Scaling Up the American Dream: A Dynamic Analysis *

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Abstract

The Moving to Opportunity (MTO) program implemented in the '90s offered vouchers to low-income people living in high-poverty neighborhoods to move to richer neighborhoods. We use a dynamic general equilibrium model with residential choice and endogenous local spillovers to explore the quantitative effects of scaling up this policy and compare them to those of alternative neighborhood-specific policies. We first contrast the MTO policy to a place-based policy that offers a transfer to all families living in a high-poverty neighborhood. The MTO program generates larger income gains for the children of the recipient families. However, as we scale up the policy, general equilibrium effects both dampen these gains and impose large welfare losses for the non-recipient families. The transfer place-based policy has overall higher average welfare gains, but it is less successful in reducing income inequality and residential segregation. We then introduce an alternative place-based policy that invests resources in local institutions, such as public schools, to directly improve the neighborhood spillover. This type of policy is less effective on impact, but realizes larger welfare gains over time, while also reducing both inequality and residential segregation.

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1 Introduction

In the last decades, the US has experienced, at the same time, a steady increase in income inequality and a rise in residential segregation by income within metro areas. In the mid '90s, the US Department of Housing and Urban Development ran a Moving To Opportunity program (MTO) offering vouchers to low-income people living in high-poverty neighborhoods to move to richer neighborhoods. Chetty et al. (2016) have shown that the program has been successful in improving the outcomes for children of voucher-recipient families. Given the success of the program, a natural question is whether would be a good idea to implement a scaled-up version of this experience.

In this paper, we use a general equilibrium model with residential choice and local spillovers, building on Fogli et al. (2022), to explore the macroeconomic effects of scaling up a voucher program similar to the MTO and to compare it to alternative neighborhood-specific policies.

The main elements of the model are the following. There is a city with three neighborhoods, inhabited by overlapping generations of agents, who live for two periods. In the first period, an agent is a child, and in the second, she becomes a parent. Parents care about their own consumption and their children's expected future income, and choose how much to consume, in which neighborhood to raise their children, and how much to invest in their children's education. Children have heterogeneous ability and their future wages are affected by the neighborhood where they grow up because the model features an endogenous local spillover, which depends on the distribution of families who live in the neighborhood. We choose a flexible formalization of the spillover to capture a variety of local effects: quality of local public schools, peer effects, social norms, networks, and so forth. In particular, we assume that the local spillover depends on the average expected income of the children growing up in that neighborhood, which means that the spillover tends to be higher in neighborhoods with richer parents and with children with higher ability. We assume that the spillover is complementary to both education and ability, so that living in a neighborhood with higher spillover generates higher returns to education, especially for the more talented children. The presence of the local spillovers generates residential sorting, as richer parents tend to choose to live in the neighborhood with the highest spillover to give their kids the best opportunity for success. We also assume that there is a government, which collects proportional income taxes to finance a public assistance program that provides free housing and a minimum level of consumption for poor families.

We calibrate the model to a representative US metro area in 1980. The key ingredient of the model is the strength of the local spillover. To discipline this moment, we use the micro estimates by Chetty and

Hendren (2018b) for the local exposure effects on children's outcomes. We then introduce a small scale voucher scheme that mirrors the MTO program. The program offers housing vouchers to subsidize poor families to move to a low-poverty neighborhood and is financed with proportional income taxes on the whole population. As a discipline device, we match the income gain of the children of voucher-recipient families as estimated in Chetty et al. (2016).

Our objective is to compare the effects of the MTO policy, for different scales, with the effects of two alternative neighborhood-specific policies, which we label place-based-transfer policy (PBT) and place-based-investment policy (PBI). To compare these policies to the MTO, we keep the total amount of taxes needed to finance each scale of the MTO constant and use them to finance the alternative policies. The PBT policy uses the resources to offer a transfer to all families living in the neighborhood with the lowest spillover. The PBI policy uses the same resources to finance local institutions, such as public schools, and directly increase the local spillover.

We first explore the effects of scaling up the MTO policy. As the scale increases, general equilibrium effects become sizeable: as a larger fraction of poor families living in the poorest neighborhood receive a voucher to move to the richest neighborhood, the size of the spillover in the three neighborhoods endogenously change, as they depend on the distribution of families living there. In particular, the size of the spillover in the richest neighborhood decreases with the scale of the program. This dampens the income gain for the children of voucher-recipient families and generates income losses for children of families who used to live in that neighborhood.

We then move to analyzing the effects of the PBT policy. Given that this policy prescribes a transfer to all families living in the poorest neighborhood, the size of the transfer going to each family is much smaller than the voucher under the MTO policy. This implies smaller welfare gains for the recipient families. Moreover, the general equilibrium effects are drastically different. In particular, the PBT policy incentivizes families to move to the neighborhood with the lowest spillover to receive the transfer. This implies that the poorest families living in the richest neighborhood move out, hence making that neighborhood even richer. This feeds back into an even higher spillover. It follows that under PBT policy, both non-recipient and recipient families experience welfare gains. So, overall the average city-wide welfare gains end up being larger than under the MTO policy, even though the welfare gains for the recipient families are smaller than under the MTO. However, as the general equilibrium effects generate more sorting by income across neighborhood, the PBT policy is less successful in reducing income inequality and residential income segregation.

Finally, we explore the effects of the PBI policy that uses the same finances to invest directly in increasing the size of the local spillover (for example, by investing in public schools) and financing a minimum level of education for the poorer families. Such a policy is not as successful as the others in improving city-wide welfare on impact. However, the effect of the spillover cumulates over time and generates larger welfare gain in the long run, and, at the same time, succeeds in reducing both inequality and residential segregation by income.

Related Literature

Our model builds on the theoretical literature that studies inequality and residential segregation in general equilibrium models with local spillovers and residential choice, going back to Benabou (1993), Benabou (1996a), Benabou (1996b), Durlauf (1996b), Durlauf (1996a), Fernandez and Rogerson (1996), and Fernandez and Rogerson (1998).

Using these types of models, there has been a recent growing body of work studying the effect of different neighborhood-specific policies. The paper that is closest to ours is Chyn and Daruich (2022) that also explores the effects of housing vouchers and place-based policies in a general equilibrium model with endogenous neighborhood externalities. Our papers are complementary. Their model is richer in the description of the skill-accumulation technology and focuses on how endogenous labor supply responds to policies and how this affects parents' investment in child development. Our model features three neighborhoods instead of two, which allows us to generate richer moving patterns, as families living in the policy destination neighborhoods may decide to move out into middle-income areas. Moreover, we model parents' investment in children's education in terms of economic resources rather than time. Given the different modeling choices, we analyze different types of place-based policies, with particular focus on the effects on residential segregation by income.

From a more micro perspective, other two related papers studying the MTO experiment using a location-choice model are Galiani et al. (2015) and Davis et al. (2021). Galiani et al. (2015) use the MTO experiment to identify structural parameters of a location-choice model and run a counterfactual to understand the role of mobility counseling in increasing take-up rates. Then they use the quantitative model to study the effect of restricting the criteria to use the voucher. In particular, they show that forcing voucher receivers to move to neighborhoods with even lower poverty rates, would reduce the take-up rates and possibly backfire. In a similar spirit, Davis et al. (2021) estimate preferences in a dynamic location-choice model and emphasize the trade-off of restricting criteria to use the voucher to move to lower poverty neighborhoods:

on the one hand, households who use the voucher end up in better locations, but on the other hand, less families end up taking up the voucher. They are closer to our paper in focusing on the general equilibrium effect of the policy. In particular, they emphasize a trade-off of restricting the use of the voucher to lower poverty neighborhoods: the endogenous increase in rental rate in high opportunity locations induces some households who used to live there to move to lower opportunity areas dampening the net benefit effects of the policy.

There is a number of papers that use general equilibrium models similar to ours to study different types of neighborhood-specific policies. Among the others, Rossi-Hansberg et al. (2010) propose a model of housing externalities, where the value of land is affected by the houses in the surrounding areas that affect the intensity of non-market interactions. They estimate how housing externalities decline with distance and use these estimate to evaluate the effect of the Neighborhoods-in-Bloom program, which is an urban revitalization program implemented in Richmond, Virginia, between 1999 and 2004.[1] Aliprantis and Carroll (2018) propose a two-neighborhood model with residential choice and local human capital externalities. They then calibrate a version of the model with no residential choice to data from Chicago in 1960 to map the initial racial composition of the two neighborhoods, and use it to explore the effects of eliminating legal racial discrimination for neighborhood selection. Diamond et al. (2019) use a dynamic model with neighborhood choice disciplined with quasi-esperimental variation in assignment of rent control to evaluate the benefits of rent controls for covered tenants and the welfare losses from decreased housing supply. More related to our paper, Agostinelli et al. (2020) focus on how parents affect the choice of peer groups. Their parenting style decision is close in spirit to our residential choice decision and is affected by the return to education. In a similar spirit to the MTO, they use this model to explore the effects of policy interventions to move children to better neighborhoods. Agostinelli et al. (2021) develop and estimate a spatial equilibrium model with residential sorting and school choice to study the effects of school bus transportation to have talented children from poor neighborhoods attending high-quality schools in richer neighborhoods. As in our paper, they have an endogenous school quality as well as heterogenous skill distribution, and they show that scaling up the policy may have general equilibrium effects that dampen its beneficial effects. Gaubert et al. (2021) explore the efficiency and equity consequences of place-based redistribution policies.

Our paper is connected to a large empirical literature that study the effects of the MTO program on both

[1] There is a vibrant empirical literature developing different strategies to estimate the strength of neighborhood externalities, including Redding and Sturm (2016) and Diamond and McQuade (2019) among others.

non-economic and economic objects. Initial research, including Katz et al. (2001), Kling et al. (2007), Clampet-Lundquist and Massey (2008), Ludwig et al. (2013), did not find significant impact of the housing vouchers on the future income and employment status of the children of the voucher recipient families. More recently, Chetty et al. (2016), using more recent administrative data including the adult income of individuals who were children when their families participated in the program, have found significant economic effects for children who moved to lower poverty neighborhoods when they were below 13 years old. Bergman et al. (2019) use a randomized controlled trial with housing voucher recipients in Seattle and King Country to show that barriers in the housing search process are an important driver of residential segregation by income.

2 Institutional Background: MTO Housing Vouchers

In this section, we first describe the Moving to Opportunity (MTO) experiment, and then report its effects according to the analysis in Chetty et al. (2016).

2.1 MTO Program Design

The MTO program was a randomized experiment conducted by the US Department of Housing and Urban Development (HUD) to improve opportunities for children of low-income families living in poor neighborhoods. This program was run from 1994 to 1998 in five cities: Baltimore, Boston, Chicago, Los Angeles, and New York.

To be eligible for the program, families had to satisfy a number of criteria: 1) they needed to have children below 18 years old of age; 2) they had to live in high-poverty neighborhoods (with more than 40% of population below the poverty line); 3) they had to live in public housing developments or project-based assisted housing, which requires them to be low income families (below 50% of the local median).

