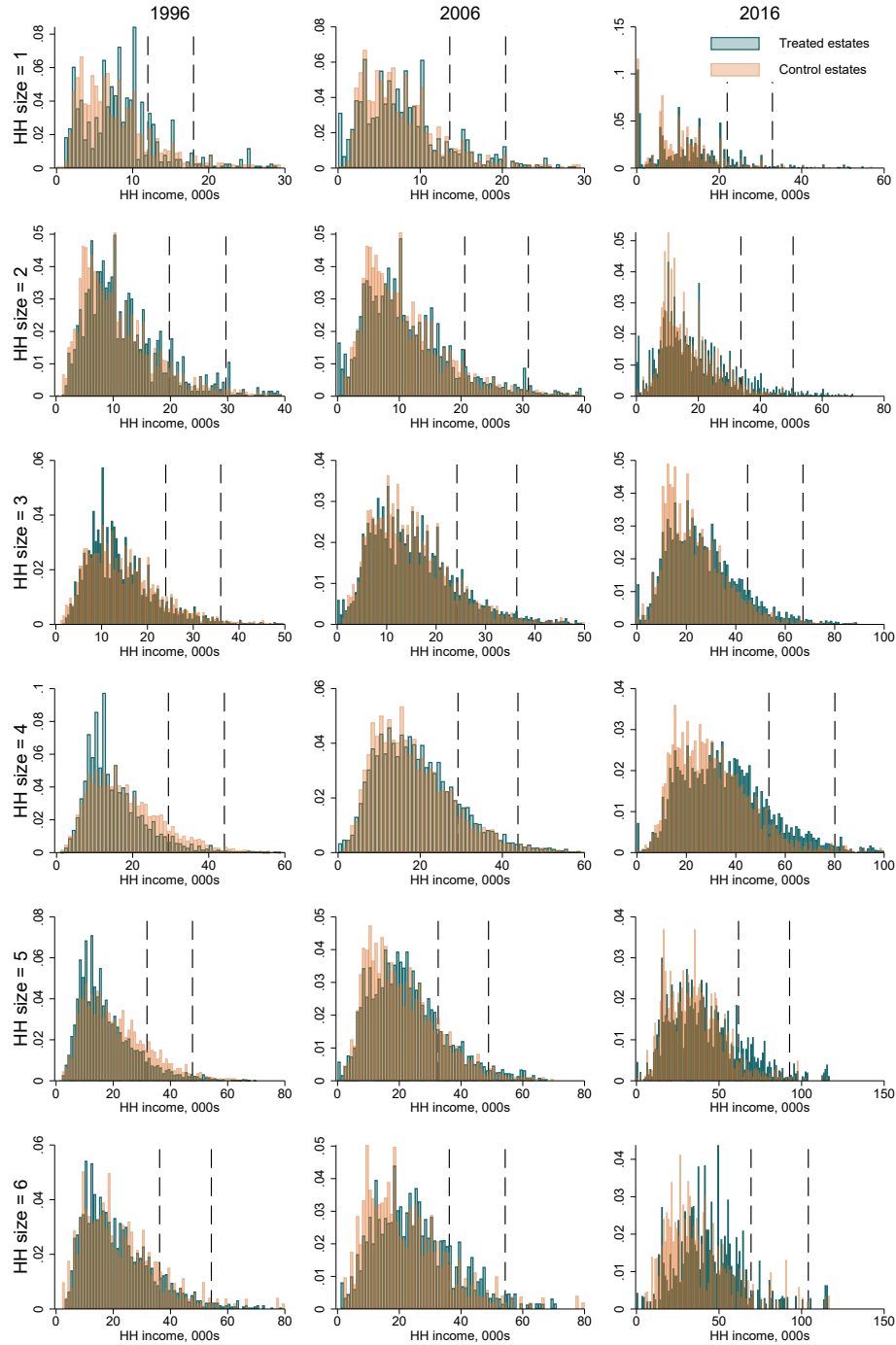
Notes: Figure plots the effect of TPS on the share of households with a given household type in the second Census year following treatment relative to that of the last Census year before treatment, estimated using the interaction-weighted estimator in Sun and Abraham (2020). Standard errors (clustered at the estate level) are shown in bars. Single households include only one person. Nuclear households include a couple and any of their children. Extended-family households include a nuclear family and additional relatives, e.g. at least one parent of the couple.

