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Social Engineering and Intergenerational Mobility in Housing Consumption

SUMIT AGARWAL
YI FAN
WENLAN QIAN
TIEN FOO SING

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Sumit Agarwal*, Yi Fan†, Wenlan Qian‡, Tien Foo Sing§

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Abstract

Using Singapore's large-scale public housing program as a quasi-natural experiment, we demonstrate that affordable public housing significantly enhances intergenerational mobility in housing consumption for families with lower socioeconomic status. By matching 147,560 parent-child pairs with housing transaction prices from 1995 to 2018, we identify three intergenerational mobility patterns: upward mobility for children from families with lower socioeconomic status, high persistence for children born to higher status parents, and downward mobility for the rest. Using the introduction of a new public housing scheme to construct a Difference-in-Differences strategy, we estimate that children born in disadvantaged families but whose parents benefit from affordable public housing have a 11.2% higher likelihood of surpassing their parents' housing status. A possible mechanism for this effect lies in an alleviation of budget constraints, which in turn facilitates greater investment in the human capital of children. Our results provide insight into a new pathway to enhance intergenerational mobility and ameliorate inequality through the provision of affordable housing.

Keywords: housing consumption, intergenerational mobility, social engineering programs, affordable housing, human capital investment

JEL Codes: J62, H4, E24, J68

*Department of Finance and Department of Real Estate, National University of Singapore. Email: bizagarw@nus.edu.sg. Sumit Agarwal acknowledges financial support from MOE AcFR Tier 2 Grant No. R-311-000-030-119.

†Department of Real Estate, National University of Singapore. Email: yi.fan@nus.edu.sg. Yi Fan acknowledges financial support from MOE AcFR Tier 2 Grant No. R-311-000-030-119.

‡Department of Finance and Department of Real Estate, National University of Singapore. Email: wenlan.qian@nus.edu.sg.

§Department of Real Estate, National University of Singapore. Email: bizstf@nus.edu.sg.

1 Introduction

Superstar cities are fighting with escalating unaffordability and rising inequality (Piketty, 2000; Krueger, 2012; Gyourko et al., 2013; Diamond and McQuade, 2019). In response to this challenge, governments have implemented diverse policy interventions, including the construction of affordable public housing, the imposition of cooling measures, and the provision of housing subsidies (Chetty et al., 2016; Chyn, 2018; Diao et al., 2019; Pollakowski et al., 2022). These policies have enduring effects, given housing constitutes the largest household consumption item and can significantly influence resource allocation within households across generations. This study delves into the impact of public housing on intergenerational mobility in housing consumption, to shed light on sustainable growth in economic wellbeing across generations.

Most existing studies investigate the intergenerational transmission of socioeconomic status as measured by income (Corak, 2004, 2013; Fan, 2016; Fan et al., 2021; Emran et al., 2019) or wealth (Charles and Hurst, 2003; Boserup et al., 2013; Adermon et al., 2018; Fagereng et al., 2021; Black et al., 2020a). While consumption is more directly connected to consumers' utility and material well-being (Charles et al., 2014), few studies have examined intergenerational correlations in consumption, due to an absence of micro-data on expenditure records of both parents and children. We fill this gap by focusing on housing consumption—housing is not only the largest consumption item for an average household, but it is also the main investment vehicle to help households accumulate wealth. To our best knowledge, this study is the first to use a large sample of *ex-post* housing transaction data matched with personal demographic data to test intergenerational correlations in housing consumption. Compared to the Move to Opportunity (MTO) experiment which involved 4,604 low-income families (Chetty et al., 2016) or the Hope VI program in which 160 public housing projects were demolished (Haltiwanger et al., 2020), Singapore's social engineering program in public housing provides a valuable institutional setting by covering more than 2 million residents to generate large variations in housing costs. It also provides a social laboratory to test the impact of public housing on intergenerational mobility by re-allocating household resources under budget constraints. Specifically, we propose a substitution effect between housing consumption and investment in human capital for offspring. It serves as a critical pathway through which public housing can promote upward intergenerational mobility, especially for children born to parents with lower socioeconomic status.

By matching housing transactions to a unique dataset on personal demographics from Singapore,

we identify housing consumption expenditures by tracking housing movements of parent-children pairs with detailed addresses from 1995 to 2018. Our individual-level matched data comprises 147,560 non-co-residing parent-child pairs, removing the co-residence bias commonly encountered in intergenerational mobility studies. We overcome the lifecycle bias (Haider and Solon, 2006; Nybom and Stuhler, 2016) by using housing transactions from the first observed wave for parents and the last observed wave for children, with a minimum age for children set at 30 years to be at the mid-life stage. Our housing consumption dataset is unlikely to be subject to attenuation bias (Solon, 1989, 1992) because housing is not frequently traded and has no excessive price fluctuations.

We assign percentile ranks for housing consumption between 0 and 100 for children and parents of the same generation and regress the children's ranks on the parents' ranks, following Chetty et al. (2014; 2018a,b). The resulting rank-rank slopes show interesting patterns in intergenerational mobility: an upward trend for children born to families with lower socioeconomic status, high persistence for children from families with higher status, and a declining trend for the rest. Specifically, children born to parents ranking in the bottom 50 percentile ranks of housing consumption have an intergenerational persistence (mobility) estimate as low (high) as 0.06. Children with wealthy parents in the top 20 percentiles have the highest intergenerational housing rank correlation of 0.9. The estimate for the rest, i.e., children born to parents in the 50-80 percentile ranks, is 0.11.

We focus on families with lower socioeconomic status and demonstrate how affordable public housing can promote intergenerational mobility for them, by alleviating budget constraints and enabling investment in children's human capital. Singapore's government offers affordable housing to over 80% of residents with generous subsidies, providing a valuable institutional setting to test this mechanism. Financially constrained parents receive proportionally more grants from the public housing program. This mechanism is expected to be more effective for lower-income families than for wealthier ones. Indeed, our findings show that children from the lower housing consumption spectrum (i.e., those who live in public/non-centrally-located housing) experience higher mobility than children from the upper housing consumption spectrum (i.e., those who live in private/centrally-located housing).

To test the causal impact of public housing on enhancing intergenerational mobility for families with lower socioeconomic status, we conduct a difference-in-differences (DiD) estimation using the launch of the Build-to-Order (BTO) scheme as a quasi-natural experiment. Under this scheme, households with monthly household income of no more than SGD14,000 (USD10,400) can be eligible

for new public housing flats, with affordable selling prices and generous subsidies. The lower the household income of buyers, the more help in term of housing grants from government is. The House Price-to-Income (HPI) ratio for BTO flat buyers is calculated to be around 4-5, which is much lower than other major superstar cities such as London, Los Angeles, Sydney (HPI between 9 and 13) and Hong Kong (HPI more than 18).[1]

The construction of the first batch of BTO flats began in 2001 and was completed in 2005. It eases demand-supply imbalances in the public housing market, especially for first-time lower-income Singaporean buyers. Taking children growing up in public housing as treatment group and those growing up in private housing as control group, our findings demonstrate significant upward mobility for the treatment group after the BTO scheme. Specifically, the probability of these children surpassing their parents' housing ranks is as high as 11.2%, with an absolute increase of 6 ranks. The estimates remain robust when using a more relaxed sample in the time span, employing different method to cluster standard errors, and including additional demographic controls.

Why can public housing promote intergenerational mobility? We hypothesize that one possible channel lies in a trade-off between housing consumption and investment in children's human capital. Using credit and debit card transaction data from a leading bank in Singapore, we show a notable increase in education expenditure, ranging from 17.4% to 29.4%, among married public housing owners after the implementation of the BTO scheme. This increase holds robust for both broadly and narrowly defined education-related expenses. However, our findings do not demonstrate similar trade-off between housing consumption and household consumption beyond education.

This study contributes to two strands of literature. The first strand focuses on exploring intergenerational mobility in income and wealth (Solon 1992; Corak, 2004; Fan, 2016; Adermon et al., 2018; Fagereng et al., 2021; Black et al., 2020a; Fan et al., 2021). This set of literature has recently extended its reach to encompass financial behaviors such as consumption, investment, and savings (Waldkirch et al., 2004, Charles et al., 2014, Black et al., 2017, 2020b; Bruze, 2018). To the best of our knowledge, our study is the first to document an intergenerational correlation in housing consumption using housing transaction data, complementing existing literature which predominantly relies on homeownership indicator or imputed housing values (Chiteji and Stafford, 1999; Helderman and Mulder, 2007; Black et al., 2020a; Blanden et al., 2021).

[1] https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/publications/hdbspeaks/Keeping-BTO-Flats-Affordable

The second strand of literature investigates the mechanisms underlying intergenerational transmission of socioeconomic status. Many studies find that the nurture channel has a stronger impact than nature on intergenerational mobility. Explored mechanisms include human capital investment (Mogstad, 2017; Fagereng et al., 2021; Li et al., 2018; Smith et al., 2019; Hu and Qian, 2023; Biasi 2023), quality of neighborhoods where children grow up (Chetty, Hendren, and Katz 2016; Chetty and Hendren, 2018a,b), social capital (Chetty et al., 2022a,b), geographic disparity (Longley et al., 2021; Connor and Storper, 2022), nutrition intake (Chakrabarti et al., 2021), genetics and environmental pathway (Engzell and Tropf, 2019; Wertz et al., 2023), preferences for redistribution (Alesina et al., 2018), and differential fertility (Yu et al., 2023). This paper presents a novel contribution by offering empirical evidence for a new channel through which affordable public housing can alleviate the financial constraints faced by disadvantaged parents, enabling greater investment in their children's human capital, and consequently fostering upward intergenerational mobility. Singapore's experience with public housing provides new insights into how social engineering initiatives can bolster intergenerational mobility for families with lower socioeconomic status. The findings have significant policy implications for other nations aiming to adopt similar public housing strategies in order to promote upward mobility across generations.

The rest of the paper is organized as follows: Section 2 provides an overview of social engineering programs in public housing in Singapore. Section 3 describes the three datasets used in the study. In Section 4, we outline empirical strategies. Section 5 presents empirical patterns in intergenerational mobility of housing consumption, while Section 6 discusses the impact of affordable public housing on intergenerational mobility. Section 7 concludes the paper.

2 Singapore's Social Engineering Programs in Public Housing

Singapore's government makes large-scale public housing programs available and accessible to families over the city-state. The Senior Minister, Mr. Tharman Shanmugaratnam, commented that *"you can't leave it to the markets to tackle divergences…They don't lead to early advantages and disadvantages in life – depending on the parents you are born to – disappearing over time. On its own, the social marketplace tends instead to replicate and even multiply initial disadvantages and advantages. And it happens in a whole range of ways: assortative mating; parents who are better-off or better educated spending a lot more time reading and talking to their kids and being able to send them for enrichment programmes; the kids growing up in very different neighbourhoods, either safe*

or dangerous, and attending schools with peers who want to score high marks versus schools where they don't…"[2] The unique institutional setting of Singapore provides a social laboratory to empirically study the effect of large-scale social engineering programs on intergenerational mobility in housing consumption.