The public housing authority (PHA) in each city outreached to all eligible families and gave them the opportunity to pre-apply for the program. After a preliminary eligibility screening, they were randomly ordered into a waiting list. Then, small groups of families from the top of the list were called to attend a visit at the PHA, where they were told the rules of the experiment and then they had to decide whether they wished to go forward with the application. If they decided to apply, they were randomly assigned to one of three groups:

1. the experimental group was given housing vouchers that they could use only to move to census

tracts with 1990 poverty rates below 10%;

2. the Section 8 group received regular Section 8 housing vouchers that they could use without any specific relocation constraint;

3. the control group received no assistance through the MTO program, but continued to be eligible for housing assistance and other welfare programs.

Voucher recipients were required to contribute 30% of their annual household income towards rent and utilities and received housing vouchers that covered the difference between their rent and the family's contribution, up to a maximum amount, defined as the 40th percentile of rental costs in a metro area (Fair Market Rent). Families remained eligible for these vouchers indefinitely as long as their income was below 50 percent of the median income in their metro area.

Table 1 shows some statistics about the MTO enrollment. The first two columns report for each site, respectively, the total population in 1990 and the estimated number of eligible families, as reported in Feins et al. (1996). The table also reports the number of families that were effectively enrolled in the MTO program according to Sanbonmatsu et al. (2011) and their assignment to the three different groups. The enrolled families are a bit less than one third of the eligible families. This is because, given the total finances available and the estimate of compliance rates, the program was designed to target an enrollment of 4,436 families, which is roughly the number of families who ended up being enrolled. As we explained above the criterion to select the families from the waiting list was random. However, there was selection in the families who effectively pre-applied for the program and also for the ones who decided to apply after their visit to the PHA. Moreover, one of the eligibility criterion was to be eligible for the Section 8 program. While the main criterion for Section 8 eligibility is to be a "low-income" family (that is, with income not higher than 80% of the median), the program explicitly targets poorer families.[2]

Finally, the table also shows the compliance rate, that is the share of enrolled families in the experimental and section 8 group who actually used the voucher. As further investigated by Bergman et al. (forthcoming), many frictions might have prevented some families to actually use the voucher, including housing

[2]From the website https://www.cbpp.org/research/policy-basics-section-8-project-based-rental-assistance: "*For each participating housing development, at least 40 percent of the subsidized units that become available annually must go to families with "extremely low incomes" (up to the poverty line or 30 percent of the local median, whichever is higher). Most of the remaining units are restricted to families or individuals with incomes not above half of the local median.*"

availability, landlords' skimming, liquidity constraints. The compliance rate is higher for the section 8 group, as the families were not constrained to find housing in a restricted set of neighborhoods.

Table 1: Eligible, enrolled, and compliant families

MTO Site	Population in 1990	All Groups		Experimental Group		Section 8 Group	
		Eligible Families	Enrolled Families	Enrolled Families	Compliance Rate	Enrolled Families	Compliance Rate
Baltimore	736,014	2,300	572	252	53.50%	123	79.80%
Boston	574,289	4,500	868	366	43.60%	176	51.10%
Chicago	2,783,660	2,415	825	460	33.40%	133	67.40%
Los Angeles	3,485,499	3,900	929	340	60.50%	200	71.60%
New York	7,322,564	2,430	948	401	46.40%	252	45.20%
All Sites	13,902,026	15,545	4,142	1,819	47.40%	844	61.60%

2.2 MTO Program Effects

Initial research evaluating the effects of the MTO program (e.g. Katz et al. (2001), Kling et al. (2007), Clampet-Lundquist and Massey (2008), Ludwig et al. (2013)) did not find significant impact of the housing vouchers on the future income and employment status of the children of the voucher recipient families. They found only effects on non-economic measures of well-being, such as phisical and mental health, safety, behavior.

However, Chetty et al. (2016) have recently revisited the economic impact of the MTO program, using more recent administrative data that include the adult labor market outcomes of individuals who were young children when their families participated in the program. Motivated by their previous work on causal effects of neighborhood exposure, they split the sample of families who participated in the MTO program into two groups: those with children younger than 13 years old at the time of the program and those with older children. With this distinction, they find significant economic effects for children who moved to lower poverty neighborhoods. In particular, they look at the treatment-on-the-treated (TOT) effect, which is the change in adult income for children of voucher recipient families who used the voucher relative to the control group. For children who were younger than 13 when their family took up an experimental voucher, they estimate an increase in adult annual income by the time they reached their mid-twenties of $3,477$, which corresponds to a 31% increase relative to a mean of $11,270$ in the control group. For children younger than 13 of families in the Section 8 group, they estimate an increase in income of 15% relative to the control group. Instead, they find negligible or slightly negative effects for the children who were older than 13 years old when their families used the voucher. They also find significant effects for college attendance for children younger than 13.

3 Model

In this section, we present a general equilibrium model with residential choice and local spillovers, building on Fogli et al. (2022). Parents choose the neighborhood where to live, taking into account that different local spillovers affect their children's future income. A key element of the model is that the local spillovers are endogenous and depend on the sorting of families into neighborhoods.

We use the model to think about the effects of different types of policies designed to improve the outcomes of children growing up in poor neighborhoods. We start by looking into a voucher policy similar to the one implemented with the MTO program and then we consider some alternatives, including place-based policies. We analyze the effects of scaling up these types of policies in an environment where they affect local spillovers and housing prices.

3.1 Environment

The economy consists of three neighborhoods, denoted by $k \in \{A,B,C\}$, and is populated by overlapping generations of agents who live for two periods. An agent is a child in the first period and a parent in the second period. A parent at time t earns a wage $w_t \in [\underline{w},\overline{w}]$, has one child with ability $a_t \in [\underline{a},\overline{a}]$, and was born in neighborhood $b_t \in \{A,B,C\}$. The ability of a child is correlated with the ability of the parent. In particular, $log(a_t)$ follows an AR1 process

$$log(a_t) = x + \rho log(a_{t-1}) + \nu_t,$$

where ν_t is normally distributed with mean zero and variance σ_ν, $\rho \in [0,1]$ is the autocorrelation coefficient, and x is a constant normalized so that the mean of a_t is equal to 1. The joint distribution of parents' wages, children's abilities, and birth neighborhoods evolves endogenously and is denoted by $F_t(w_t,a_t,b_t)$, with $F_0(w_0,a_0,b_0)$ taken as given.

There is a continuum of landlords who build houses every period and rent them out to the parents. Each period the houses fully depreciate. All houses are of the same dimension and quality and the rent in neighborhood k at time t is denoted by R_{kt}. The construction cost in each neighborhood k is pinned down to generate an upward-sloping housing supply curve at each time t, given by

$$H_{kt} = \lambda_k R_{kt}^{\phi_k},$$

where ϕ_k represents housing elasticity in neighborhood k, and λ_k is a shift parameter in the same neighborhood. At the end of each period, the landlords pool their profits Π_t and redistribute them to the parents with income in the top x-th percentile of the city-wide income distribution, in proportion to their income. In particular, the total landlord's profits Π_t are equal to

$$\Pi_t = \sum_{k=A,B,C} \left\{ R_{kt} H_{kt} - \frac{\phi_k}{1+\phi_k} \lambda_k^{-\frac{1}{\phi_k}} H_{kt}^{1+\frac{1}{\phi_k}} \bar{w}_t \right\},$$

where

$$H_{kt} = \int\int\int_{n_t(w_t,a_t,b_t)=k} F_t(w_t,a_t,b_t) dw_t da_t db_t.$$

Parents with wage $w_t \geq \bar{w}_t$, where $F_t(\bar{w}_t) = 1-x$, will get a fraction of the total profits Π_t equal to $s(w_t,a_t,b_t) = f_w(w_t)/[1-F_w(\bar{w}_t)]$.

A parent with income w_t, child's ability a_t, and birth neighborhood b_t chooses consumption, $c_t(w_t,a_t,b_t)$, the neighborhood where to raise their children, $n_t(w_t,a_t,b_t)$, and how much to invest in their children's education, $e_t(w_t,a_t,b_t)$. Parents who choose a neighborhood n_t different from their birth neighborhood b_t, incur in a utility cost μ. The educational choice is continuous and the cost of education is equal to τe_t^{γ}, with $\tau > 0$ and $\gamma > 0$.

The future wage of a child with parent (w_t,a_t,b_t) who grows up in neighborhood n_t and receives education e_t is equal to

$$w_{t+1} = \Omega(w_t,a_t,e_t,S_{n_t t},\varepsilon_t) \equiv (y + a_t e_t \eta_t(\beta_0 + \beta_1 S_{n_t t}^{\xi})) w_t^{\alpha} \varepsilon_t, \tag{1}$$

where ε_t is an iid noise with cdf Ψ, normally distributed with mean one and standard deviation σ_ε, $\eta_t > 0$ captures a skill premium shock, and $S_{n_t t}$ is the strength of a local spillover in neighborhood n_t at time t that affects the returns to education. The wage equation shows that a child's wage is increasing in her ability, in her education level, in her parent's income, and is affected by the neighborhood where she grows up because of the local spillover.[3]

The strength of the spillover effect in neighborhood k at time t is equal to the expected future income of the children growing up in that neighborhood:

$$S_{kt} = \frac{\int\int\int\int_{n_t(w_t,a_t,b_t)=k} W_{t+1}(w_t,a_t,b_t,\varepsilon_t) F_t(w_t,a_t,b_t) \Psi_t(\varepsilon_t) dw_t da_t db_t d\varepsilon_t}{\int\int\int_{n_t(w_t,a_t,b_t)=k} F_t(w_t,a_t,b_t) dw_t da_t db_t}, \tag{2}$$

[3] Parents' wages affect children's wages both directly and indirectly through the educational and residential choices.

where we define $W_{t+1}(w_t, a_t, b_t, \varepsilon_t) \equiv \Omega(w_t, a_t, e_t(w_t, a_t, b_t), S_{n_t(w_t,a_t,b_t)t}, \varepsilon_t)$, that is, the children's wage given optimal education and residential choices of the parents. Given that wages are increasing in ability and in parents' wage, neighborhoods with higher spillovers are neighborhoods with both richer parents and children with higher ability. This formalization allows us to capture a number of different sources of local spillovers, from pecuniary ones such as the quality of public schools, to non-pecuniary ones such as social norms, peer effects, information externalities and so forth. We chose this general specification because we are going to discipline quantitatively the strength of the local externalities with the estimates of neighborhood exposure effects in Chetty and Hendren (2018b), who do not distinguish among different channels. From now on, we define the neighborhood with the highest and lowest spillover as $\bar{n}_t \equiv \arg\max_{k \in A,B,C} S_{kt}$ and $\underline{n}_t \equiv \arg\min_{k \in A,B,C} S_{kt}$.