Figure A4: Effect of TPS on estate composition, additional outcomes



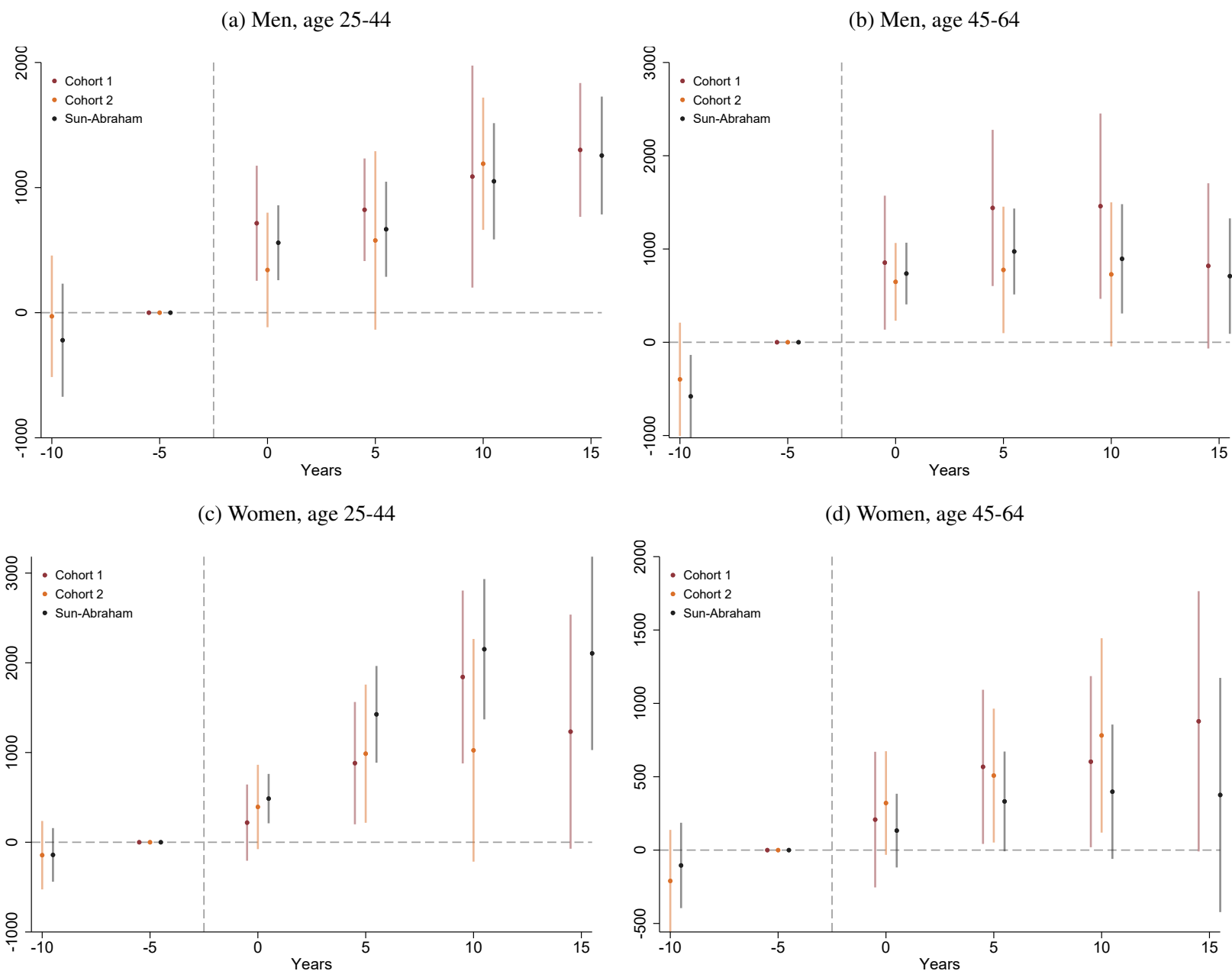
Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.