Singapore's Housing Market and Homeownership Rate Singapore has a dual-structured housing market consisting of a private and a public market. The private housing market offers diverse choices for homebuyers, including landed houses (terraces, semi-detached and detached houses) and non-landed houses (condominiums and apartments). The public housing market is divided into a primary and a secondary market. The primary market is a regulated market selling housing flats at subsidized prices to Singaporean citizens subject to meeting the eligibility criteria (Sing et al., 2006). Foreigners cannot buy public housing flats; they can only buy non-landed properties in the private market.[3]

Singapore faced acute housing shortage problems in the 1960s, with people living in crowded squatters without proper sanitation and clean water supply. In 1964, the government introduced the "Home Ownership for the People Scheme" to encourage families to own their homes. The Housing & Development Board (HDB) was set up in 1960 as the national housing agency to carry out large-scale public housing construction programs to build affordable housing to meet the nation's housing needs. Between 1960 and 1990, HDB completed nearly 667,575 housing flats and was instrumental in attaining the country's high homeownership rate of 87% by 1990, and stabilizing at around 90% as of 2022. Figure A1 portrays the geographic distribution of different generations of HDB public housing blocks. A majority of the expansive public housing complexes established in recent decades are situated on the outskirts of the city-state. We classify the regions into Core Central Region (CCR) and non-CCR to facilitate heterogeneous analysis in Section 5.

[2] This is extracted from a speech on social mobility, trust in the government and institutions delivered by Singapore's Senior Minister Tharman Shanmugaratnam in the UK in June 2019: https://www.pmo.gov.sg/Newsroom/SM-Tharman-Shanmugaratnam-at-the-Institute-for-Government-10th-Anniversary-Conference

[3] In 2017 and 2018, the average private residential property price was SGD1,183,375 (USD880,000), whereas public housing flats sold for an average SGD439,792 (USD327,000) in the resale housing market. In the new (primary) sale by the HDB, new housing flat prices are heavily subsidized, ranging from SGD86,000 (USD63,950) for a two-room flat to SGD415,000 (USD398,600) for a five-room flat in non-mature towns, and from SGD117,000 (USD87,000) for a two-room flat to SGD562,000 (USD418,000) for a four-room flat in mature towns. The Residential Property Act (Chapter 274) prohibits foreigners from owning vacant residential lands and landed houses without prior approval from the Controller of Residential Property, with the exception of landed developments in designated locations in Sentosa, a tourist island to the south of Singapore. We use the exchange rate of USD1: SGD0.74 as in 2023 for the conversion throughout the paper.

Build-To-Order System and Allocation of Public Housing HDB implemented different flat allocation systems over the years. Before 2001, HDB used a queue system known as the Registration for Flats System (RFS) to allocate new flats under construction. The RFS system could not quickly respond to changing market conditions, causing over-construction after the 1997 Asian Financial Crisis. The new Build-To-Order (BTO) system was implemented in April 2001 to replace the RFS system. Under the new BTO system, HDB will only commence construction of new public housing projects after 70% of the project's units have been registered. New HDB flats built under the BTO system after 2001 were called "BTO projects". The typical time from flat allocation to completion and taking possession of BTO flats ranges from four to five years. The first BTO project was completed in 2005. In this study, we leverage the implementation of the BTO system as a quasi-natural experiment, dividing the timeline into periods before and after 2005. Through Singapore's institutional context, we investigate the impact of affordable public housing on intergenerational mobility, especially for disadvantaged families.

To apply for a BTO Flat, applicants must form a family nucleus made up of spouses, parents, children, or siblings. Unmarried couples could apply for new HDB flats under the Fiancé/Fiancée program. At least one of applicants must be Singaporean citizen, and at least one other is a Singapore citizen or permanent resident. Singles can apply for BTO flat when reaching 35 years of age. Applicants cannot own any other property and must have a household income of no more than SGD14,000 (USD10,400) for families or SGD7,000 (USD5,200) for singles.[4] In 2022, about 98% of 4-room BTO flats in non-mature estates were priced below SGD400,000 (USD296,000), according to government statistics.[5]

Housing Grants and Subsidy Programs In addition to affordable selling prices of the new BTO flats, eligible first-time buyers are given housing grants of up to SGD80,000 (USD59,490) to ensure primary HDB flats are accessible to lower-income families.[6] The lower the income of buyers, the more help

[4] To reflect the growth in national income, the income ceiling has been raised three times in 8 years to reflect growth in national income from SGD8,000 to SGD10,000 in August 2011, SGD12,000 in 2015, and to SGD14,000 in September 2019.

[5] https://www.hdb.gov.sg/cs/infoweb/about-us/news-and-publications/publications/hdbspeaks/Keeping-BTO-Flats-Affordable

[6] First-timer families who buy housing flats from the HDB can receive the Enhance Central Provident Fund (CPF) Housing Grant (EHG) of up to SGD80,000, which is tiered based on the income of first-time buyers, subject to the income cap of SGD9,000 (USD6,660) per month.

from the government is. BTO applicants are also eligible for housing loans offered by HDB, which consists of a downpayment equal to 10% of the loan value, and at an interest rate pegged to 0.1% above the interest rate of the national pension scheme—typically around 2.5%, that lasts up to a maximum of 25 years (HDB, 2022). Alternatively, applicants can choose to take up loans from private financial institutions. Housing grants are also provided for eligible buyers when buying public housing flats in the secondary (resale) market. Applicants for resale HDB flats may also subscribe to loans, should they meet the eligibility criteria on income ceiling.

Singapore government introduced various priority allocation schemes to promote intergenerational family bonding, such as the Married Child Priority Scheme (MCPS) and the Multi-Generation Priority Scheme (MGPS).[7] The schemes encourage married children to live near their parents and facilitate caregiving support within families. If married couples buy flats from the resale market, they will receive the Proximity Housing Grants (PHGs) of SGD30,000 (USD22,000) from the government if they live with their parents in the resale flat or SGD20,000 (USD15,000) if a resale flat is within 4 km of their parents' flats.[8]

3. Data Sources and Summary Statistics

We construct parent-child pairs from a large dataset of residents with social demographic characteristics and histories of residential addresses. Conventional household survey data do not track the movements of household members outside of their original families and are subject to small sample size constraints; they are not ideal for studying intergenerational mobility. To address those concerns, we turn to an alternative residential data which survey the demographic information of each Singapore resident at least 20 years old at each residential address. To combine with housing consumption, we merge the parent-child samples with housing transactions in the private and public housing markets. We also use alternative credit and debit card data obtained from a leading bank in Singapore to investigate the impact of affordable public housing on other household consumption such as education expenditure.

[7] Under the MGPS, parents and their married children can make a joint application for two flats, which may include either studio apartments, two-room Flexi or three-room flats in a BTO project. If balloted, both parents and married children are given the opportunity to choose flats on the same floor or elsewhere in the BTO project.

[8] In 2018, the PHG was raised to SGD30,000 from SGD20,000 for married children, if they buy a resale flat to live with parents. The PHG remains at SGD20,000 if they buy a resale flat to live near their parents. The definition of "near" has been extended from 2km to within 4 km to give buyers more housing options (Chia, 2018).

3.1 Residential Data

We first use a proprietary dataset containing demographic information, such as gender, age, race, home address, and housing type, for a large sample of 2,171,383 Singaporean residents of at least 20 years old from 1996 to 2018.[9] The residential data that capture longitudinally residents' address details in multiple waves allow us to track residents' housing movements based on changes in home addresses between any two consecutive waves of data.

We keep the cohorts to residents born in or after 1965, when Singapore gained independence, and the children's cohorts to those at least 30 years old to capture housing mobility in the mid- to late-life stages when they likely purchase their own homes. The youngest cohort in our sample consists of children born in 1984. We drop residences with more than 10 people in the same residence address. These houses could be rented out and used for worker quarters and other purposes, and people who lived in the houses could be unrelated non-residents. After dropping these residences, we retain 99.2% of the samples by residential address (Figure A2), and the samples are representative of the resident population.

Our residence database does not reveal information on the relationships of family members. Instead, we identify parent-child relationships based on people who share the same home addresses and have an age gap between 18 and 45 years. We omit those with more than two different parents (13.5%) in the same address, which may be those in the parent-in-law and child relationships. We also omit children with two parents of the same gender, which could be caused by measurement errors (3%). We further restrict parent-child pairs existing in the sample for at least two waves to minimize measurement errors, which reduces it by 10%.

We use the unique personal identity (ID) numbers and home addresses of residents in different years to track whether parents or children have moved and where they moved. We use the residential status in the first and the latest waves to represent the housing status of parents and children, respectively. Like in Charles et al. (2014), we focus on non-co-residing parent-child pairs since the homeownership status could not be observed from the dataset, and the co-residing parents and children share the same housing consumption. Specifically, we could identify a non-co-residence status for children referenced in the first data wave when they move out of the parent's residence. The final

[9] According to 2019 mid-year estimates from the Department of Statistics Singapore, the total population of Singapore is 5,703,600 of which 4,026,200 are Singapore citizens or permanent residents. The total population equal to or above 20 years old is 3,213,000. Approximately 99.4% of the data are from 1996, 1998, 2000, 2005 and 2011.

dataset of 147,560 non-co-residing parent-child pairs is one of the most comprehensive datasets constructed in Singapore. With the dataset, we conduct a series of empirical tests of patterns and mechanisms in intergenerational mobility of housing consumption.

3.2 Housing Transaction Data

We use two housing transaction price datasets: private housing transaction records from the Real Estate Information System (REALIS) published by the government agency Urban Redevelopment Authority (URA) and public housing transaction records from the HDB website.[10] The REALIS database covers private housing transactions from 1995 to 2018, with information on residential addresses, floor levels, door numbers, transaction prices, floor areas, and sale dates. We match the residence address records to the latest private housing transaction price (in or before the observed data waves) by parents and children in the paired sample.

The public housing dataset contains resale transactions in the secondary market between 1997 and 2012, which include information on building addresses, room types (number of rooms), transaction prices, floor areas, and sale dates.[11] The resale market is a *laisser-faire* market where prices are determined and negotiated by willing buyers and willing sellers. The floor level and unit number of each transacted housing unit are not disclosed for privacy reasons. The floor level is instead reported by categories of 5 floors, such as floors 1-5, 6-10, etc.