Parents care about their own consumption and about their child's future income.[4] We also introduce two types of preference shocks over neighborhoods to capture the role of fixed amenities (e.g., waterfront, parks, and so forth) as well as idiosyncratic preference for different locations (e.g., family network). We assume that neighborhood A has better amenities than B, and B has better amenities than C and that only a random fraction π of parents care about amenities. Hence, the utility from consumption for a parent who chooses neighborhood n is given by $log(\theta_n c)$, where $\theta_A > \theta_B = 1 > \theta_C$ with probability π and $\theta_A = \theta_B = \theta_C = 1$ with probability $1 - \pi$.

The preferences of parent (w_t, a_t, b_t) can be written as

$$log(\theta_{n_t t} c_t) + log[w_{t+1}] + \sigma_\zeta \zeta_{n_t t} - \mu I_{n_t \neq b_t}$$

where $\zeta_{n_t t}$ is the idiosyncratic shock, which follows a Type-I Extreme Value distribution with scale parameter σ_ζ. This shock introduces some additional randomness that is not systematically related to some particular ranking of the neighborhoods and helps making the model analytically tractable. Moreover μ is the utility cost of moving neighborhood.

We assume that the government runs a public assistance (PA) program for the parents with low income to ensure everybody a minimum level of consumption $\underline{c}$. The program is financed with a proportional income taxation with tax rate κ_t. Parents are eligible if they have income below the cut-off $\hat{w}_t = (R_{\underline{n}_t} + \underline{c})/(1 - \kappa_t)$. Eligible parents have to live in the neighborhood with the lowest spillover $\underline{n}_t$. If their income is higher

[4] This assumption is common in this class of models. The assumption that agents cannot save (if not by investing in housing or kids'education) is for simplicity. The assumption that agents cannot borrow is for realism, given that typically people cannot borrow against children's future income. An alternative specification could have parents getting utility directly from their children's consumption, but with the introduction of a borrowing constraint.

than the rental rate in that neighborhood, they have to pay for it and they will receive a consumption transfer (e.g. food stamps) such that they achieve a minimum level of consumption $\underline{c}$. If their income is below the rental rate, the government will cover the remaining portion of the rent and transfer $\underline{c}$ to them. To sum up, a parent with $w_t < \hat{w}_t$ will receive a transfer in terms of consumption equal to $T_t(w_t) = \underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t}, 0\}$.[5] For each eligible parent with $w_t < \hat{w}_t$, the government will need resources equal to $R_{\underline{n}_t} + \underline{c} - (1-\kappa_t)w_t$.[6] The government's budget balance condition at each time t is then given by

$$\int\int\int_{w_t<\hat{w}_t} (R_{\underline{n}_t t} + \underline{c} - (1-\kappa_t)w_t)dF_t(w_t,a_t,b_t) \leq \kappa_t \left(\int\int\int w_t dF_t(w_t,a_t,b_t)\right). \tag{3}$$

To summarize, the optimization problem for a parent (w_t,a_t,b_t) with $w_t \geq \hat{w}_t$ at time t can be written as:

$$\begin{aligned} U(w_t,a_t,b_t) = & \max_{c_t,e_t,n_t} log(\theta_{n_t t}c_t) + E_t[log(w_{t+1})] + \sigma_\zeta \zeta_{n_t t} - \mu I_{n_t \neq b_t} \\ s.t.\ & c_t \leq (1-\kappa_t)w_t + s_t(w_t)\Pi_t I_{w_t > \bar{w}_t} - R_{n_t t} - \tau e_t^\gamma \\ & w_{t+1} = \Omega(w_t,a_t,e_t,S_{n_t t},\varepsilon_t), \end{aligned} \tag{P1}$$

taking as given spillovers and rental rates in the two neighborhoods, $S_{n_t t}$ and $R_{n_t t}$ for $n_t = A,B,C$.

Instead a parent (w_t,a_t,b_t) with $w_t < \hat{w}_t$ will have to live in the neighborhood with the lowest spillover $n_t(w_t,a_t,b_t) = \underline{n}_t$, and her optimization problem will be[7]

$$\begin{aligned} U(w_t,a_t,b_t) = & \max_{c_t,e_t} log(\theta_{\underline{n}_t}c_t) + E_t[log(w_{t+1})] + \sigma_\zeta \zeta_{\underline{n}_t t} - \mu I_{n_t \neq b_t} \\ s.t.\ & c_t \leq (1-\kappa_t)w_t - \min\{(1-\kappa_t)w_t, R_{\underline{n}_t t}\} - \tau e_t^\gamma + T_t(w_t) \\ & T_t(w_t) = \underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t t}, 0\} \\ & c(w_t,a_t,b_t) \geq T_t(w_t) \\ & w_{t+1} = \Omega(w_t,a_t,e_t,S_{\underline{n}_t t},\varepsilon_t). \end{aligned} \tag{P2}$$

All parents with after-tax income below the rental rate in the neighborhood will have consumption $c_t(w_t,a_t,b_t) = \underline{c}$, and no resources for education, so $e_t(w_t,a_t,b_t) = 0$. Parents who have leftover income after paying the rent could choose some positive level of education.

[5]Given that this transfer is in terms of consumption, a parent with transfer $T_t(w_t)$ will have to choose $c(w_t,a_t,b_t) \geq T_t(w_t)$.

[6]If the eligible parent has a wage smaller than the rental rate, then the government has to pay for the residual rental rate on top of the transfer.

[7]Notice that there are no landlords' profits in the budget constraint because $\bar{w}_t < \hat{w}_t$.

In our analysis, we assume that there are complementarities between the spillover and ability, education, and wages, and between education and ability, and education and wages.

Assumption 1 *The composite function $\Omega(w,a,e,S,\varepsilon)$ has increasing differences in a and S, in e and S, in w and S, in a and e, and in w and e.*

These complementarities assumptions drive residential segregation by income and ability in equilibrium. Although it is hard to get direct estimates of innate ability, the complementarity between innate ability and education and between innate ability and neighborhood spillover reflect some of the findings of the recent empirical literature. [8]

3.2 Equilibrium

We are now ready to define an equilibrium.

Definition 1 *For a given initial wage distribution $F_0(w_0,a_0,b_0)$, an equilibrium is characterized by a sequence of educational and residential choices, $\{e_t(w_t,a_t,b_t)\}_t$ and $\{n_t(w_t,a_t,b_t)\}_t$, a sequence of rents and spillover's sizes in the three neighborhoods, $\{R_{kt}\}_t$ and $\{S_{kt}\}_t$ for $k=A,B,C$, a sequence of tax rates $\{\kappa_t\}_t$, and a sequence of distributions $\{F_t(w_t,a_t,b_t)\}_t$ that satisfy:*

1. *agents' optimization: for each t and given R_{kt} and S_{kt} for $k=A,B,C$*
   (a) *for (w_t,a_t,b_t) with $w_t \geq \hat{w}_t$, the policy functions e_t and n_t solve problem (P1);*
   (b) *for (w_t,a_t,b_t) with $w_t < \hat{w}_t$, $n_t = \underline{n}_t$ and the policy function e_t solves problem (P2);*
2. *spillovers' consistency: for each t, equation (2) is satisfied for $n=A,B,C$;*
3. *market clearing: for each t and $k \in \{A,B,C\}$, R_{kt} ensures housing market clearing in neighborhood*

[8] Our assumptions of complementarity between innate ability and education and between innate ability and neighborhood spillover are consistent with the latest research on technology of skill formation. Cunha et al. (2010) show that the higher the initial conditions for cognitive and non-cognitive skills of children, the higher the return to parental investment in children at later stages in life. As they highlight, "Family environments and genetic factors may influence these initial conditions." In our model, parental investment in children's future outcomes takes place both through educational investment and through residential choice. Moreover, the recent human capital literature, reviewed in Sacerdote (2011), also highlights the presence of non-linearity in peer effects, which are one of the forces behind our spillover effects. In particular, Sacerdote (2001), Imberman et al. (2012), and Lavy et al. (2012) find that high ability students are the ones who benefit the most from peer effects of other high ability students. Another paper that speaks more specifically to the complementarity between ability and spillover effects is Card and Giuliano (2016), which shows that high achievers from minority and disadvantaged groups show high returns when included in school tracking programs.

k

$$\lambda_k \left(\frac{R_{kt}}{\bar{w}_t}\right)^{\phi_k} = \int\int\int_{n_t(w_t,a_t,b_t)=k} G_t(w_t,a_t,b_t) dw_t da_t db_t; \tag{4}$$

4. *wage dynamics are consistent with optimal choices: for each t,*

$$w_{t+1} = \Omega(w_t, a_t, e_t(w_t,a_t,b_t), S_{n_t(w_t,a_t,b_t)t}, \varepsilon_t). \tag{5}$$

5. *budget balance: for each t, κ_t is such that equation (3) is satisfied.*

In equilibrium, the presence of local spillovers, together with assumption 1, generate residential segregation by income and ability. Moreover, residential segregation by income is also driven by the presence of local amenities. Talented children from poor families who grow up in the poorer neighborhoods do not have the same opportunities as children of richer families who can afford a neighborhood with higher spillover and higher amenities. Moreover, since higher local spillovers increase the return to education, parents who live in poorer neighborhoods end up investing less in education, while parents in richer neighborhoods invest more. This amplifies future inequality and segregation and further reduces intergenerational mobility.

3.3 MTO Policy

We now analyze the effect of different types of policies that try to mitigate the rise in inequality and residential segregation and allow for a higher degree of intergenerational mobility.

We start by introducing in the model the MTO program. This will allow us to explore whether this type of program would be as effective, once it is scaled up, as general equilibrium effects may become quantitatively relevant. In particular, as poorer families move to the better neighborhood, the selection of families living in the three neighborhoods endogenously change, affecting the local spillovers as well as the local rental rates.

We assume that the policy is permanent and is unexpectedly introduced at time $\bar{t}$. For each $t \geq \bar{t}$, let $\chi(w_t,a_t,b_t)$ denote the eligibility indicator, with $\chi_t(w_t,a_t,b_t) = 1$ if the parent is eligible for the program and equal to 0 otherwise. To map the MTO policy eligibility criteria, we require that families need to : 1) live in the neighborhood with the lowest spillover, and 2) belong to the poorest $p-th$ percentile of the metro income distribution. That is, we assume that $\chi(w_t,a_t,b_t) = 1$ if $b_t = \underline{n}_t$ and $w_t \leq \tilde{w}_t$, where $\tilde{w}_t$ is such that

$$F_w[\tilde{w}_t] = p,$$

where p is a given percentile of the income distribution of the metro area. In our model the neighborhood with the lowest spillover is also the one where the poorer families live. However, given that local spillovers are endogenous and evolve over time, and so does the composition of the neighborhood, the worst neighborhood may change in response to the policy.

Eligible families are offered a housing voucher to cover the difference between their rent and the family's contribution, equal to a fraction q of their income, with a cap $\bar{r}$. We assume that under the "experimental policy", families accepting the voucher have to move to the neighborhood with the highest spillover, $\bar{n}_t$, while under the "section 8 policy", families do not have any specific relocation constraint and can even decide to stay in their birth neighborhood.