Figure A5: HH income distribution by household size, treated vs control estates



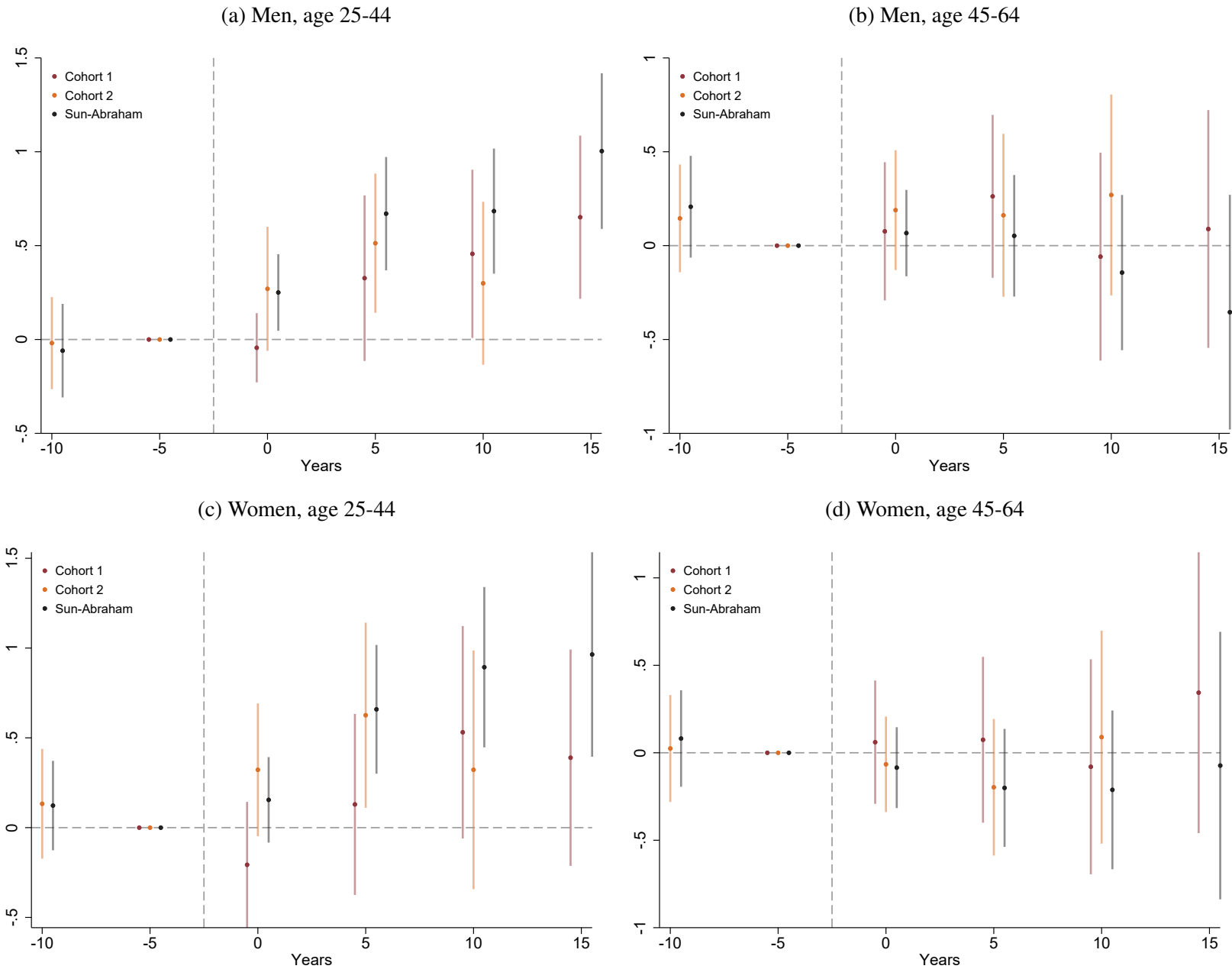
Notes: Figure plots the distribution of household income in treated and control estates, respectively in 1996, 2006, and 2016. The 1.5X and 2X rent income limits are plotted in dashed vertical lines. Households with all members above age 60 are excluded.

Figure A6: Effect of TPS on estate average income by demographic group



Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.