We thus match the nearest public housing transaction records in or before the observed data waves in the same buildings with the same floor divisions and room types paid by parents and children, respectively. The measurement errors in the matching process are considered immaterial because public housing flats are highly homogenous. We drop the parent-child pairs with multiple public housing transactions by the same floor category, room type, and year, which account for 1.3% of the samples. All transaction prices are adjusted to 2014 Singapore dollars.

3.3 Credit and Debit Card Data

To have a complete picture of household consumption, we supplement the housing data with a

[10] Due to the high homeownership rate among Singapore residents as discussed in Section 2, we do not include rental transactions in our analysis.

[11] Due to data limitations, we do not have complete details for the HDB resale transaction data after 2012 or first-time public housing purchase prices with generous government subsidies. Taking this into account, our estimate likely provides a lower bound of the true degree of intergenerational mobility in housing consumption.

proprietary dataset of 187,249 debit and credit card members between 2010:04 and 2012:03 obtained from a leading bank in Singapore (Agarwal et al., 2020). The dataset covers information on other non-housing consumption by parents and children, which includes detailed transaction-level records on credit cards, debit cards, and cash withdrawals. It also contains a rich set of demographic and socioeconomic information, including age, gender, ethnicity, marriage status, residence type (owner or renter, public or private housing), and property address (at building level).

We restrict the sample to married homeowners between 25 and 55 years old, who likely have children. Based on the transaction date, amount, and merchant category in the records, we sum up individual consumption expenditure by month from all identified categories: education, transportation, supermarkets, entertainment, apparel, dining, travel, services, durables, bill payments and others from credit and debit cards. To facilitate mechanism analysis, we generate narrowly and broadly defined education consumption, where the former refers to the classification of "education" under debit and credit card consumption while the latter refers to "education" and "books and news". The final sample consists of 23,634 individuals with non-zero monthly education consumption under broad definition.

One potential caveat is that data on credit and debit card accounts for customers from other banks are unavailable. However, given the large market share of the bank, the dataset will be representative of average consumption behaviors by typical cardholders in Singapore. The expenditures computed from the bank's database are not likely to be subject to large measurement errors (Agarwal et al., 2020).

3.4 Summary Statistics

Table 1 presents the summary statistics for the sample of 147,560 non-co-residing parent-child pairs from residential data, with children born in 1965-1984 cohorts. By matching the resident samples to the housing transactions, we estimate the average housing price of children in the latest wave is SGD498,944.8 (USD369,219.2), which is approximately 30% higher than the average housing price of SGD385,226.7 (USD285,067.8) for parents in the first wave. The average age of children and parents is 39 and 58 years, respectively, representing the mid to late-life stages which are least subject to lifecycle bias (Nybom and Stuhler, 2016). The gender of children is balanced with 52% male. The proportion of children living in public housing flats is 83%, which is lower than 95% for their parents. The average number of children is 2.65 per household indicating multiple parent-child pairs from one family.

4. Empirical Strategies

This section describes empirical challenges in examining intergenerational mobility in housing consumption, displays our strategies to overcome those challenges, and explore possible mechanisms.

4.1 Empirical Challenges

Co-residence bias is one major concern in intergenerational mobility studies based on household surveys. Conventional survey data usually cannot track individuals who move out of the households but maintain a close economic relationship, such as adult children. In this case, there is a selection bias if individuals self-select to remain at home. To overcome this empirical challenge, we use a large sample of residential data which track histories of changing residence status of parents and children over the years, as detailed in Section 3.1. We focus on non-co-residing parent-child pairs and by restricting children to be at least 30 years old in the main analysis—and using 35 in the robustness check—the non-co-residence status is likely to be stable, which is less likely to be affected by the co-residence bias at early stage of life.

Other than co-residence bias, two potential biases: lifecycle bias and attenuation bias, are also found in many empirical studies of intergenerational mobility. Lifecycle bias is caused by the correlations between the current and lifetime earnings or consumption that vary systematically over time. The current consumption of children, especially in an early stage, can produce inconsistent estimates of intergenerational mobility (Haider and Solon, 2006; Grawe, 2006). We eliminate this bias in the following four steps: first, we restrict a child's age to at least 30 to be at the mid to late-life stages which are least subject to lifecycle bias (Nybom and Stuhler, 2016), and explicitly control the age polynomials; second, we use the housing consumption of parents and children from the first and last observed data wave, as proxy for the their lifetime housing consumption respectively; third, we use a robust intergenerational rank correlation—rather than intergenerational elasticity (IGE) or intergenerational log-correlation (Nybom and Stuhler, 2016; 2017)—to measure intergenerational mobility in housing consumption; and fourth, we adopt a set of robustness checks, such as restricting children's age to 35 years and above and including additional control variables on gender and ethnicity.

Attenuation bias arises from transitory fluctuations in income or consumption in a specific year (Solon, 1989, 1992; Mazumder, 2005). The literature addresses this bias by either taking the average income or consumption over multiple years (Mazumder, 2005; Lee and Solon, 2009) or generate

predicted values with instrumental variables (Gong et al., 2012). In the context of housing consumption, the attenuation bias is not likely material as housing is not traded frequently and housing prices are unlikely to fluctuate excessively. In addition, we use the transaction prices in the nearest years as proxy of housing consumption to further mitigate the attenuation bias.

4.2 Estimate of Intergenerational Mobility in Housing Consumption

We use the intergenerational rank correlation, i.e., the rank-rank slope, as our main estimate of intergenerational mobility in housing consumption (Chetty et al., 2014; 2018a,b). Nybom and Stuhler (2017) argue that the rank correlation is a more robust measure for intergenerational mobility than other measures, such as intergenerational elasticity or intergenerational log-correlation. We estimate the rank-rank slope as follows:

$$y_i^k = \alpha_0 + \alpha_1 x_i^p + Z_i' \alpha_Z + \epsilon_i \quad (1)$$

where y_i^k denotes the housing rank of a child from family *i* in the last observed wave, and x_i^p denotes the housing rank of their parents in the first observed wave. Specifically, we calculate the percentile rank between 0 and 100 for housing consumption based on the housing transaction prices in the first and last observed survey waves for parents and children, respectively (Dahl and DeLeire, 2008; Chetty et al., 2014). The rank of housing consumption for parents and children measures relative housing consumption in the respective generation. *Z* is a vector of controls, including parents' and children's age and age squared (Solon, 1989, 1992; Nybom and Stuhler, 2016, 2017). Standard errors are clustered at the family level.

We conduct a battery of robustness checks. First, we include additional control variables such as the ethnicity of parents and children, as well as the gender of children. Second, we restrict children's age to be at least 35 years old and parents' age to be at most 65 years old. Third, we cluster the standard errors at the building level instead. Last, we use alternative measure of intergenerational elasticity of housing consumption, instead of intergenerational rank correlation.

To test the heterogenous effect, we interact the parents' housing ranks with their housing category, type, or location in Eq. (1):

$$y_i^k = \beta_0 + \beta_1 x_i^p + \beta_2 I_i + \beta_3 x_i^p \times I_i + Z_i' \beta_Z + \delta_i \quad (2)$$

where I_i is a vector of dummy variables indicating that parents are from the bottom 50 housing ranks, middle class (50-80 ranks), or top category (80-100 ranks), in the specification of housing category.

In the parents' housing type specification, I_i equals 1 if parents are observed living in the private residence in the first wave; otherwise, it equals 0 indicating parents from public housing flats. In the specification of housing location, I_i is equal to 1 if the parents' first observed residence is in a Core Central Region; otherwise it refers to areas outside of CCR.

The rank-rank slope in Eq. (1) measures the relative mobility of children from families with lower versus higher housing consumption families. However, we cannot distinguish if the high mobility is driven by upward mobility from children born to parents with lower housing consumption or by downward mobility from children born to parents with higher housing consumption. Thus, we supplement the relative measure with a measure of absolute mobility, defined as the expected housing rank of a child conditional on parents' housing rank (Chetty et al., 2014). It investigates the outcomes of children from families of given housing consumption in absolute terms. We estimate the slope and intercept of the rank-rank relationship by regressing children's housing consumption rank on parents' housing consumption rank without control variables as revised from Eq. (1):

$$y_i^k = \gamma_0 + \gamma_1 x_i^p + \mu_i \quad (3)$$

Obtaining $\widehat{\gamma_0}$ and $\widehat{\gamma_1}$ from Eq. (3), we then calculate the threshold point below which children's housing rank surpasses parents' housing rank:

$$y^* = \frac{\widehat{\gamma_0}}{1-\widehat{\gamma_1}} \quad (4)$$

where y^* represents the threshold at which children's housing rank equals parents' housing rank.

4.3 Difference-in-Differences Estimate: Impact of Public Housing on Intergenerational Mobility

We focus on families with lower socioeconomic status and examine the impact of public housing on their intergenerational mobility. We employ the introduction of the BTO scheme as a quasi-natural experiment. The new BTO public housing flats alleviate the demand-supply disparity in the public housing market, as explained in Section 2. Given the co-movement between the new and resale public housing markets, the demand absorbed by the BTO sector tames the resale market, which is the source of our public housing transaction data. It contributes to improved affordability in both the new and resale markets. Consequently, we anticipate that this alleviation of financial constraints for parents will lead to increased investment in their child's human capital, resulting in a higher housing rank of child compared to that of the parents. To test this hypothesis, we specify a difference-in-differences

strategy:

$$y_{it} = \lambda_0 + \lambda_1 HDB_i \times BTO_t + X'_{it}\lambda_X + \varphi_t + \delta_i + \varepsilon_{it} \quad (5)$$

where y_{it} is the outcome variable measured by either an indicator variable equal to 1 if a child's housing rank surpasses parents' housing rank, or the difference in rank between the child and parents. HDB_i equals 1 if the first observed housing of parents is public housing, and 0 otherwise. BTO_t is defined as a dummy variable equal to 1 if the first observed year of parents is in or after 2005, since the first batch of BTO flats were completed in 2005. X_{it} is a vector of demographic variables which include the age and age squared of parents and children. φ_t and δ_i indicate time and regional fixed effect, respectively. Standard errors are clustered at the family level. In the main analysis, we focus on the period of 1999-2007, mitigating potential confounding factors from the 1997-1998 Asian Financial Crisis and the 2008-2009 Financial Crisis. In robustness checks, we relax the sample restriction to include complete timeframe from 1997 to 2009, cluster standard errors at building level, and include additional control variables such as gender and race of children.

5. Intergenerational Correlation in Housing Consumption

We present baseline estimate on the average correlation in housing consumption across generations and heterogeneous patterns across housing category, type, and location in this section.