We assume that the policy is financed with income taxes on the whole population and that the government budget has to balance. The public assistance program is still in place and if a family is eligible for both, she will get the housing voucher transfer from the MTO program, with the same contribution rules, and the consumption transfer $T(w_t)$ from the public assistance program. The eligibility cut-off for the public assistance program is unchanged, so that families who were eligible without the MTO program in place, are still eligible afterwards. The government budget balance condition can be written as

$$\int\int\int_{v_t=1} min\{(R_{\bar{n}_t t} - qw_t), \bar{r}\} dF_t(w_t,a_t,b_t) + \int\int\int_{w_t<\hat{w}_t \& v_t=0} (R_{\underline{n}_t t} + \underline{c} - (1-\kappa_t)w_t) dF_t(w_t,a_t,b_t)$$
$$\int\int\int_{w_t<\hat{w}_t \& v_t=1} [\underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t t}, 0\}] dF_t(w_t,a_t,b_t) \leq \kappa_t \left(\int\int\int w_t dF_t(w_t,a_t,b_t)\right).$$

Parents who are eligible for the program take up the voucher if the utility from using it is larger than the one from not using it. Define $v_t(w_t,a_t,b_t)$ as the voucher take-up indicator. Let us first consider the case of experimental policy. For all parents such that $\chi_t(w_t,a_t,b_t) = 0$, $v_t(w_t,a_t,b_t) = 0$, while for all parents such that $\chi_t(w_t,a_t,b_t) = 1$ with $w_t \geq \hat{w}_t$, $v_t(w_t,a_t,b_t)$ solves

$$max_{v_t}\{U^V(w_t,a_t,b_t), U^N(w_t,a_t,b_t)\}, \tag{6}$$

where

$$\begin{aligned} U^V(w_t,a_t,b_t) &= \max_{e_t} \log[\theta_{\bar{n}_t}((1-\kappa_t)w_t - \max\{qw_t, R_{\bar{n}_t t} - \bar{r}\} + s_t(w_t)\Pi_t I_{w_t \geq \bar{w}_t} - \tau e_t^{\gamma})] \\ &\quad + \log[\Omega(w_t,a_t,e_t,S_{\bar{n}_t t},\varepsilon_t)] + \sigma_\zeta \zeta_{\bar{n}_t t} - \mu I_{n_t \neq b_t}, \end{aligned} \tag{7}$$

and

$$\begin{aligned} U^N(w_t,a_t,b_t) &= \max_{e_t,n_t} \log[\theta_{n_t}((1-\kappa_t)w_t + s_t(w_t)\Pi_t I_{w_t \geq \bar{w}_t} - R_{n_t t} - \tau e_t^{\gamma}] + \\ &\quad + \log[\Omega(w_t,a_t,e_t,S_{n_t t},\varepsilon_t)] + \sigma_\zeta \zeta_{n_t t} - \mu I_{n_t \neq b_t}, \end{aligned} \tag{8}$$

where $U^V(w_t, a_t, b_t)$ is the value of taking up the voucher, $U^N(w_t, a_t, b_t)$ the value of not taking it up, and $\Omega(w_t, a_t, e_t, S_{n_t t}, \varepsilon_t) = (y + a_t e_t \eta(\beta_0 + \beta_1 S_{n_t t})^{\xi}) w_t^{\alpha} \varepsilon_t$. A parent taking up the voucher has to move to the neighborhood with the highest spillover and has to use a fraction q of her income to contribute for the rent. The voucher covers the difference between $R_{\hat{n}t}$ and her contribution up to the cap $\bar{r}$. A parent not taking up the voucher has to pay the full rent, pays taxes on the total income, but can choose the optimal neighborhood. For a parent with $w_t < \hat{w}_t$, the value of taking up the voucher is the same as in (7), except that she will get a transfer $T_t(w_t) = \underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t}, 0\}$ that she is forced to consume. Moreover, the value of not taking it up is equal to (8), except that she now is subject to the standard rules of the PA program, that is, she has to choose neighborhood $\underline{n}_t$, she has to use her income to pay as much as she can of the rent, and she gets a transfer $T_t(w_t) = \underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t}, 0\}$ that needs to be consumed.

Under section 8 policy, parents taking up the voucher can choose their neighborhood, so equation (7) becomes

$$
\begin{aligned}
U^V(w_t, a_t, b_t) \quad = \quad & \max_{e_t, n_t} \log[\theta_{n_t}((1-\kappa_t)w_t - \max\{qw_t, R_{\bar{n}_t t} - \bar{r}\} + s_t(w_t)\Pi_t I_{w_t \geq \bar{w}_t} - \tau e_t^{\gamma}] \\
& + \log[\Omega(w_t, a_t, e_t, S_{n_t t}, \varepsilon_t)] + \sigma_{\zeta}\zeta_{n_t t} - \mu I_{n_t \neq b_t}.
\end{aligned} \tag{9}
$$

To sum up, there are two main reasons why the model can generate a take-up rate smaller than 100%. First, the rental rate in the worse neighborhood may be lower than the required down-payment to move to the best neighborhood, as required if accepting the voucher. Moreover, the required down-payment may be higher than 30% of the income if the voucher cap is binding. Second, the moving costs together with the idiosyncratic preference shocks may be such that some eligible families may prefer to remain in their original neighborhood.

We will consider the case of experimental policy our benchmark and we will compare it to section 8 policy and other alternatives in the quantitative exercise.

The equilibrium definition is the natural generalization of the equilibrium defined in section 3.2.

3.4 Place-Based Policies

We now introduce two different types of policies that are place-based, that is, that target families living in a specific neighborhhood. In particular, we will propose a place-based transfer policy (PBT from now on) and a place-based investment policy (PBI from now on). We will compare the effects of these policies to the MTO program, keeping constant the total finances used.

PBT Policy

As an alternative policy, we consider a permanent PBT policy, which is unexpectedly introduced instead of the MTO policy at the same time $\bar{t}$ when the MTO was introduced, and gives at any time $t \geq \bar{t}$ a transfer $\tilde{T}_t$ to all parents choosing to live in the neighborhood with the lowest spillover $\underline{n}_t$. As for the case of the MTO, the public assistance program is still in place and if a family is eligible for both, she will get the transfer $\tilde{T}_t$ on top of the PA transfer $T_t(w_t) = \underline{c} - \max\{(1-\kappa_t)w_t - R_{\underline{n}_t}, 0\}$. As before, the government finance both the PA and the PBT programs with income taxes and the budget balance condition at time t is now given by

$$\int\int\int_{w_t<\hat{w}_t} (R_{\underline{n}_t t} + \underline{c} - (1-\kappa_t)w_t) dF_t(w_t, a_t, b_t) + \tilde{T}_t \left(\int\int\int_{n_t=\underline{n}_t} dF_t(w_t, a_t, b_t)\right)$$
$$\leq \kappa_t \left(\int\int\int w_t dF_t(w_t, a_t, b_t)\right).$$

To compare the effect of the two different policies, we find the tax rate κ_t such that the total tax revenues used under PBT are equal to the total tax revenues used under the MTO program for each scale p.[9] We then back up as a residual the place-based transfer $\tilde{T}_t$. However, given that parents make their residential choice knowing that the policy is in place, this becomes a fixed point problem.

PBI Policy

We now consider an alternative type of place-based policy, where the same finances are used to directly invest into improving the spillover of the neighborhood, i.e. investment in public school, crime reduction, information diffusion. Given that in this model, a higher spillover is beneficial for the families living in the neighborhood because it increases the returns to education, the effectiveness of this policy relies on parents investing in education. We then assume that the government also subsidizes the cost of some basic level of education for those families that are so poor that would not have otherwise afforded it.

Again, for each scale of the MTO policy p, we compare a place-based investment policy that uses the same total finances. The funds are used to pay for a basic level of education $\underline{e}$ for families living in $\underline{n}_t$ that belong to the lowest x-th percentile , where x is such that those families would otherwise choose education below that level.[10] Let us define $\hat{\hat{w}}_t$ the cut-off such that $F(\hat{\hat{w}}_t) = x\%$. The remaining resources $\bar{I}_t$ are used

[9] At time $\bar{t}$, this means simply that we keep the tax rate $\kappa_{\bar{t}}$ the same as under MTO. However, for the following periods $t > \bar{t}$, the tax rate might be different because the distribution $F_t(w_t, a_t, b_t)$ evolves endogenously in a different way under the two policies.

[10] In this exercise we set the basic level of education to 0.12, which is a bit below the average of the other families in the city.

to increase directly the spillover of neighborhood $\underline{n}_t$, and, once it reaches the level of the second highest spillover, to further increase both the second highest and the lowest spillovers. The government budget balance condition is now

$$\int\int\int_{w_t<\hat{w}_t}(R_{\underline{n}_t t}+\underline{c}-(1-\kappa_t)w_t)dF_t(w_t,a_t,b_t)+\tau\underline{e}^{\gamma}\left(\int\int\int_{n_t=\underline{n}_t\&w_t<\hat{\hat{w}}_t}dF_t(w_t,a_t,b_t)\right)$$
$$+\bar{I}_t\leq\kappa_t\left(\int\int\int w_t dF_t(w_t,a_t,b_t)\right),$$

where the right-hand-side is the total level of finances equalized to the finances used under MTO for each scale p, and $\bar{I}_t$ is the residual amount of resources after paying for basic education and PA programs. The effective spillover in neighborhood n at time t, S^*_{nt}, is now

$$S^*_{nt}=S_{nt}+\psi I^{\zeta}_{nt},$$

where S_{nt} is the standard spillover, as defined in equation 2, and I_{nt} is the amount of resources used to increase the spillover in neighborhood n at time t. In particular, $I_{\underline{n}_t t}=\bar{I}_t$ if $S^*_{\underline{n}_t t}<S_{\tilde{n}_t t}$ where $\tilde{n}_t$ is such that $S_{\underline{n}_t t}<S_{\tilde{n}_t t}<S_{\bar{n}_t t}$. When the effective spillover in neighborhood $\underline{n}_t$ reaches the spillover in the intermediate neighborhood, then the resources will be split equally among them, so that $I_{\underline{n}_t t}=I_{\tilde{n}_t t}=\bar{I}_t/2$. This means that over time, the spillovers in the three neighborhoods will converge.

4 Quantitative Analysis

In our quantitative analysis, we map our model to the average US metro area and explore the effects of alternative neighborhood-specific policies.

4.1 Calibration

First we calibrate the model assuming that the US economy with public assistance program in place, but without neighborhood-specific policies, is in steady state in 1980. In order to replicate the pattern of increasing inequality in the US data, we feed the model with a sequence of skill premium shocks that match the time series of the college premium between 1980 and 2010. Moreover, in 1990 we introduce a permanent unexpected neighborhood-specific policy to resemble the MTO program that was implemented in 1994-1998.