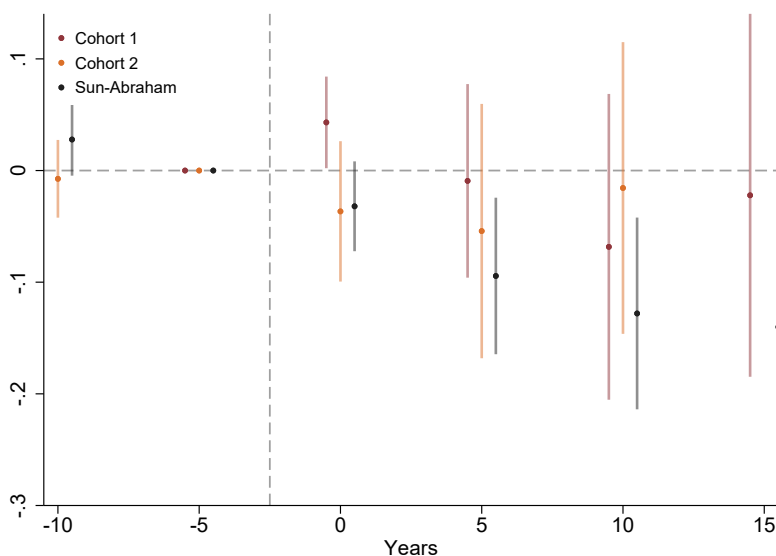
Figure A7: Impact of TPS on estate average schooling by demographic group



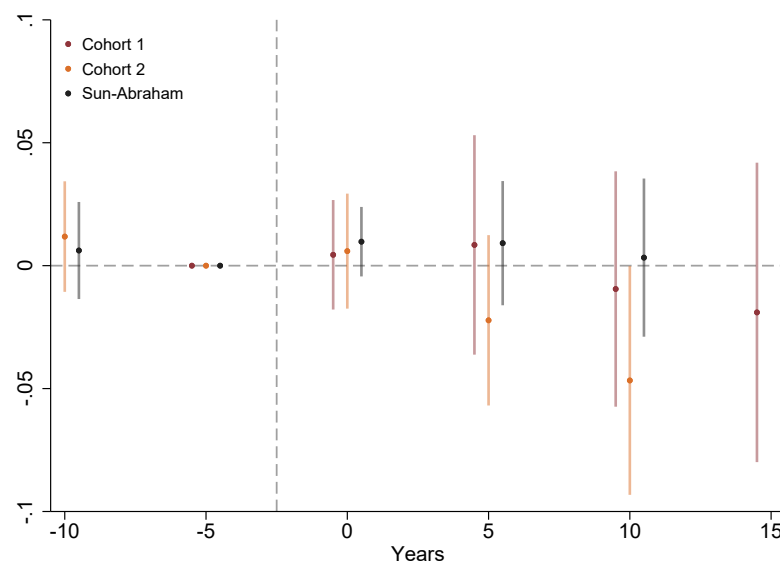
Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.