5.1 Baseline Estimate

Panel A of Table 2 presents estimates on the average rank-rank slope in housing consumption using Eq. (1). Columns (1) and (2) report the results without and with age controls for children and parents, respectively. We find high mobility in housing consumption across generations on average, with an estimate of 0.18 with statistical significance at the 1% level from both specifications. It indicates that if parents' housing rank increases by 10 percentile ranks, their child's housing rank will rise by 1.8 percentile ranks. This estimate is close to the intergenerational income correlation of 0.22 as estimated using 40,000 father-son pairs in Singapore by Yip (2019). It is also similar to the intergenerational linkages in home ownership of 0.11 estimated using the US PSID data (Waldkirch et al., 2004).

Our results survive a battery of robustness checks as presented in Table A1. Specifically, we include additional demographic controls on the gender of children and ethnicity of parents and children (Panel A), use sub-samples at mid-life stages consisting of children at least 35 years old and parents

at most 65 years old (Panel B), and cluster standard errors at alternative building level (Panel C). We also use an alternative measure of intergenerational elasticity in housing consumption which generates a comparable estimate of 0.27 with statistical significance at the 1% level (Panel A of Table A2).

To look for the threshold point below which children's housing rank surpasses parents' housing rank, we follow Eqs. (3)-(4) to calculate y^*. The result is presented in Column (1) in Panel A of Table 2, The threshold point is determined to be 50.07, indicating that, on average, children born to parents within the lower 50 percentile ranks exceed their parents in terms of housing consumption ranks. On the contrary, children born to parents in the upper-half percentile ranks exhibit, on average, lower performance than their parents. This motivates our subsequent heterogeneity analyses.

5.2 Heterogeneity Analyses

Graphic evidence Figure 1 presents intriguing visual patterns through a joint density depiction of the housing consumption ranks of parents and children. The *x, y,* and *z* axes represent the percentile ranks of parents, children, and their joint densities, respectively. We find that in general, the closer the children's ranks to their parents' ranks, the higher the joint probabilities are, as captured by the prominent ridge in the 3D graph. Notably, the joint density reaches its pinnacle for the richest families, indicating the highest degree of housing consumption persistence across generations. However, with the distance between children's and parents' ranks widening, the joint density declines, as manifested by the tapering skirt and the base of the 3D graph. It corroborates the existence of heterogeneous patterns in intergenerational mobility, which vary across families with different housing consumption profiles.

Figure 2 presents a 2D projection of the ridge observed in Figure 1. This illustration captures the nonlinear pattern by plotting the average housing rank of children (*y*-axis) against the corresponding rank of their parents (*x*-axis). The 45-degree line indicates that children maintain the same housing rank as their parents, reflecting the concept of no absolute mobility. The point at which the plotted line intersects the 45-degree line indicates the threshold point y^* at the 50.07 percentile rank. Again, this nonlinear pattern visualizes pronounced upward mobility in housing consumption for children born to parents in the bottom half of the housing consumption spectrum. Conversely, there is strong persistence in intergenerational housing consumption for children born to families with the highest housing ranks. Children from the rest of the spectrum exhibit a decline in housing consumption compared to their parents.

Empirical evidence Panel B of Table 2 displays intergenerational rank estimates conditional on parents' housing categories. Corresponding to the threshold point of 50.07 percentile rank, we divide parents' housing ranks into the bottom (0-50 ranks), middle (50-80 ranks), and upper (80-100 ranks) parts. For children born to parents with housing consumption in the bottom 50 percentile ranks, the estimate is as low as 0.06 and is statistically significant at the 1% level. Such an estimate implies high upward mobility for children born to bottom-half parents; the level of the estimate is comparable to the grandparent-grandchild rank correlation in wealth reported in Sweden (Adermon et al., 2018). The intergenerational rank correlation for children born to parents with 50-80 housing ranks is almost twice as high as those born to bottom-half parents, reaching 0.17. This point estimate and the difference with the bottom-half estimate are statistically significant at the 1% level. For children born to parents at the top 20 percentile ranks, the intergenerational estimate is as high as 0.96, indicating high persistence in housing consumption across generations.

To test the robustness of this nonlinear pattern, we replicate Table 2 but using an alternative measure of intergenerational elasticity of housing consumption. The corresponding estimates are presented in Table A2. Once more, a similar nonlinear pattern is evident in intergenerational housing consumption across the three segments of the housing consumption spectrum.[12]

Expanding the analysis to include the influence of social engineering programs in public housing, we delve deeper into the intergenerational rank correlation with respect to parents' residential type and location. These findings are presented in Panels A and B of Table 3, respectively. For children who were raised in public HDB flats, the rank-rank estimate is approximately 0.14, indicating substantial mobility in intergenerational housing consumption. On the contrary, the estimate is notably higher for children brought up in private housing, reaching 0.91. This higher estimate underscores a significant level of persistence in housing consumption across generations. Both estimates, along with their differences, are statistically significant at a high 1% level.

This aligns well with the graphic evidence observed in Figure 2. Specifically, while children raised in

[12] The elasticity estimates for top families are smaller than the corresponding rank estimates, possibly due to relatively large variation in the housing consumption in levels, as shown in Figure A3. We also show the results of intergenerational mobility in housing consumption sorted by family size and ethnicity in Table A3, following Eq. (2). The difference in intergenerational mobility in housing consumption is not material among families with different sizes (Panel A). Malay families show the highest mobility in intergenerational housing consumption than Chinese and Indian families (Panel B).

public housing experience an upward shift in their housing consumption relative to their parents, those born to parents occupying higher-end residences, primarily private housing, tend to maintain their housing status. A similar pattern emerges when considering the location of parents' residences. Children born to parents residing in non-CCR (Core Central Region) areas, where the majority of large-scale public housing estates are situated, exhibit a notably low intergenerational rank correlation of approximately 0.17. In contrast, their counterparts born to families residing in CCR, which comprises a higher proportion of private residences, manifest a higher estimate of 0.32. Both estimates and the differences between them are statistically significant at the 1% significance level.

6. Impact of Public Housing on Intergenerational Mobility

Why is there substantial upward mobility in housing consumption for children born to parents with lower housing ranks? What accounts for the higher intergenerational mobility for children raised in public housing compared to those from private residences? In this section, we examine the impact of affordable public housing on intergenerational mobility in housing consumption and delve into mechanisms that drive these outcomes.

6.1 Graphic Evidence

To start, we visualize the correlation between the proportion of public housing and intergenerational mobility in housing consumption at the subzone level. Specifically, we first divide Singapore into 156 subzones, with each defined by a diagonal spanning of 4km, aligning with the priority allocation schemes for public housing outlined in Section 2. Figure A4 shows the divisions of subzones and Figure A5 presents the public vs. private housing classification in each subzone. We then calculate the percentage of public housing and the intergenerational rank-rank coefficients for each subzone. These values are plotted on the *x* and *y* axis of Figure 3, respectively.[13] Notably, the graph exhibits a statistically significant and negative correlation of -0.2, affirming the existence of a negative (positive) association between the prevalence of public housing and intergenerational persistence (mobility). The higher the share of public housing in a subzone, the lower the intergenerational rank correlation, and the higher the intergenerational mobility is.

[13] We exclude subzones with intergenerational rank-rank slope less than 0 or larger than 1, due to measurement errors or small sample bias.

6.2 Empirical Evidence

Table 4 presents the DiD estimates using Eq. (5). Columns (1)-(3) display the results using the indicator variable of child surpassing their parents in housing rank as the outcome variable, while Columns (4)-(6) show the results using alternative measure of rank differences. Figure A6 justifies the parallel trend assumption for the DiD estimation. Controlling year and postal sector fixed effects, we find that children growing up in the affordable BTO public housing are 16.6% more likely to surpass their parents in housing ranks, compared to their counterparts brought up in the private residences (Column (1)). This estimate is statistically significant at a high 1% level. To account for regional discrepancies at a more granular level, we introduce postal code (building) fixed effects, leading to results presented in Column (2). The estimate remains positive and statistically significant, with a magnitude of 9.9%. To address the influence from time-varying unobservables, we incorporate additional year × postal sector fixed effects in Column (3). Again, the estimate of 11.2% remains robust in both magnitude and level of statistical significance. We take this estimate from Column (3) as our preferred one, as it encompasses granular building fixed effects and accounts for unobserved time-varying factors.

Similar results are presented when using alternative rank differences between the two generations as the outcome variable. Specifically, residing in the BTO public housing significantly elevates a child's rank by 5.99-8.59 compared to their parents, controlling for different combinations of time and regional fixed effects. All these estimates are statistically significant at the 1% level. We designate the estimate of 5.99 in Column (6) as our preferred one, given its incorporation of building fixed effects and taking of time-varying unobservable factors into account. Our results survive a battery of robustness checks as presented in Table A4, such as using the full sample including Financial Crisis periods, clustering at alternative building level, or controlling additional variables of gender and race of children. The DiD estimates consistently suggest a positive and significant impact of affordable public housing on the upward intergenerational mobility in housing consumption, which especially benefit children born to disadvantaged families with budget constraints.

6.3 Relaxed Budget Constraints and Children's Human Capital Investment

Through which channel can the affordable public housing promote upward mobility across generations especially for the disadvantaged families? We hypothesize that one possibility lies in a relaxed budget constraint derived from the affordable public housing. Parents with financial constraints face a tradeoff

between housing consumption and investment in children's human capital. The availability of affordable public housing alleviates these budget constraints, enabling parents to allocate more resources towards investing in their children's human capital. This in turn promotes intergenerational mobility in housing consumption, as children from such households now have the opportunity to improve their housing status compared to their parents.

To test this hypothesis, we turn to the credit and debit card dataset from a leading bank in Singapore, as introduced in Section 3.3. We first calculate monthly education expenditure of married homeowners between 25 and 55 years old, as proxy for investment in children's human capital.[14] This expenditure is classified into two categories: narrowly defined consumption, which includes transactions related solely to "education", and broadly defined consumption, which encompasses transactions from both "education" and "books and news" items. We then test the interactive effect between public HDB housing and introduction of the BTO scheme on education expenditure:

$$ln(edu)_{it} = \kappa_0 + \kappa_1 HDB_i + \kappa_2 BTO_t + \kappa_3 HDB_i \times BTO_t + Z'_{it}\kappa_Z + \mu_t + \nu_i + \pi_{it} \qquad (6)$$

where $ln(edu)_{it}$is the logarithm of monthly education consumption, measured in either narrowly or broadly defined term. HDB_i equals 1 if an individual resides in public housing flats, and 0 if he/she is in private residence. BTO_t is defined as a dummy variable equal to 1 if the completed date of the building is in or after 2005. Z_{it} is a vector of socioeconomic controls which include age, age squared, and the logarithm of monthly income. μ_t and υ_i indicate year-month and individual fixed effect, respectively. Standard errors are clustered at the postal code (building) level.