We build our calibration strategy on Fogli et al. (2022). In order to map our model to the data, we interpret one period as ten years, given our focus on the education investment.[11] Moreover, to define the three neighborhoods, we rank census tracts in each MSA according to the number of families living there who belong to the top 20th percentile of the income distribution ("rich families" from now on). For each MSA, we define neighborhood A as the group of census tracts with more than 30% rich families, neighborhood C as the group of tracts with less than 17% rich, and neighborhood B as the residual. Then we map the neighborhoods in our model to the average neighborhoods A, B, and C across all US MSAs in our sample, weighting by population.[12] The cut-offs chosen to define the neighborhoods imply that in 1980 roughly 50% of the US population lives in neighborhood C and the rest is roughly split between A and B. Given our interest in studying the scaling up of MTO policies, this definition of C allows us to have enough room to expand the policy to a progressively larger number of families targeted by the program. Table 2 shows the targets of our baseline calibration, which we are now going to discuss.

The first three targets in Table 2 are measures of residential segregation by income and income inequality at the metro area level. For all these measures, we restrict the sample to families with children because our mechanism emphasizes the parental decision to invest in the children' future. First, we target the 1980 value of the dissimilarity index by income as a measure of segregation. We calculate the dissimilarity index for each MSA and then take the average, weighting by population.[13] Second, we target the value of the Gini in 1980 as a measure of income inequality. Using Census data, we calculate the Gini coefficient for each metro area and then we average them, weighting by population. Third, as an additional measure of income inequality, we target the ratio of the average income for families in the top 25th percentile of the income distribution to the average income for families in the bottom 25th percentile.

In addition, we target the level of intergenerational mobility, measured as the rank-rank correlation between log wages of parents and children estimated using administrative records by Chetty et al. (2014). In particular, they use children born between 1980 and 1982, calculate parental income as mean family income between 1996 and 2000 and children's income as mean family income between 2011 and 2012, when the children are approximately 30 years old. Given that this correlation is calculated over several decades, we map it in the model to the average rank-rank correlation across 1980, 1990, and 2000.

[11]The schooling age could be interpreted as 10 or 15, years depending on which level of education one targets. Another factor in our choice of 10 years is that census data are available every 10 years.

[12]See Appendix for summary statistics.

[13]We define the dissimilarity using rich and poor as the mutually exclusive groups, where rich are again the families in the top 20th percentile of the MSA income distribution and poor are all the others. Moreover, we use the grouping of census tracts in neighborhoods A, B, and C as described above as the geographic subunit of analysis.

Table 2: *Calibration Targets*

Description	Data	Model	Source
Dissimilarity index by income	0.334	0.334	Census 1980
Gini coefficient	0.376	0.374	Census 1980
Income 25th/75th p	0.667	0.685	Chetty and Hendren (2018b)
Rank-rank correlation	0.341	0.352	Chetty et al. (2014)
Return to spillover 25th p	0.06	0.06	Chetty and Hendren (2018b)
Return to spillover 75th p	0.05	0.05	Chetty and Hendren (2018b)
Return to college 1980	0.391	0.389	Goldin and Katz (2009)
Return to college 1990	0.549	0.557	Goldin and Katz (2009)
Return to college 2000	0.607	0.614	Goldin and Katz (2009)
Return to college 2010	0.596	0.599	Goldin and Katz (2009)
Neighborhood A size 1980	0.194	0.193	Census 1980
Neighborhood A size 1990	0.217	0.210	Census 1990
Neighborhood B size 1980	0.301	0.301	Census 1980
Neighborhood B size 1990	0.250	0.281	Census 1990
Share of rich in A 1980	0.437	0.508	Census 1980
Share of rich in B 1980	0.225	0.248	Census 1980
College share A	0.340	0.338	Census 1980
College share B	0.178	0.203	Census 1980
Dissimilarity index by education	0.243	0.253	Census 1980
R_A/R_B	1.253	1.270	Census 1980
R_B/R_C	1.277	1.264	Census 1980
SNAP population share 1980	0.07	0.07	USDA Food Nutrition Service
MTO take-up rate	0.47	0.48	MTO Manual
MTO income gain	0.15	0.18	Chetty et al. (2016)

An important target for our exercise is the "return to spillover", that is, the effect of the neighborhood exposure on children's income in adulthood. To measure this effect, following Fogli et al. (2022) we rely on the results from the quasi-experiment in Chetty and Hendren (2018b), who use tax returns data for all children born between 1980 and 1986, to estimate the effect of local spillovers on children's future income, by looking at movers across US counties.[14] We target their estimates which imply that for a child with parents at the 25th (75th) percentile of the national income distribution, growing up in a 1 standard deviation better county from birth would increase household income in adulthood by approximately 6.2%

[14]Chetty and Hendren (2018b) control for selection effects by looking at families who move from one county to another with kids of different age, so that they were exposed for different fractions of their childhood to the new county. We focus on their estimations for families moving across counties within the same commuting zone, given that we use the metro area as our geographic unit of analysis.

(4.6%). [15] In our model, we consider parents at the 25th percentile and at the 75th percentile of the income distribution who decide to live in a neighborhood different from their birth neighborhood and calculate the ratio of the standard deviation of the expected future wage of their children divided by the average wage of the parents. Given the timing of the estimates from the data, we again map these numbers to the average "spillover effects" in the model across 1980, 1990, and 2000.

As we mentioned before, we choose η_t to target the time series of US college premium between 1980 and 2010 from Goldin and Katz (2009). In the model, we map the skill premium in 1980 to the steady state difference between the average log wage of college-educated individuals and the average log wage of the others. To define college-educated individuals, given that the educational choice is continuous, we define a cut-off $\hat{e}$ such that individuals with an education level above $\hat{e}$ are college educated, and the ones with education below are not. We choose $\hat{e}$ so that, in 1980, 17.8% of the population is college educated, as in the Census data.[16] Finally, we map the skill premium in the subsequent years to the same object, keeping the college cut-off $\hat{e}$ constant.

In our model, the size of the three neighborhoods are endogenous. We use micro data on census tracts' population, to target the size of the three neighborhoods both in 1980 and 1990. It is useful to use both years, to recover both the housing supply shifters and the housing supply elasticities for the three neighborhoods. We also target the share of rich families in the different neighborhoods in 1980, where rich are again defined as families in the top 20th percentile of the income distribution. Moreover, we use Census tract data to calculate the number of people above 25 years old who completed college residing in neighborhood A, B, and C for the average MSA. We also use these data to calculate the dissimilarity index by education for the average MSA, where the two exclusive categories are college educated and non-college educated.

Two other key objects in the model are the ratio of rental rates in neighborhood A to neighborhood B and in neighborhood B to neighborhood C in 1980. We use housing values in 1980 at the census tract level from the Census data and convert them into rental rates.[17]

In 1990, we introduce an housing voucher policy that resembles the actual MTO experiment implemented in 1994-1998. We set the eligibility percentile in the model p to match the number of families effectively

[15] See table II in Chetty and Hendren (2018b).

[16] To calculate this number, we look at the number of people above 25 year old who completed college at the census tract level.

[17] We use a standard coefficient of 0.05 for the conversion.

Table 3: *Parameters*

Parameter	Value	Description
		— Panel A. Internal Calibration —
ρ	0.35	Autocorrelation of log ability
σ_v	1.06	St. dev. of log ability
σ_ε	0.65	St. dev. of log wage noise shock
α	0.25	Wage function parameter
β_0	0.16	Wage function parameter
β_1	0.19	Wage function parameter
ξ	1.05	Wage function parameter
b	1.20	Wage fixed component for no-college
γ	4.69	Education cost parameter
θ_A	1.29	Preference shock for neighborhood A
θ_C	0.46	Preference shock for neighborhood C
π	0.47	Preference shock probability
σ_ζ	0.14	St. dev. of idiosyncratic preference shock
λ_A	0.94	Shift parameter of housing supply in A
λ_B	0.41	Shift parameter of housing supply in B
ϕ_A	2.37	Elasticity of housing supply in A
ϕ_B	0.35	Elasticity of housing supply in B
ϕ_C	4.36	Elasticity of housing supply in C
η_{1990}	3.00	Skill premium 1990
η_{2000}	3.19	Skill premium 2000
η_{2010}	2.74	Skill premium 2010
μ	0.13	Moving cost
$\bar{r}$	0.81	Voucher cap as a fraction of R_A
		— Panel B. External Calibration —
n	1.09	Average population growth
$F(\bar{w})$	0.80	Income threshold for landlords
$\underline{c}$	0.005	Minimum Consumption
q	0.70	MTO income share after down-payment
p	0.0015	MTO eligibility income percentile
ψ	0.5	PBI spillover parameter
ζ	2	PBI spillover parameter
$\underline{e}$	0.12	PBI basic education level
$F(\hat{\hat{w}}_t)$	0.10	PBI basic education income threshold

enrolled in the MTO program (4,142), as described in Table 1, relative to the total population in the five cities where the MTO was introduced (13,902,026), assuming that they were the poorest of the eligible families and that each family had on average 4 members. We then obtain that MTO involved a share of about 0.001 of the population of the five cities (4,142 $\times$ 4 / 13,902,026). We then additionally require that only individuals living in the neighborhood with the lowest spillover in our model are eligible for MTO. We set the eligibility percentile $p = 0.0015$ in order to obtain an enrollment share of 0.001, because not all individuals with income below p live in the neighborhood with the lowest spillover.[18] We think that targeting the poorest of the eligible families is a reasonable assumption because of three reasons: 1) the tracts effectively targeted by the program had average poverty rate of 57%,[19] which is stricter than what the eligibility criterion would have required; 2) one of the criterion to be enrolled for the MTO program was to live in public housing developments or project-based assisted housing, which give priority to the poorer families as emphasized in Section 2; 3) the families who enrolled in the MTO program were poorer than families living in the same public housing developments who did not enroll in the MTO.[20] Of the 4,142 families that applied, only 47% ended up taking up the voucher. In our model the decision of using the voucher is affected by the moving cost μ. We target the voucher take-up rate to discipline the size of the moving cost.

Finally, we target the income gain for the kids of the MTO recipients families. As discussed in Section 2, Chetty et al. (2016) estimate an increase in adult annual income of 31% for children younger than 13 at the time when their family took up the MTO voucher in the experimental group relative to the control group, while they find negligible or slightly negative effects for children older than 13. In our model, we compute the income gain for kids in families that receive the voucher once they become adult, relative to kids in families in the same income percentile in neighborhood C if the voucher policy was not in place.[21] Given that our model does not distinguish between young and old kids, we set the target for the income gain from the MTO policy to a simple average income gain of young and old kids in the data, which correspond to 15.5%. In our model, the income gain from the MTO policy is affected by the voucher cap for the MTO program, $\bar{r}$, which affects how much families need to put down towards rent and, as a result, how much income they have left to invest in education. Thus, we target the voucher cap to discipline the size of the income gain.[22]

On top of p, there are other 4 parameters that we directly feed from external sources in the quantification

[18]The effective income cutoff required for eligibility according to the MTO manual is less stringent than $p = 0.0015$, as 15,545 families were estimated to be eligible for the program (Table 1). However, our stringent threshold captures that the enrolled families were only a fraction of the eligible, and they were among the poorest.