Figure A8: Impact of TPS on share married by demographic group

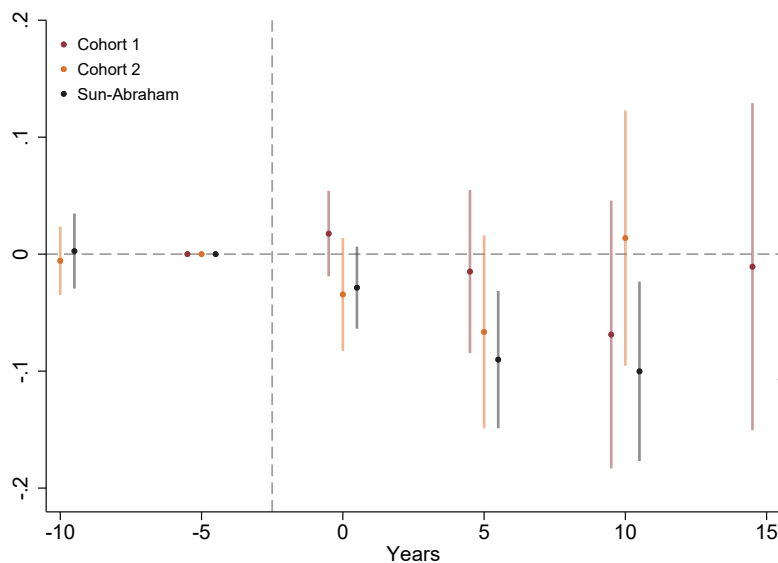
(a) Men, age 25-44



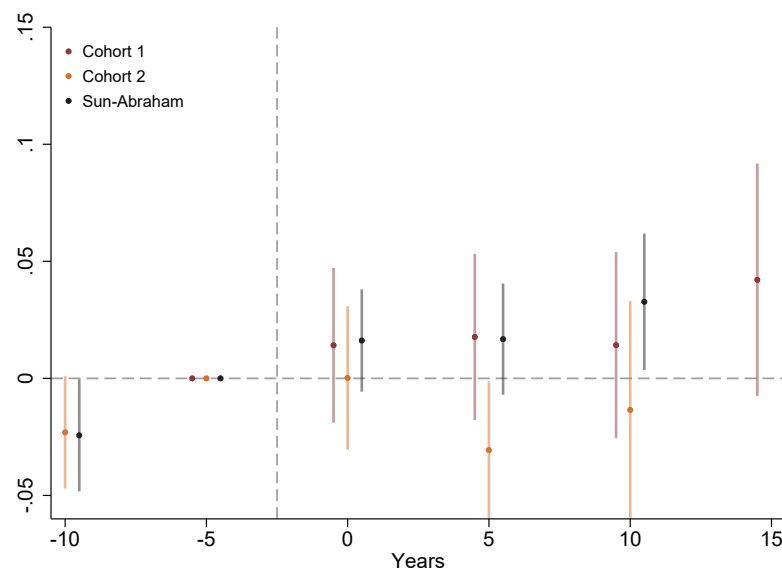
(b) Men, age 45-64



(c) Women, age 25-44



(d) Women, age 45-64



Notes: The black series plots coefficients from the interaction-weighted estimator in Sun and Abraham (2020). The maroon and yellow series plots cohort-specific coefficients, estimated with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996. Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars.



Table A1: Sample restrictions

	Treated	Control
All estates observed in Census years 1996-2016	39	97
No construction after 1996	39	72
No construction before 1980	39	43

Notes: Table counts the number of estates identified in the data and after imposing sample restrictions.

Table A2: List of estates

Treated estates, Cohort 1	Treated estates, Cohort 2	Control estates	
Cheung On Estate	Yiu On Estate	Ap Lei Chau Estate	Lower Wong Tai Sin (2) Estate
Choi Ha Estate	Cheung Fat Estate	Butterfly Estate	Lung Hang Estate
Chuk Yuen North Estate	Cheung Wah Estate	Chak On Estate	Mei Lam Estate
Fu Heng Estate	Fu Shin Estate	Cheung Hang Estate	On Ting Estate
Fung Tak Estate	Hing Tin Estate	Choi Fai Estate	On Yam Estate
Fung Wah Estate	King Lam Estate	Choi Yuen Estate	Sam Shing Estate
Heng On Estate	Kwai Hing Estate	Chuk Yuen South Estate	Sha Kok Estate
Hin Keng Estate	Kwong Yuen Estate	Chun Shek Estate	Shek Wai Kok Estate
Kin Sang Estate	Lei Cheng Uk Estate	Hau Tak Estate	Shun Tin Estate
Tai Wo Estate	Lei Tung Estate	Hing Man Estate	Siu Sai Wan Estate
Tak Tin Estate	Leung King Estate	Jat Min Chuen	Sun Chui Estate
Tin King Estate	Long Ping Estate	Ka Fuk Estate	Sun Tin Wai Estate
Tin Ping Estate	Lower Wong Tai Sin (1) Estate	Ka Wai Chuen	Tai Yuen Estate
Tsui Wan Estate	Nam Cheong Estate	Kai Yip Estate	Tin Shui (1) Estate
Wah Kwai Estate	Po Lam Estate	Kwong Fuk Estate	Tin Shui (2) Estate
Wah Ming Estate	Pok Hong Estate	Kwong Tin Estate	Tin Yiu (1) Estate
Wan Tau Tong Estate	Shan King Estate	Kwun Tong Garden Estate	Tin Yiu (2) Estate
Yiu On Estate	Tai Ping Estate	Lai Kok Estate	Tsz Man Estate
	Tsing Yi Estate	Lai On Estate	Wang Tau Hom Estate
	Tsui Lam Estate	Lee On Estate	Wu King Estate
	Tsui Ping North Estate	Lok Wah North Estate	Yiu Tung Estate
	Tung Tau (2) Estate	Lok Wah South Estate	

Notes: Table tabulates all estates included in analysis.