Results are presented in Table 5. Columns (1) and (2) display the estimates using narrowly and broadly defined education consumption as the outcome variable, respectively. Prior to the introduction of the BTO scheme, growing up in public housing is associated with an increase in education expenditure, though the estimate is not statistically significant, controlling age, income, year-month and individual fixed effects. After the BTO scheme, however, the expenditure on education significantly rises. Specifically, the estimates show an increase of 29.4% in the narrowly defined education consumption category and a 17.4% increase in the broadly defined education consumption category. This implies that growing up in public housing, particularly after the BTO scheme, appears to alleviate parents' budget constraints, leading to increased investment in their children's human

[14] The sample is restricted to married homeowners between 25 and 55 years old, with non-zero monthly education consumption in a broadly defined term, to capture parents' investment in children's human capital.

capital. In other words, it is suggested that affordable public housing serves as a crucial factor in facilitating intergenerational mobility through the mechanism of relaxing budget constraints, particularly benefiting disadvantaged families.

One potential concern is that parents may trade off housing consumption with other non-housing consumption instead of investing in children's human capital. To test this hypothesis, we examine explicitly the effect of HDB housing, interacted with the timeline of the BTO scheme, on non-housing consumption other than education. Results are presented in Column (3) of Table 5. No statistically significant impact appears, suggesting no evident trade-off between housing and non-housing consumption, with the exception of education.

7. Conclusion

This paper investigates the pattern and mechanism of intergenerational mobility in housing consumption, leveraging Singapore's extensive public housing program as a quasi-natural experiment. We find upward intergenerational mobility for children born to families with lower housing consumption ranks, high persistence for children born to top-ranked parents, and downward mobility for the rest. The intergenerational mobility in housing consumption is more pronounced for children raised in public housing flats and in the non-CCR areas.

Utilizing the introduction of the BTO scheme to develop a DiD estimator, we demonstrate that the affordable public housing significantly enhances upward mobility across generations. Children raised in these public housing estates exhibit an 11.6% higher likelihood of surpassing their parents' housing ranks, translating into an increase of 6 ranks in magnitude. We find that affordable housing alleviates financial constraints for parents, leading to increased investment in their children's human capital, and consequently, driving intergenerational upward mobility. Our results survive a battery of robustness checks and are remain unaffected by potential concerns related to trade-off between housing and non-housing consumption, apart from education expenditure.

While our study is grounded in the context of Singapore, the implications of our findings are relevant for other countries that use social engineering programs to promote upward mobility, particularly for children originating from disadvantaged backgrounds. Governments worldwide, whether in developed or developing countries, are grappling with the increase in unaffordability and the reproduction of inequality across generations (Krueger, 2012; Corak, 2013; Fan et al., 2021). We

introduce a new approach which utilizes affordable public housing as a means to promote intergenerational mobility; a solution that contributes to stability and equity in cities on a broad scale.

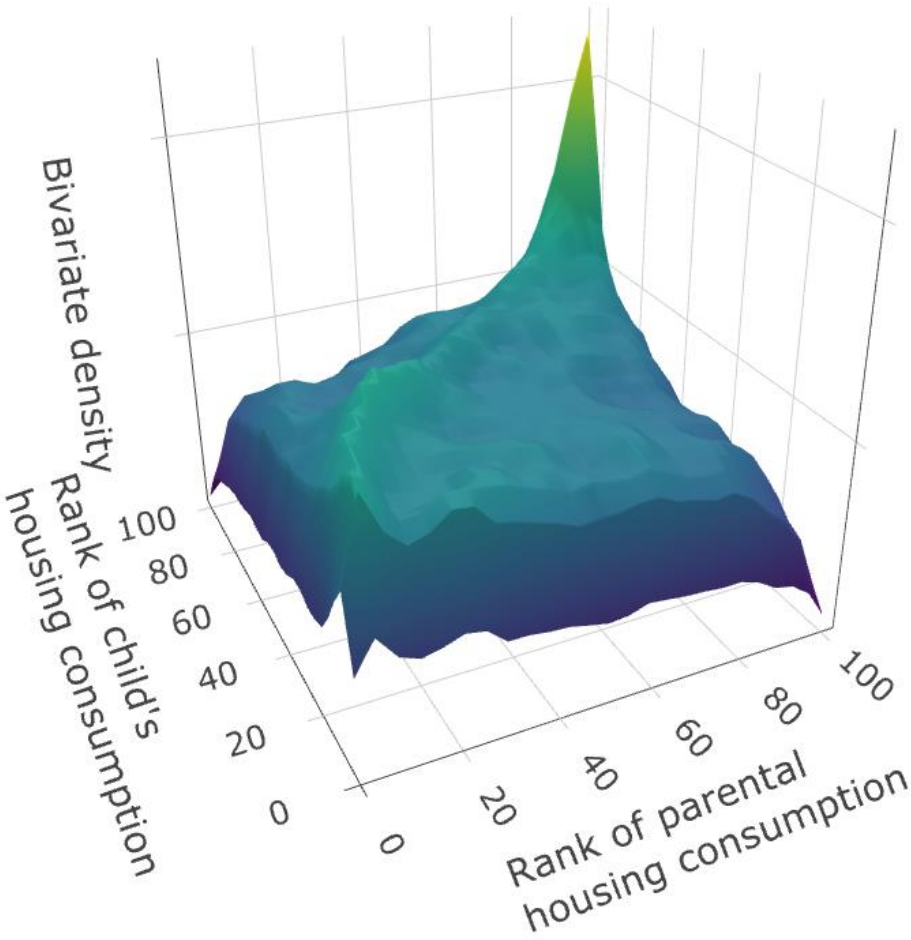

Figure 1: Joint Density of Housing Consumption Ranks of Parents and Children

Note: The x axis shows the percentile ranks of parents' housing consumption from 0 to 100. The y axis presents the percentile ranks of children's housing consumption from 0 to 100. The z axis indicates the joint density.

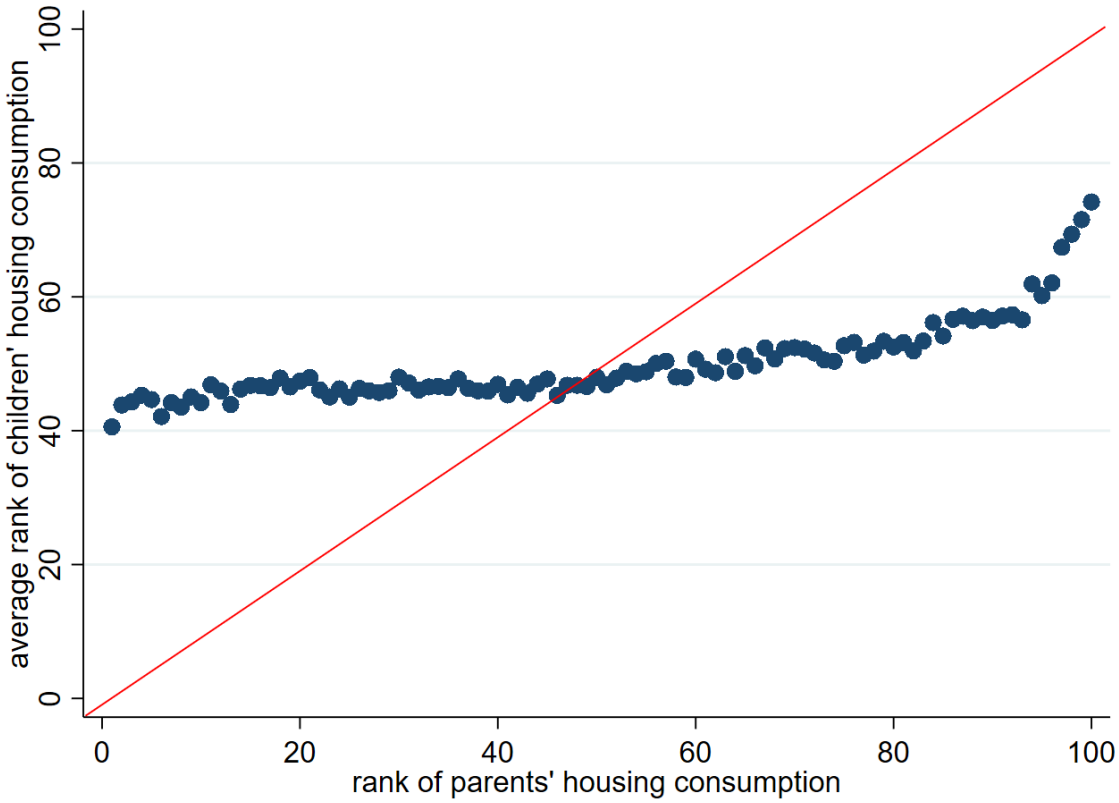

Figure 2: Child's Housing Rank versus Parents' Housing Rank

Note: The x axis shows the percentile ranks of parents' housing consumption, from 0 to 100. On the y axis, we calculate the mean of children's housing consumption ranks, corresponding to the parents.

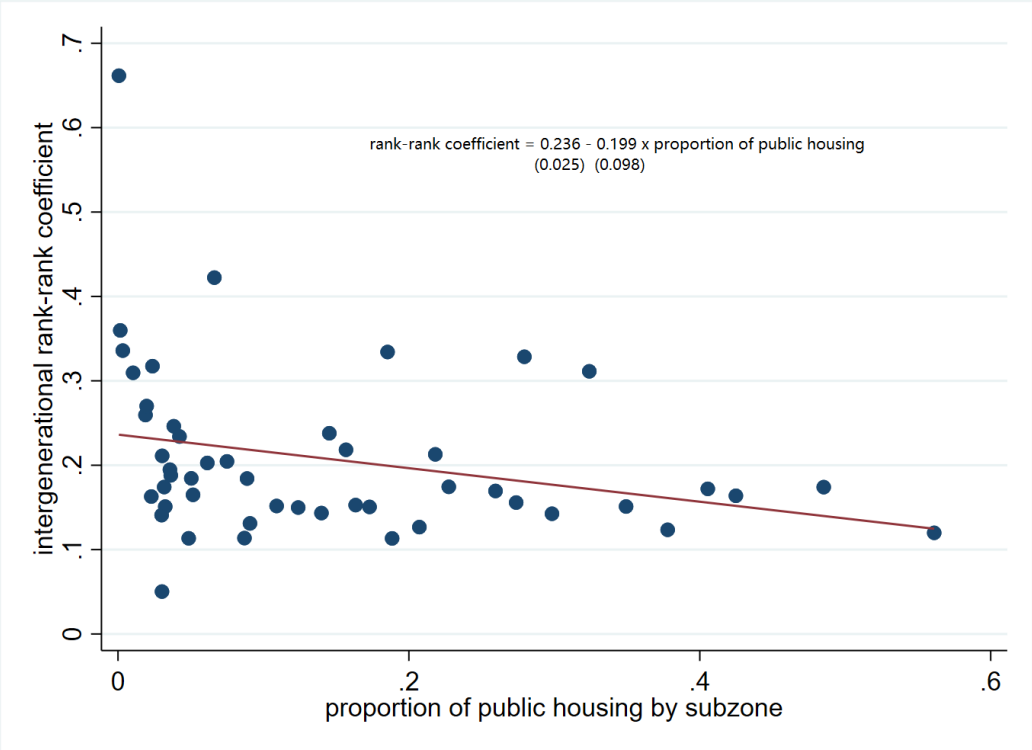

Figure 3: Correlation between Intergenerational Rank-Rank Coefficient and Proportion of Public Housing at Subzone Level

Note: The x axis shows the percentage of public housing in each of the 156 subzones in Singapore, each of which is defined with a diagonal of 4km. The y axis presents intergenerational rank-rank coefficient estimated from Eq. (1).