[19]This number comes from Appendix B in the MTO Congress Report.

[20]See Table 5 from Goering et al. (1999).

[21]Given that the policy is very small, general equilibrium effects are negligible.

[22]We obtain that the value of the voucher cap, $\bar{r}$, is about 81% of the rent in A in our model. As a comparison, in the data we observe a value of 0.68 for the ratio of the voucher cap, set at the 40th percentile of rental costs in the metro area, relative to the average rent in the census tracts corresponding to neighborhood A in our model in 1980.

exercise. First we assume that population grows at a constant growth rate that is equal to the average population growth rate across US MSAs in 1980-2010. Second, we pick $\bar{w}_t$ such that $F_{wt}(w) = .8$, so that landlords' profits are redistributed to the top $20-th$ percentile of the distribution.[23] Third, we map the minimum level of consumption $\underline{c}$ guaranteed by our public assistance policy to the food stamps in the Supplemental Nutrition Assistance Program (SNAP). In 1980, about 7% of US households were receiving SNAP benefits.[24] We pick the value of $\underline{c}$ so that 7% of the families in our model receive public assistance. Finally we set the share of income that families contribute to rent under the MTO, q, to be equal to 0.3, following the rules of the MTO program.

Table 3 shows our model parameters, their calibrated value, and their description. We normalized the value of η_1, τ, the mean of the ability process, the mean of the noise shock to the wage process to be all equal to 1 in steady state. Moreover, λ_C is pinned down by normalizing the average wage to be equal to 1 in 1980.

4.2 Model Validation

To validate the model, Figure 1 shows that the dynamic pattern of income inequality and segregation by income implied by our model between 1980 and 2010 is able to roughly replicate the patterns in the data. Recall that by calibration design, we match the pattern of the college premium in the same time period. This helps to obtain an increase in inequality in line with the data. Moreover, our model generates an endogenous feedback between inequality and segregation. As the skill premium increases, the return to live in neighborhoods with higher spillover increases, pushing up the house prices in those neighborhoods and generating more residential segregation by income. In turns, this further amplify future inequality.

5 Policy Experiments

5.1 MTO Program

Given the success of the MTO program, a natural question is whether we can scale up this type of programs to further reduce inequality and improve intergenerational mobility. While for the small scale experiment, the general equilibrium effects are negligible, the natural challenge when we scale up the policy is to consider that the general equilibrium effects may become sizeable and affect the efficacy of the program.

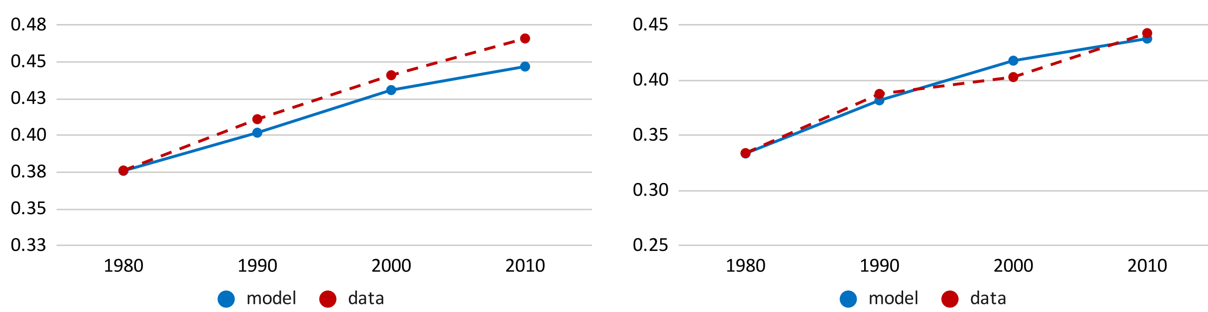
We now use our model to study the effects of scaling up the MTO program. To do so, we relax the

[23] We have done some robustness analysis around this parameter, but the results are not significantly affected.

[24] Pew Research Center analysis of data from USDA Food and Nutrition Service, https://www.pewresearch.org/short-reads/2023/07/19/what-the-data-says-about-food-stamps-in-the-u-s/

Figure 1: Inequality and Segregation: Model vs. Data

(a) Inequality (b) Segregation



eligibility requirements for voucher assignment by increasing the income threshold for families living in the worst neighborhood. In particular, we explore the effects of increasing the percentile of eligible families from $0.0015th$ up to $25th$ percentile. In our analysis, we focus on the results for the experimental group and leave the analysis of the section 8 policy to the appendix. Table 4 shows the proportion of families eligible for the voucher over time for different income cutoffs. It is important to notice that as we scale up the program, we also change the distribution of ability and income of the families who receive the voucher.[25]

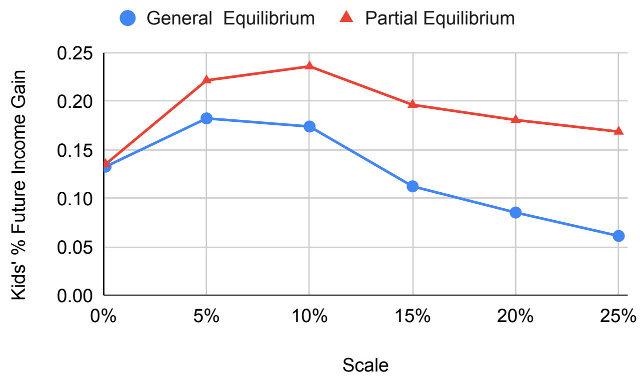
Table 4: MTO Eligible Families for different scales p

	0.0015%	5%	10%	15%	20%	25 %
1980	0	0	0	0	0	0
1990	0.0009	0.0385	0.065	0.1019	0.1242	0.1489
2000	0.0009	0.0309	0.0488	0.072	0.085	0.1180
2010	0.0007	0.0341	0.0539	0.0951	0.1137	0.1299

A first statistic to evaluate the effectiveness of the policy is the income gain of the children of voucher recipient families, who benefit from growing up in a neighborhood with a higher spillover. Such statistic is calculated as the percentage difference between the adult expected income of children in families who

[25] An alternative way of scaling up the policy is to choose a higher eligibility percentile and then randomly assign vouchers to an increasing proportion of eligible families. This would eliminate selection effects, but would target a less poor portion of the population, while Section 8 eligibility criteria that need to be satisfied for the MTO seem to target the poorest families in the eligible pool.

Figure 2: Income gain for voucher receivers' kids



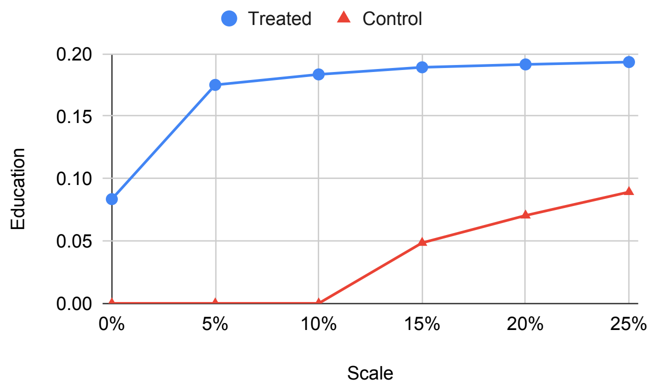
received the voucher relative to the adult expected income of the same children if there was no policy in place.

The blue line in Figure 2 shows how the income gain of voucher receivers' children change as we scale up the policy. As more families receive the voucher, the average income gain increases at first, but then it starts to decline. To better understand this pattern, we first study the income gain that would arise in partial equilibrium (red line), when both rental rates and spillover sizes are kept constant. The figure shows that the non monotonicity already arises in partial equilibrium. This is due to different forces working in opposite directions. On the one hand, as the income cutoff of the eligible families increases, richer families will be able to take up the voucher. This also means that families with more talented kids will be able to move to the better neighborhood.[26] Given the complementarity between local spillover and education, between spillover and parents' wage, and between spillover and ability, richer families will have a larger income gain from moving to a neighborhood with higher spillover. Moreover, the presence of a cap on the voucher policy contributes to most of the increase in income gain going from $p = 0.0015\%$ to $p = 5\%$.[27]

[26] This is because the ability follows a persistent stochastic process, so that income and ability are positively correlated.

[27] When the scale is small, a large fraction of the eligible families are so poor that they end up not taking up the voucher. The reason is that the housing cost is higher than 30% of their income and is beyond the cap imposed by the policy. This means that these families would have to pay additional out-of-pocket expenses to move to A and a large of fraction of them end up deciding not to take up the voucher, even if they have high ability children. When the scale increases, a larger fraction of families take up the voucher, so more high ability children have a chance to move to A and, given the complementarity between ability and spillover, the average income gain becomes larger.

Figure 3: Education level for treated vs control group

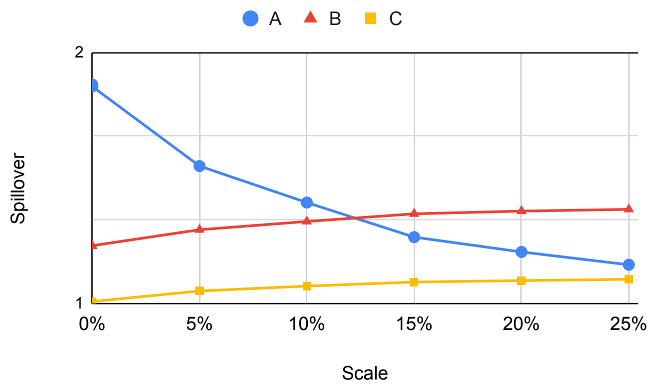


On the other hand, children of richer families have a smaller gain from the voucher policy because their parents would have invested in education even in the absence of the voucher. This second effect dominates when the scale of the policy becomes large enough, generating the inverted U shape.

To clarify the education investment channel, Figure 3 compares the education level chosen by the families receiving the voucher when the policy is in place (treated group in blue) with the education level chosen by the same families if there was no policy (control group in red). The figure shows that the families who receive the voucher when the percentile is below or equal to 10% are poor enough that if there was no voucher policy, they would have chosen not to invest in education. This is why when they receive the voucher to move to a neighborhood with high spillover and start investing in education, their children expect a large income gain. When the scale increases above 10% the families receiving the voucher would have invested in education even with no policy and so the income gain of their children from the policy gets smaller.

On top of the effects described, as we scale up the policy, there is a general equilibrium effect that further reduces the income gain of the voucher receivers' children and becomes stronger the larger is the scale. This can be observed in Figure 2 by comparing the blue line, which represents the actual income gain, with the red line, which represents the income gain that would arise in partial equilibrium. The general equilibrium effect dampens the income gain of the children of the voucher receivers because of the endogenous change of spillovers and rental rates in the three neighborhoods.