Table A3: Estate characteristics, treated vs control estates, 1996

	Treated estates	Control estates	Standardized difference
Year built	1989 (2)	1986 (5)	0.57
Population	18794 (7722)	15318 (6232)	0.5
Number of HHs	4768 (1965)	4167 (1639)	0.33
Average HH size	4.0 (0.3)	3.7 (0.4)	0.89
HH with all 60+ y. o.	0.07 (0)	0.09 (0)	-0.39
Working persons per HH	1.62 (0.27)	1.63 (0.24)	-0.04
Average HH income	16221 (2782)	16323 (2307)	-0.04
Average rent	1255 (180)	1297 (281)	-0.17
HH above 1.5X rent cutoff	0.10 (0.05)	0.12 (0.04)	-0.33
HH above 2X rent cutoff	0.02 (0.01)	0.03 (0.01)	-0.18
Number of estates	39	43	

Notes: Table shows mean estate characteristics in 1996, respectively for TPS and non-TPS estates.

Table A4: Estate HH composition, treated vs control estates, 1996

	Treated estates	Control estates	Standardized difference
Single-person HH	0.07 (0.05)	0.09 (0.05)	-0.32
Nuclear family HH	0.70 (0.11)	0.68 (0.09)	0.12
Extended family HH	0.22 (0.09)	0.22 (0.07)	0.09
Non-family HH	0.005 (0.005)	0.007 (0.007)	-0.37
HH size = 1	0.07 (0.05)	0.09 (0.05)	-0.32
HH size = 2	0.09 (0.04)	0.14 (0.06)	-1.11
HH size = 3	0.18 (0.03)	0.20 (0.04)	-0.62
HH size = 4	0.33 (0.08)	0.30 (0.05)	0.51
HH size = 5	0.20 (0.04)	0.18 (0.05)	0.58
HH size = 6	0.09 (0.03)	0.07 (0.03)	0.64
HH size = 7	0.03 (0.02)	0.02 (0.02)	0.51
HH size = 8	0.01 (0.01)	0.01 (0.01)	0.47
HH size = 9	0.003 (0.003)	0.002 (0.002)	0.43
HH size = 10	0.001 (0.002)	0.001 (0.002)	0.06
Number of estates	39	43	

Notes: Table shows mean estate characteristics in 1996, respectively for TPS and non-TPS estates.

Table A5: Estate characteristics, treatment vs weighted controls, 1996, by treatment cohort

	Cohort 1			Cohort 2		
	Treated estates	Control estates	Standardized difference	Treated estates	Control estates	Standardized difference
Year built	1989 (1)	1989 (5)	0	1988 (2)	1988 (5)	0
Population	18576 (7603)	15544 (5207)	0.47	18980 (8005)	15945 (5420)	0.44
Number of HHs	4636 (1876)	3889 (1310)	0.46	4882 (2077)	4072 (1369)	0.46
Average HH size	4.0 (0.2)	4.0 (0.4)	0	3.9 (0.3)	3.9 (0.4)	0
HH with all 60+ y. o.	0.06 (0.04)	0.04 (0.03)	0.61	0.07 (0.05)	0.05 (0.04)	0.43
Working persons per HH	1.63 (0.26)	1.68 (0.29)	-0.18	1.61 (0.28)	1.65 (0.27)	-0.14
Average HH income	16360 (2722)	16355 (2689)	0	16103 (2894)	16048 (2466)	0.02
Average rent	1278 (147)	1328 (279)	-0.23	1236 (206)	1279 (262)	-0.18
HH above 1.5X rent cutoff	0.10 (0.05)	0.10 (0.05)	0.03	0.10 (0.05)	0.10 (0.04)	0.04
HH above 2X rent cutoff	0.02 (0.01)	0.02 (0.01)	0.23	0.02 (0.01)	0.02 (0.01)	0.15
Number of estates	18	43		21	43	

Notes: Table shows mean estate characteristics in 1996, separately for the two treated cohorts and their respective controls, whose means are computed with entropy balancing weights (Hainmuller 2012) that are based on estate-level average household size and income in 1996.