Table 1: Summary Statistics

Variable	Mean (Standard deviation)
Housing price of children in the latest wave	498944.8 (461466.2)
Housing price of parents in the first wave	385226.7 (362975.5)
Children's age in the last wave	38.92 (4.24)
Parents' age in the first wave	58.25 (7.46)
Children's gender (male=1)	0.52 (0.50)
Children's type of Residence (HDB=1, other=0)	0.83 (0.38)
Parents' type of residence (HDB=1, other=0)	0.95 (0.22)
Number of children per family	2.65 (1.20)
Observation	147,560

Note: Children are born in 1965 to 1984 cohorts and are at least 30 years old. Housing prices are adjusted to 2014 prices.

Table 2: Intergenerational Rank Correlation in Housing Consumption

Outcome Variable: Housing Rank of Children		
	(1)	**(2)**
Panel A. Full Sample		
Parents' housing rank	0.175***	0.176***
	(0.00292)	(0.00292)
Constant	41.31***	-
	(0.165)	-
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.031	0.036
Threshold for children's upward mobility (surpassing parents' rank)	50.073	-
Panel B. Parents' Rank in [0, 50], [50, 80], and [80, 100] Categories		
Parents' housing rank	0.0576***	0.0570***
	(0.00796)	(0.00795)
Parents' housing rank × I (parents in ranks 50-80)	0.111***	0.115***
	(0.0190)	(0.0189)
Parent's housing rank × I (parents in ranks 80-100)	0.901***	0.903***
	(0.0334)	(0.0333)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.041	0.046

Note: Additional regressors in Panel B include dummy variables for parents' housing rank categories. Standard errors are clustered at the family level.

Table 3: Intergenerational Rank Correlation in Housing Consumption by Parents' Residential Type and Location

Outcome Variable: Housing Rank of Children		
	(1)	**(2)**
Panel A. Parents in Private vs. Public Housing		
Parents' housing rank	0.136***	0.137***
	(0.00309)	(0.00310)
Parents' housing rank × I (parents in private residence)	0.770***	0.783***
	(0.155)	(0.154)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.040	0.045
Panel B. Parents living in outside core central region vs. core central region		
Parents' housing rank	0.171***	0.172***
	(0.00295)	(0.00295)
Parents' housing rank × I (parents in core central region)	0.146***	0.145***
	(0.0186)	(0.0186)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.033	0.038

Note: Additional regressors include dummy variables for parents' housing type in Panel A and parents' housing location in Panel B. Standard errors are clustered at family level.

Table 4: DiD Estimates on the Impact of BTO Launching on Upward Mobility of Children

	I (child's rank surpasses parents' rank)			child's rank - parents' rank		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
HDB parents × After BTO scheme	0.1662***	0.0985**	0.1120**	8.5913***	6.6131***	5.9903***
	(0.029)	(0.047)	(0.057)	(2.265)	(1.408)	(1.625)
Age of children	0.0558***	-0.0111**	-0.0122**	5.7353***	-0.0408	-0.0655
	(0.006)	(0.005)	(0.005)	(0.446)	(0.163)	(0.152)
Average age of parents	0.0194***	0.0084***	0.0064***	1.4818***	0.3708***	0.1864***
	(0.003)	(0.002)	(0.002)	(0.200)	(0.075)	(0.070)
Age^2 of children	-0.0739***	0.0134**	0.0146**	-7.4819***	0.0472	0.0671
	(0.008)	(0.006)	(0.006)	(0.572)	(0.209)	(0.195)
Average age^2 of parent	-0.0148***	-0.0068***	-0.0052***	-1.1088***	-0.2944***	-0.1406**
	(0.002)	(0.002)	(0.002)	(0.163)	(0.062)	(0.058)
Year FE	Y	Y	Y	Y	Y	Y
Postal sector FE	Y			Y		
Postal code FE		Y	Y		Y	Y
Year * Postal sector FE			Y			Y
Observation	104,341	104,341	104,341	104,341	104,341	104,341
R-squared	0.172	0.674	0.685	0.247	0.931	0.941

Note: Additional regressors include dummy variables indicating after 2005 and housing status of parents. Standard errors are clustered at family level. Years are restricted to be between 1999 and 2007 to exclude potential contamination from 1997-1998 Asian Financial Crisis and 2008-2009 Financial Crisis. "After BTO scheme" is defined as a dummy variable equal to 1 if the year is later than or equal to 2005, and 0 otherwise.

Table 5: Effect of Public Housing on non-Housing Consumption

	Ln(education consumption) (narrowly defined)	Ln(education consumption) (broadly defined)	Ln(non-housing consumption except education)
	(1)	**(2)**	**(3)**
HDB (=1)	0.0739	0.0534	-0.0222
	(0.0829)	(0.0415)	(0.0462)
After BTO scheme	0.0345	0.0442	0.0369
	(0.105)	(0.0521)	(0.0425)
HDB * After BTO scheme	0.294*	0.174**	0.0546
	(0.162)	(0.0805)	(0.0776)
Age	-1.935	-0.990	-0.915
	(1.821)	(1.062)	(0.935)
Age^2	0.00817	-0.236***	-0.0782
	(0.117)	(0.0607)	(0.0549)
Ln (income)	0.0245	0.0160	0.0529***
	(0.0262)	(0.0147)	(0.0185)
Year-month FE	Y	Y	Y
Individual FE	Y	Y	Y
Observation	138,115	138,115	138,115
R-squared	0.629	0.503	0.644
Mean (SGD)	129.151	185.079	1,677.496

Note: The data are from the debit and credit card consumption records from a leading bank in Singapore from 2010:04 to 2012:03. The narrowly defined education consumption refers to consumption from the classification of "education". The broadly defined education consumption refers to consumption from the classification of "education" and "books and news". The sample is restricted to married homeowners between 25 and 55 years old, with non-zero monthly education consumption, in terms of broad definition. "After BTO scheme" is defined as a dummy variable equal to 1 if the completed date of the building is later than or equal to 2005, and 0 otherwise. Standard errors are clustered at postal code level.

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Like Father Like Son?

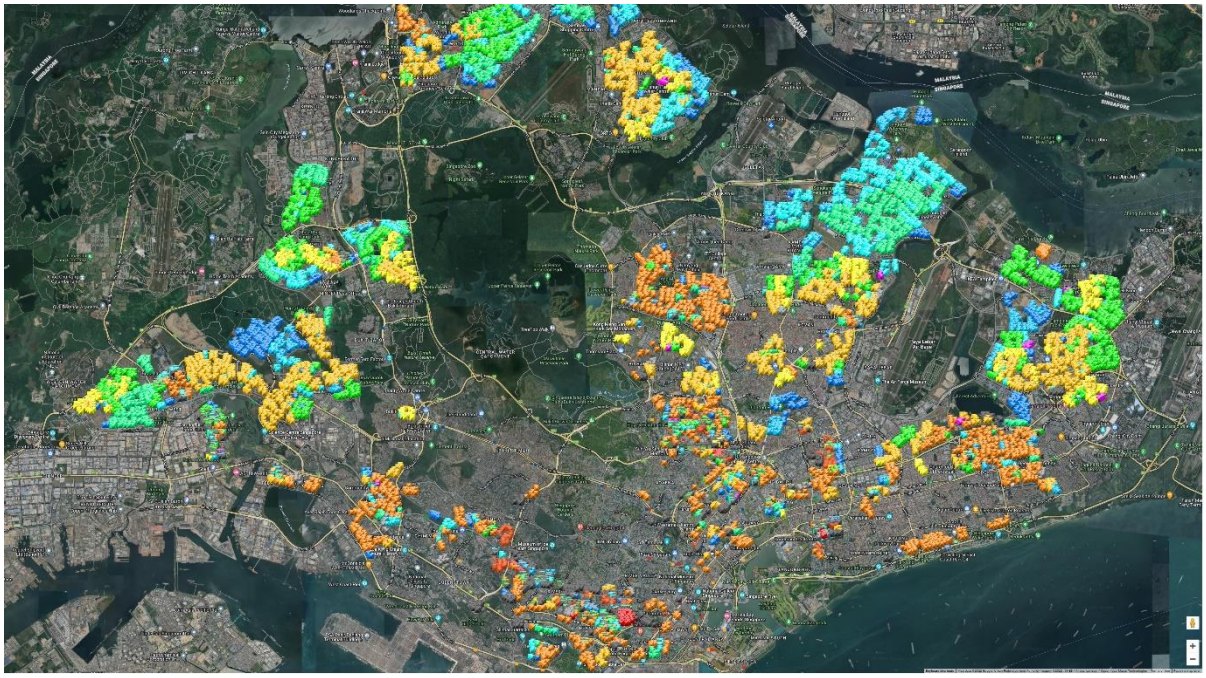
Social Engineering and Intergenerational Mobility in Housing Consumption

Online Appendix

Sumit Agarwal*, Yi Fan†, Wenlan Qian‡, Tien Foo Sing§

August 2023

*Department of Finance and Department of Real Estate, National University of Singapore. Email: bizagarw@nus.edu.sg.
Sumit Agarwal acknowledges financial support from MOE AcFR Tier 2 Grant No. R-311-000-030-119.
†Department of Real Estate, National University of Singapore. Email: yi.fan@nus.edu.sg. Yi Fan acknowledges financial support from MOE AcFR Tier 2 Grant No. R-311-000-030-119.
‡Department of Finance and Department of Real Estate, National University of Singapore. Email: wenlan.qian@nus.edu.sg
§Department of Real Estate, National University of Singapore. Email: bizstf@nus.edu.sg



HDB block color legend

As November 2021 the map contains **12470** residential buildings, with the following breakdown:

- **Brown** (102): Blocks built by SIT (1927-1960).
- **Red** (1988): Classic blocks 1STD, 2STD, 3STD, 4STD, 1I, 2I, 3I, 4I, 3NG, 4NG, 5STD, 5I (1961-1981).
- **Orange** (2467): Classic blocks 3I, 5I, 3NG 4NG, 3S, 4S, 3A, 4A, 5A, EA / EM with 3 bedrooms (1980-1988).
- **Yellow** (881): Classic blocks 4A, 5I, EA / EM with 4 bedrooms (1987-1991).
- **Light green** (1687): Blocks with centralized refuse chute and lifts stopping at every floor 4A, 5I, 5A, EA / EM (1991-1998).
- **Green** (1473): Blocks with household shelter (1997-2004), including SERS replacement blocks (1997-2005).
- **Light blue** (1120): Blocks sold via BTO (2004-present) or SERS (2006-present) available on resale market.
- **Sky** (567): Blocks sold via BTO or SERS under minimum occupation period.
- **Lavender** (65): Blocks sold via DBSS (2009-2015).
- **Cloud** (643): Blocks under construction.
- **Forest** (166): Blocks demolished or converted for other use than public housing after 2013.
- **Grey** (1311): Blocks demolished or converted for other use than public housing before 2013 (incomplete info available) **Please contribute** if you them, I am mostly interested in number of units and flat types.