Figure 4: Spillover in the three neighborhoods

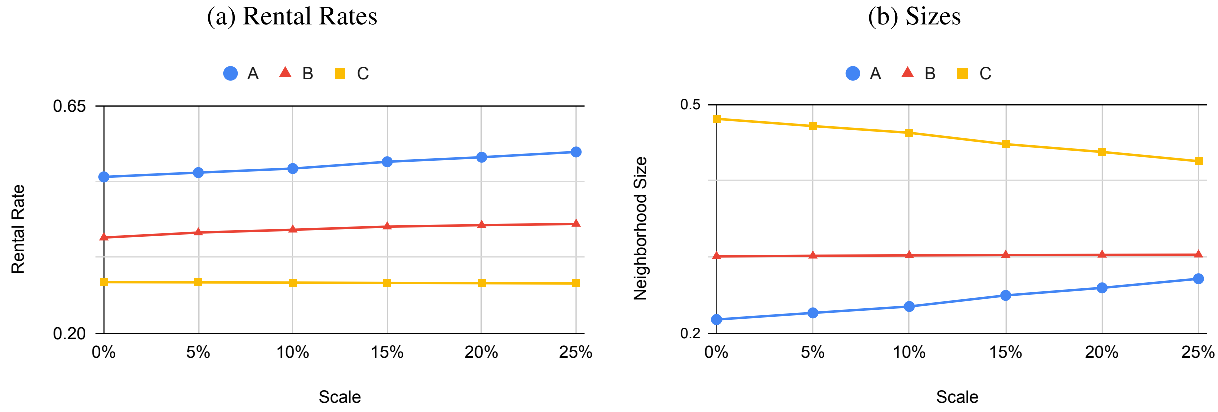


The first general equilibrium effect is due to the change in spillovers. Figure 4 shows the impact response of the spillover in the three neighborhoods to the introduction of the policy, as a function of its scale. As the scale increases, more poor families move from C to A. This reduces the spillover in neighborhood A, while increases the spillover of neighborhood C, reducing the advantage of moving from C to A. At the same time, as the spillover in neighborhood A decreases, more families decide to move from neighborhood A to neighborhood B, increasing the spillover in B. As we scale up the policy, such a process gets more pronounced until it can lead to a switch in the ranking of the neighborhoods' spillovers. In particular, when the cutoff is equal or larger than the 15th percentile, the spillover in B becomes larger than the spillover in A, making B the most desirable neighborhood.[28]

The other general equilibrium effect is driven by the change in the rental rates and in the sizes of the three neighborhoods. The two panels in Figure 5 show, respectively, the rental rates and the sizes of the three neighborhoods as a function of the policy's scale. The decline in the spillover of neighborhood A tends to decrease demand to live there. However, the increase in demand because of the voucher receivers moving to A dominates and makes overall demand for neighborhood A higher. This translates into both an increase in the rental rate in A and an increase in the size of the neighborhood. Demand to live in B also increases because of the increase of families who decide to move from A to B, due to the fact that the gap in spillover declines, while the rental rate in A increases. This increases the rental rate and also slightly the

[28]If the scale of the program increases further, the spillover in A further decreases to the point that for some parameters and a scale large enough, it can become even lower than the spillover in C.

Figure 5: Neighborhoods Rental Rates and Sizes



size of neighborhood B. The demand to live in neighborhood C decreases because of the voucher receivers who are moving to A, although this effect is partially offset by the increase in the spillover due to the improvement of the composition of families living there. As a result, both the size and the rental rate in neighborhood C decline. The increase in rental rate in A and the decrease in rental rate in C further reduce the advantage of moving from C to A, contributing to the dampening of the kids' income gain due to the policy.[29]

5.2 Place-Based Transfer Policy

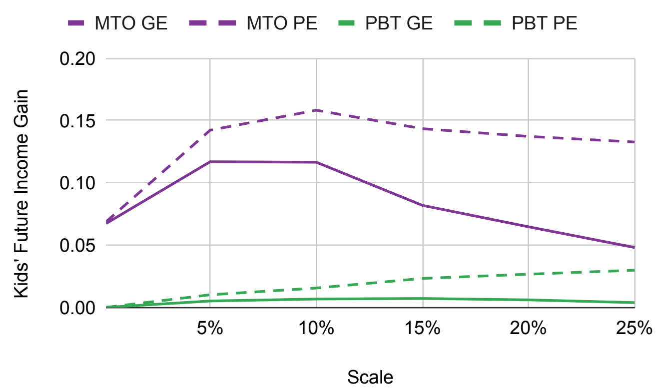
We now compare the MTO policy with a place-based transfer policy (PBT from now on). In particular, we consider a policy that gives a transfer to all families living in the worst neighborhood, neighborhood C. We compare the MTO policy for each scale with a place-based policy that levies the equivalent total amount of taxes.

Figure 6 compares the income gain of the kids of the voucher recipients under the MTO policy with the income gain of the kids of the families who obtain the transfer under the place-based policy.

The green solid line shows the income gain of the kids growing up in C under the place-based policy relative to the income of the same kids without policy. The green dashed line shows the same income gain in partial equilibrium, that is, if rental rates and spillovers were held constant to their levels in the case

[29]Notice that rental rates do not move much in C as it is the neighborhood with highest housing supply elasticity.

Figure 6: Income gain for children of recipient families



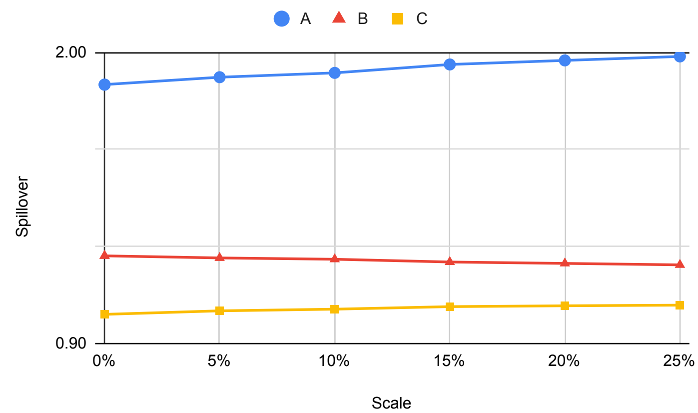
of no policy. For comparison, the purple lines also report the kids' income gain under the MTO policy relative to the control group, which we discussed in the previous section. The comparison shows that the kids' income gain is much smaller under the place-based policy. The main reason for that is that the place-based policy targets all families living in neighborhood C, which is a much larger share of families than the ones who are eligible to take up a voucher under the MTO policy, who are families born in neighborhood C and with income below a certain threshold. When we compare the two policies by keeping constant the total tax revenues raised to finance the policy, the transfer per family under the place-based policy is much smaller than the value of the voucher under the MTO policy.

Despite the small scale of the total effect, let us now try to understand the partial equilibrium and general equilibrium forces behind the behavior of the income gain. The figure shows that the kids' income gain has a non monotonic pattern, first increasing and then decreasing with the scale of the policy. This non-monotonicity is due to general equilibrium effects, as the figure shows that the kids' income gain in partial equilibrium increases monotonically with the scale.

The increasing pattern under partial equilibrium is due to the fact that as the scale becomes larger, the transfer per family becomes larger and parents can invest more in their kids' education. [30]

[30]Notice that if we define the control group as the group of families that benefit from the policy, the control group changes for different scale, as more families are attracted to neighborhood C when the transfer increases. This implies that even for the control group education increases with the scale, even if less than with the policy, because as the scale increases, the average income of the control group increases and so does their investment in education even absent the transfer. Notice that the education level of the control group for the MTO policy was much lower than the

Figure 7: Neighborhood spillovers

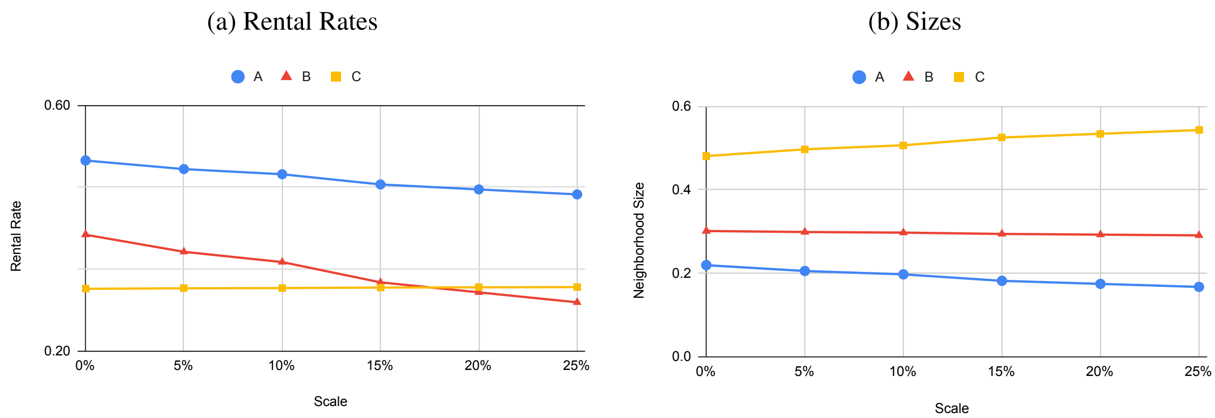


On top of this partial equilibrium force, there are two changes in general equilibrium that affect the children's income gain: changes in spillovers and in rental rates. On the one hand, the spillover in neighborhood C increases as the scale of the policy becomes larger because richer families move into the neighborhood. This has a direct positive effect on the future income of the children growing up in neighborhood C and exposed to that spillover. However, the increase in the spillover also means that the rental rate in the neighborhood increases, reducing the amount spent in education, and hence introducing a force that dampens the children' income gain with the scale. Let us now explore in more detail these general equilibrium effects.

Figure 7 shows the behavior of the spillover in the three neighborhoods under the place-based policy, as a function of the policy's scale. The figure shows that the spillover effects are quite different from the case of the MTO policy. In particular, under the place-based policy, neighborhood C becomes more attractive because families living there obtain a subsidy. This implies that some of the poorer families living in neighborhood A will move to neighborhood C, making A more selective and increasing A's spillover. This is very different from the MTO policy we analyzed, where the spillover in neighborhood A was deteriorating as an effect of the policy. At the same time, the spillover in neighborhood B declines, because, although some of the poorer families move to C, there are fewer families moving into the neighborhood

one for this control group and, in particular, was equal to zero for smaller scales of the policy. This is because the beneficiaries of the policy where families below a certain percentile of the income distribution.