Table A6: Effect of TPS on estate HH composition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Share of TPS units sold	Log population	Log num. of HH	Average HH size	Share of single- person HH	Share of nuclear family HH	Share of extended family HH	Share of HH moved in last 5 years
t = -10	0.00~ (0.00)	0.00 (0.02)	-0.002 (0.018)	0.03 (0.06)	0.002 (0.009)	-0.004 (0.009)	0.001 (0.008)	-0.13~ (0.07)
t = 0	0.60** (0.03)	-0.05** (0.01)	-0.035** (0.009)	-0.08* (0.03)	0.001 (0.005)	0.018* (0.007)	-0.021** (0.007)	-0.01 (0.05)
t = 5	0.65** (0.02)	-0.05** (0.01)	-0.025* (0.010)	-0.13** (0.04)	0.008 (0.007)	0.017~ (0.010)	-0.029** (0.009)	0.01 (0.05)
t = 10	0.71** (0.02)	-0.07** (0.02)	-0.023* (0.010)	-0.19** (0.04)	0.016~ (0.008)	-0.008 (0.012)	-0.012 (0.012)	0.02 (0.05)
t = 15	0.79** (0.01)	-0.07* (0.03)	-0.031~ (0.017)	-0.21** (0.07)	0.011 (0.012)	0.006 (0.021)	-0.020 (0.021)	0.00 (0.10)
Treated mean, 1996	0.00	18794	4768	3.96	0.07	0.70	0.22	0.14
R2	0.98	0.99	1.00	0.94	0.87	0.88	0.81	0.50
Num. of estate-years	410	410	410	410	410	410	410	410
Num. of estates	82	82	82	82	82	82	82	82

Notes: Table shows coefficients from the interaction-weighted estimator in Sun and Abraham (2020). Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars, with ~ = significant at the 10% level, \* = significant at the 5% level, and \*\* = significant at the 1% level.

Table A7: Effect of TPS on estate HH income distribution

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Average real HH income	Share of HH above 1.5X rent cutoff	Share of HH above 2X rent cutoff	Working persons per HH	Average real personal income			
					Men, 25-44 y.o.	Women 25-44 y.o.	Men, 45-64 y.o.	Women, 45-64 y.o.
t = -10	-347 (460)	-0.003 (0.010)	0.000 (0.003)	-0.06 (0.06)	-220 (231)	-141 (152)	-580* (227)	-104 (148)
t = 0	1132** (294)	0.032** (0.005)	0.009** (0.002)	0.12** (0.04)	559** (153)	486** (140)	737** (169)	133 (128)
t = 5	2153** (466)	0.065** (0.008)	0.017** (0.003)	0.21** (0.06)	667** (194)	1426** (275)	973** (235)	332~ (174)
t = 10	2807** (610)	0.077** (0.009)	0.019** (0.003)	0.20** (0.07)	1050** (237)	2151** (399)	895** (299)	398~ (234)
t = 15	3712** (1012)	0.081** (0.014)	0.022** (0.004)	0.22* (0.10)	1256** (240)	2105** (550)	710* (316)	376 (407)
Treated mean, 1996	16221	0.102	0.023	1.62	9815	3985	6830	1959
R2	0.71	0.70	0.63	0.67	0.71	0.82	0.63	0.66
Num. of estate-years	410	410	410	410	410	410	410	410
Num. of estates	82	82	82	82	82	82	82	82

Notes: Table shows coefficients from the interaction-weighted estimator in Sun and Abraham (2020). Sample is all estates where all buildings were built after 1979 and before 1996. Year 0 denotes first observed Census year following treatment. Standard errors (clustered at the estate level) are shown in bars, with ~ = significant at the 10% level, \* = significant at the 5% level, and \*\* = significant at the 1% level.