Update February 2022: **12500** residential buildings, May 2022: **12523** buildings.

Figure A1: HDB Buildings and Distribution

Note: data are retrieved from Teoalida.com.

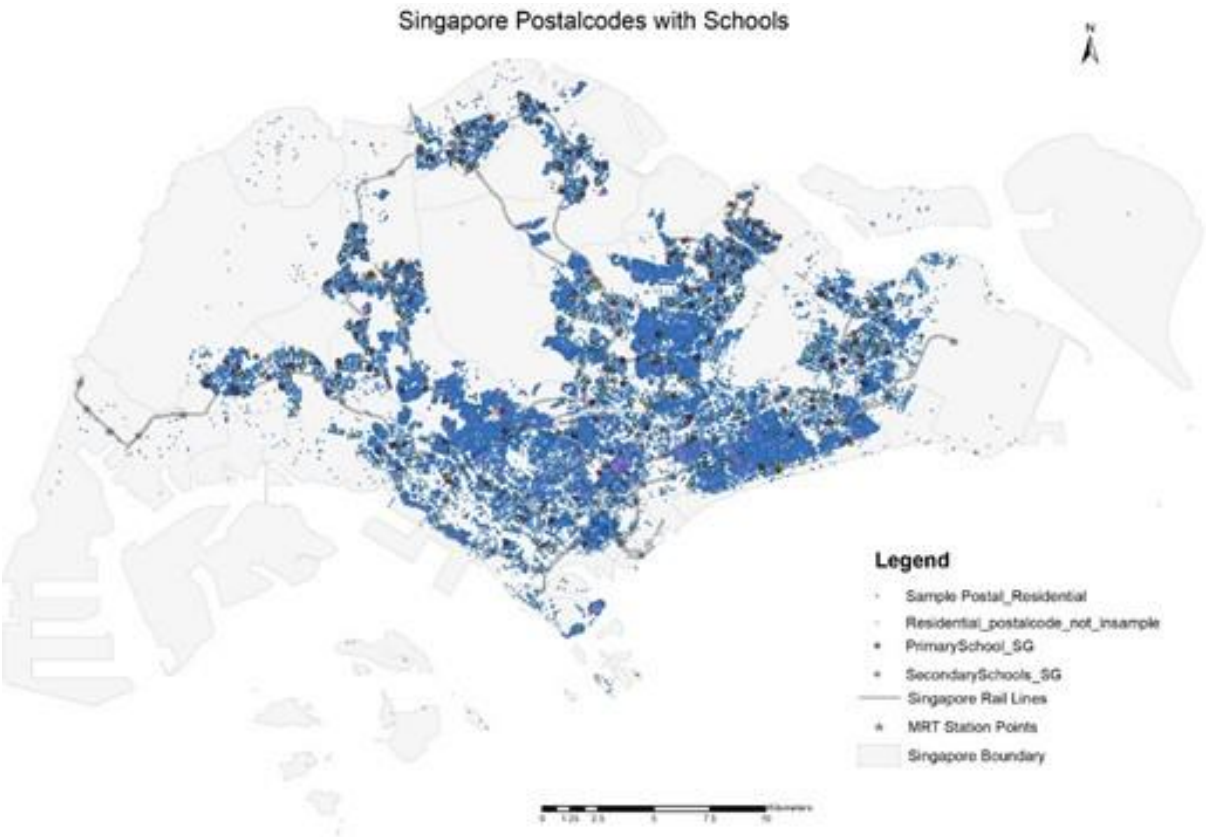


Figure A2: Residential Buildings Covered in the Data (89,624/90,370=99.2%)

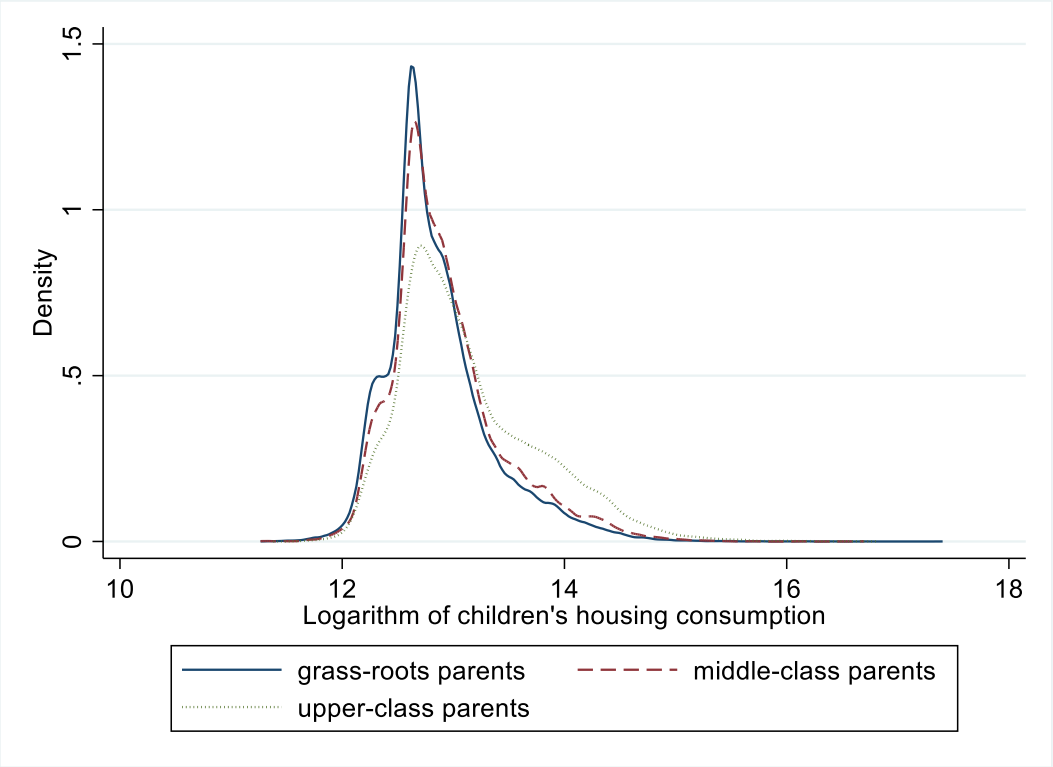


Figure A3: Density Distribution of Log Children's Housing Consumption conditional on Parents' Housing Category

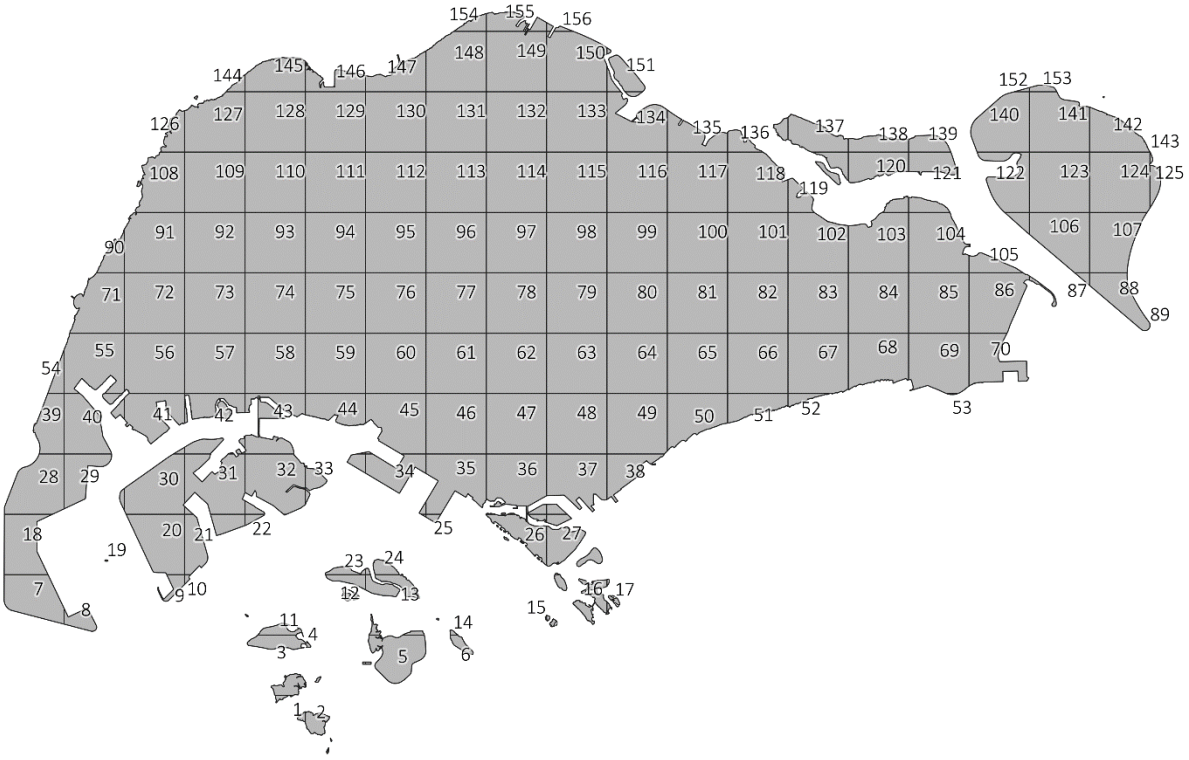


Figure A4: 156 Subzones in Singapore with Diagonals of 4 Kilometers

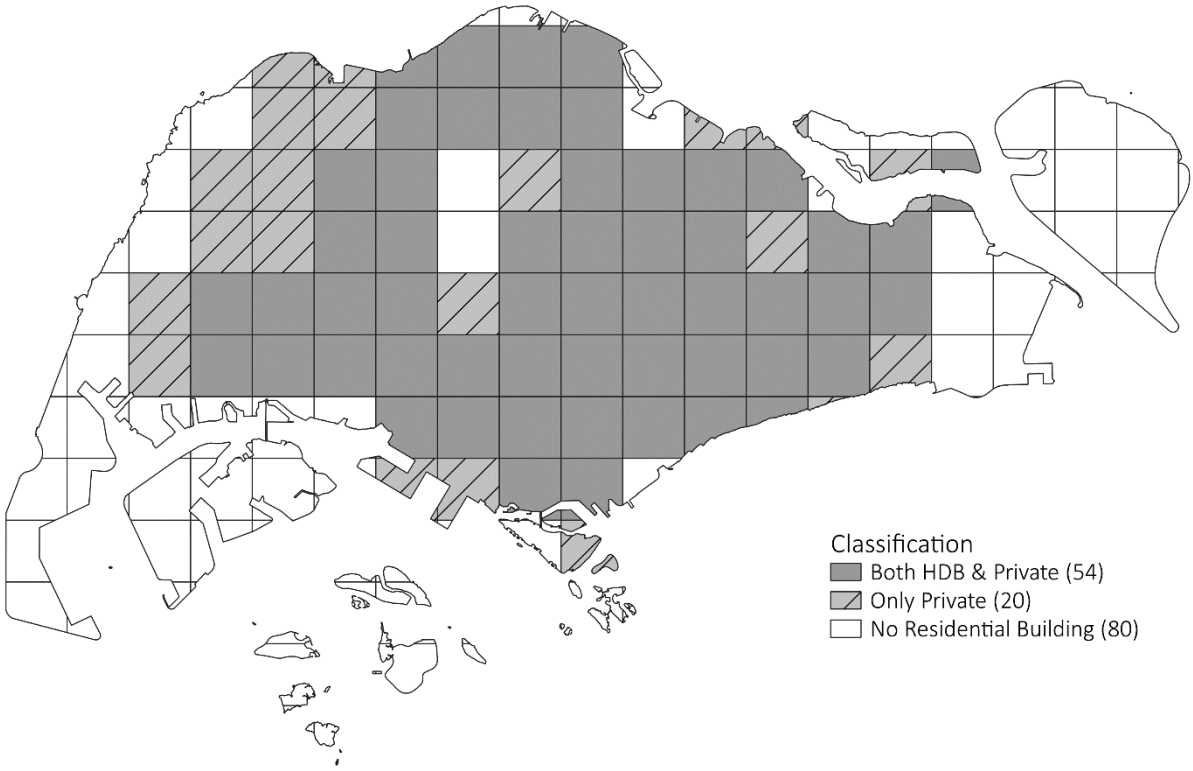


Figure A5: Distribution of Public and Private Housing across Constructed Subzones with Diagonal of 4 Kilometers

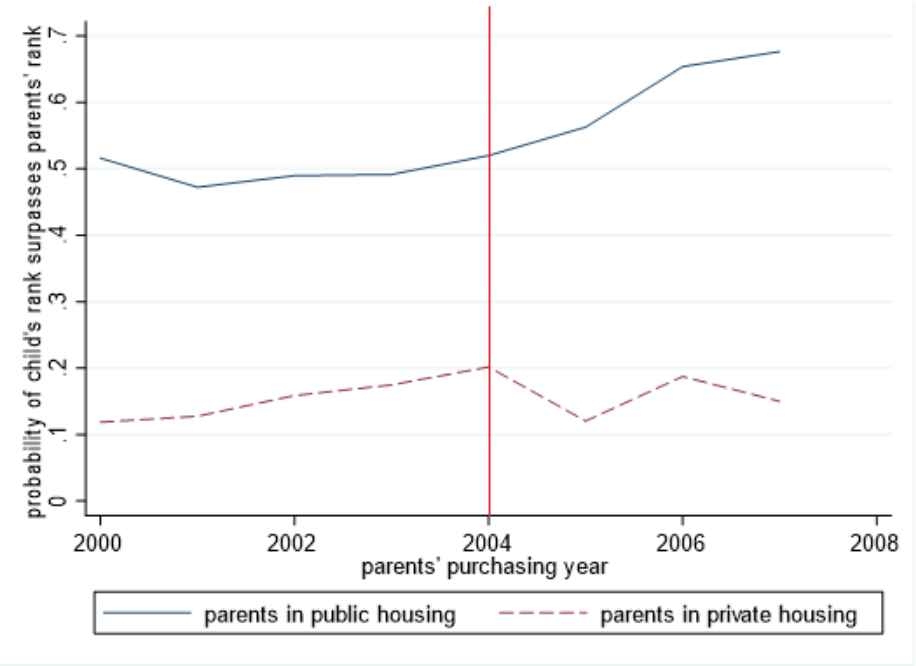


Figure A6: Probability of Child's Housing Rank Exceeding Parents' Housing Rank by Home Purchase Year of Parents

Table A1: Robustness Checks: Intergenerational Correlation in Housing Consumption

Outcome Variable: Housing Rank of Child		
	(1)	**(2)**
Panel A. Robustness Check 1. Including additional demographic controls		
Parents' housing rank	0.176***	0.164***
	(0.00292)	(0.00288)
Age polynomial controls for parents and children	Y	Y
Controls on ethnicity of parents and children and children's gender	N	Y
Observation	147,560	147,560
R-squared	0.036	0.061
Panel B. Robustness Check 2. Children at Least 35 & Parents at Most 65 Years Old		
Parents' housing rank	0.178***	0.180***
	(0.00421)	(0.00421)
Age polynomial controls for parents and children	N	Y
Observation	67,822	67,822
R-squared	0.032	0.036
Panel C. Robustness Check 3. Standard Errors Clustered at Building Level		
Parents' housing rank	0.175***	0.176***
	(0.00353)	(0.00353)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.031	0.036

Note: Standard errors are clustered by family in Panels A and B.

Table A2: Robustness Check: Intergenerational Elasticity of Housing Consumption

Outcome Variable: Log Housing Consumption of Children		
	(1)	**(2)**
Panel A. Full Sample		
Log housing consumption of parents	0.268***	0.271***
	(0.00410)	(0.00411)
Age polynomial controls for parents and children	N	Y
Observation	147,560	149,745
R-squared	0.056	0.060
Panel B. Parents in 0-50, 50-80, and 80-100 Categories		
Log housing consumption of parents	0.0912***	0.0919***
	(0.0101)	(0.0100)
Log housing consumption of parents × I (parents in ranks 50-80)	0.136***	0.145***
	(0.0269)	(0.0269)
Log housing consumption of parents × I (parents in ranks 80-100)	0.316***	0.316***
	(0.0155)	(0.0155)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.062	0.066

Note: Additional regressors in Panel B include dummy variables for parents' housing category. Standard errors are clustered at family level.

Table A3: Heterogeneity in Intergenerational Correlation in Housing Consumption: by Family Size and Ethnicity

Outcome Variable: Housing Rank of Child		
	(1)	**(2)**
Panel A. by Family Size		
Parent's housing rank	0.181***	0.186***
	(0.00680)	(0.00679)
Parent's housing rank	-0.00665	-0.00900
× I (family with 2-3 children)	(0.00778)	(0.00776)
Parent's housing rank	-0.0165	-0.0185*
× I (family with 4 children or more)	(0.0101)	(0.0101)
Age polynomial controls for parents and children	N	Y
Observation	133,350	133,350
R-squared	0.036	0.040
Panel B. by parents' ethnicity		
Parent's housing wealth rank	0.132***	0.133***
(baseline = Malay parents)	(0.00663)	(0.00664)
Parent's housing wealth rank	0.0391***	0.0375***
× I (Chinese parents)	(0.00739)	(0.00739)
Parent's housing wealth rank	0.0334**	0.0306*
× I (Indian parents)	(0.0160)	(0.0160)
Parent's housing wealth rank	0.0408	0.0379
× I (other parents)	(0.0321)	(0.0320)
Age polynomial controls for parents and children	N	Y
Observation	147,560	147,560
R-squared	0.055	0.059

Note: Additional regressors include dummy variables for family size in Panel A and dummy variables for ethnics in Panel B. Ethnicity is defined as father's race. If there is no information on the father's ethnicity, mother's ethnicity is used instead. Standard errors are clustered at family level.

Table A4: Robustness Check: DiD Estimates on the Impact of BTO Launching on Upward Mobility of Children

	I (child's rank surpasses parents' rank)			**child's rank - parents' rank**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Full sample	Cluster s.e. at building level	Gender & race controls	Full sample	Cluster s.e. at building level	Gender & race controls
HDB parents × After BTO scheme	0.1270***	0.1120*	0.1120**	8.2250***	5.9903***	6.0059***
	(0.047)	(0.063)	(0.057)	(1.614)	(1.940)	(1.624)
Age of children	-0.0098**	-0.0122**	-0.0122**	0.0190	-0.0655	-0.0695
	(0.004)	(0.005)	(0.005)	(0.140)	(0.152)	(0.152)
Average age of parents	0.0059***	0.0064***	0.0063***	0.1661***	0.1864***	0.1771**
	(0.002)	(0.002)	(0.002)	(0.063)	(0.070)	(0.070)
Age^2 of children	0.0117**	0.0146**	0.0146**	-0.0122	0.0671	0.0742
	(0.005)	(0.006)	(0.006)	(0.179)	(0.196)	(0.195)
Average age^2 of parent	-0.0047***	-0.0052***	-0.0051***	-0.1301**	-0.1406**	-0.1342**
	(0.001)	(0.002)	(0.002)	(0.052)	(0.058)	(0.058)
Gender of children			-0.0001			-0.0835
			(0.002)			(0.064)
Chinese			-0.0105			0.5940
			(0.013)			(0.457)
Indian			-0.0126			0.3008
			(0.014)			(0.500)
Malay			-0.0141			0.2935
			(0.014)			(0.466)
Year FE	Y	Y	Y	Y	Y	Y
Postal code FE	Y	Y	Y	Y	Y	Y
Year * Postal sector FE	Y	Y	Y	Y	Y	Y
Observation	142,109	104,341	104,341	142,109	104,341	104,341
R-squared	0.664	0.685	0.685	0.929	0.941	0.941

Note: Additional regressors include dummy variables indicating after BTO scheme and housing status of parents. Standard errors are clustered by family if not specified.