Figure 8: Neighborhoods Rental Rates and Sizes

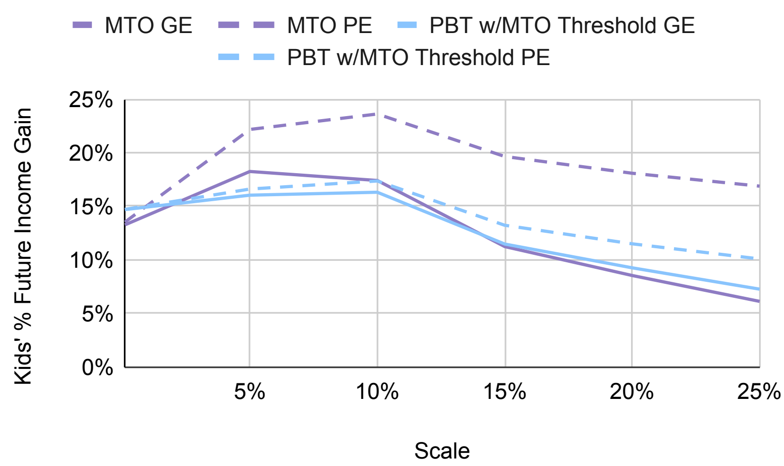


from A. This is also in contrast with what happens under the voucher policy, where neighborhood B was attracting more families from A. Finally, the spillover in neighborhood C increases, as under the MTO policy, but for different reasons: under MTO it was because the poorer families were moving out, while under the place-based policy it is because families from richer neighborhoods move in to receive the transfer.

The two panels in Figures 8 show respectively what happens to the rental rates and the sizes of the three neighborhoods as a function of the scale of the policy. The place-based policy incentivizes families to move to C. As the scale of the policy increases, families receive a larger transfer if they live in neighborhood C, and hence more families want to move there. Given the elastic housing supply, this translates in part in an increase in the rental rate of neighborhood C and in part in an increase in its size. At the same time, there is less demand for neighborhoods A and B, which translates into a reduction of both interest rates and sizes of those neighborhoods.

Given that the place-based transfer policy we analyzed so far benefits all families living in C, irrespective of their income, and so, for the same finances, has small effects on kids' income gain, we also consider a variant of the policy where eligibility requires two criteria: not only to live in neighborhood C, but also to have an income below a certain percentile. In particular, for each scale of the policy, we choose the same finances and the same percentile as in the design of the MTO policy. Figure 9 compares the kids' income gain for the targeted families from this policy relative to the baseline place-based transfer policy and the

Figure 9: Kids' income gain: place-based vs MTO



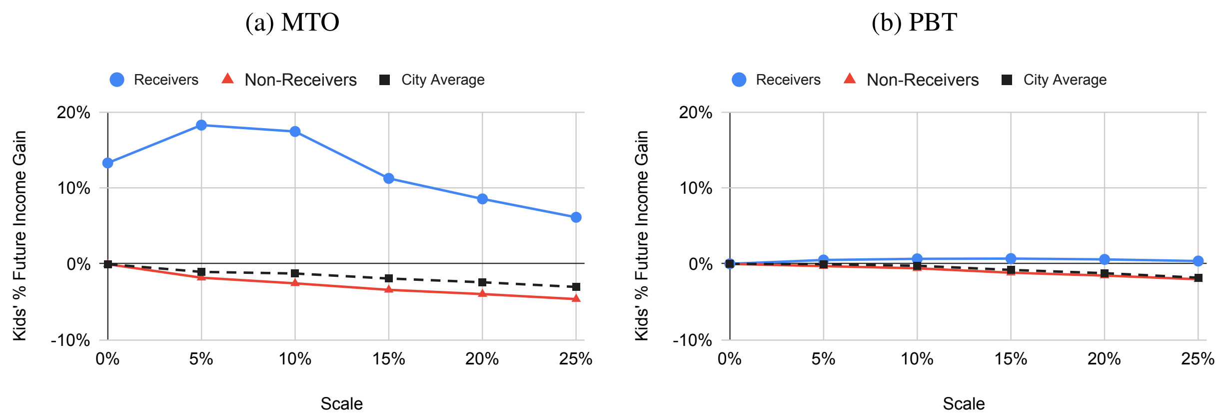
MTO policy.

The figure shows that when we restrict the eligibility criterion for the place-based transfer policy by imposing the same income percentile cutoff of the MTO policy, the size of the income gain for the kids of the families who are beneficiaries of the policy is in the same ballpark than with the MTO policy. This is because the mass of families who receive the transfer is more comparable to the mass of voucher receivers under the MTO policy.[31] However, behind this similarity in levels, the general equilibrium effects of the restricted place-based policy is similar to the baseline place-based policy we just described, and so quite different from the MTO policy.

To sum up, the MTO policy is more effective than a place based transfer policy in increasing the expected income of the children in the receiving families. We are now interested to see what happens to the expected income of all the other children in the metro area and what is the impact in terms of welfare for the different families.

[31] While the income percentile criterion is the same, the MTO policy targets families born in neighborhood C, while the place-based policy targets families who decide to live in C, but are not necessarily born there.

Figure 10: Children's expected income under MTO and PBT



5.3 City-Wide Policy Effects: Expected Income

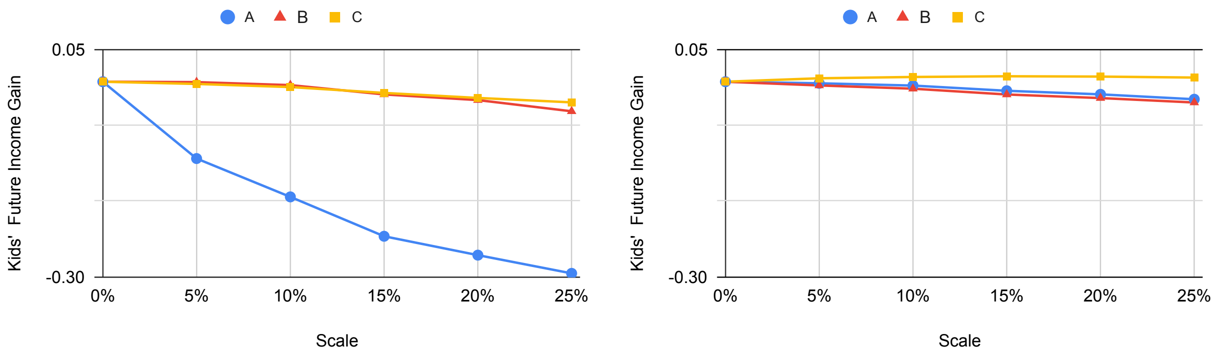
In this subsection, we are going to use the model to explore the effects of the policy not only on the voucher recipient families, but also on all the other families in the city.

The two panels in Figure 10 show the expected income of all children in the city respectively for the MTO and the PBT policies. The blue lines show the average expected income of the children of recipient families (corresponding to the solid lines respectively in figures 2 and 6), and the red lines show the average for the children of non-recipient families. The figure shows that children of recipient families experience gains in expected income, but at the expenses of a reduction in expected income for the children of non-recipient families. Overall, the average expected income for children in the city is lower under both policies relative to the benchmark, and the gap gets larger with the scale. Moreover, comparing the left and the right panels, we find that not only the gains for recipients families are much larger with the MTO policy, but also the losses for non-recipient families are larger. With both policies, children of non-recipient families have lower expected income because the higher taxes levied to finance the policy reduce parental investment in education. Moreover, the expected income of these children is also affected by the endogenous general equilibrium effect.

To investigate the role of general equilibrium effects, the two panels in Figure 11 plot the expected income of children in the city by neighborhood of birth for the two policies. The left panel shows that, under MTO, the children who experience the larger losses are the ones who are born in neighborhood A because, as we have seen in Section 5.1, not only the spillover in A declines substantially, directly reducing future wages,

Figure 11: Children's expected income under MTO and PBT by neighborhood

(a) MTO (b) PBT



but also the rental rate increases reducing the resources available for parental investment in education. Moreover, also children born in neighborhoods B and C on average experience lower future expected income because the increase in taxes and the increase in rental rates in neighborhood B overcome the positive effect of the increase in the spillover in both neighborhoods. Overall, with the MTO policy, the only children who experience positive future income effects are the ones of the families receiving the housing voucher. The right panel shows the distributional effects under the PBT policy. All the families in C are recipient of the policy and, hence, their kids experience an increase in expected future income.[32] On the contrary, children born in neighborhoods A and B experience a loss in expected future income because of the higher taxes and the decline in spillover of neighborhood B. However, the decline is smaller than with the MTO policy because it is dampened by the reduction of rental rates in both neighborhoods (both increase under MTO) and the increase in spillover in A (which declines under MTO), as explained in Section 5.2.

5.4 City-Wide Policy Effects: Welfare

Let us now turn to the welfare implications of the different policies. In particular, we are going to use utilitarian welfare and give the same weight to the utility of all the parents at each point in time. Recall, that the utility of each parent comes from two components: her own consumption and the expected future income of her child.

[32]The yellow line is similar to the blue line in the right panel of figure 11, but not exactly the same because the blue line include families who move to C, while the yellow line only families with children born in C.

Figure 12: Welfare

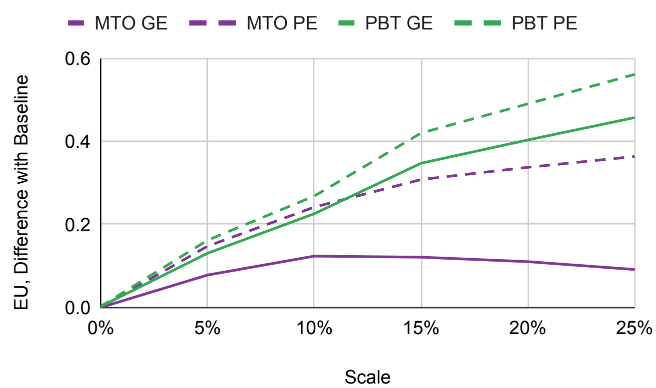


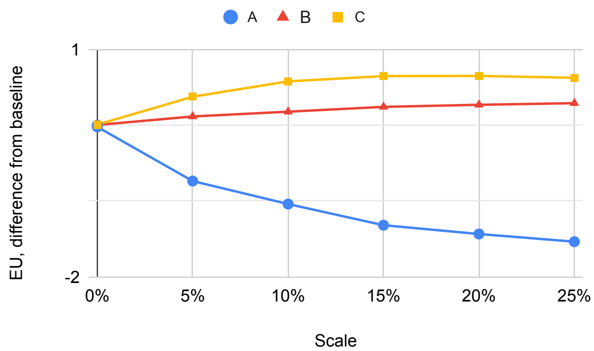
Figure 12 compares welfare under the MTO policy (solid purple line) and under the baseline PBT policy (solid green line). The figure shows that under the MTO, welfare is hump-shaped, while under the PBT policy welfare is steadily increasing. Moreover, the PBT policy always generates higher welfare than the MTO with a gap that increases with the policy's scale.

To understand these patterns, let us start describing the partial equilibrium effects. Under the MTO policy, in partial equilibrium, welfare is monotonically increasing because of the recipient families, who have more resources to invest in education and consume because they can now use the voucher to pay a large part of their rental rate. Similarly, partial equilibrium welfare is increasing under the PBT policy, because the recipient families can invest more in education and consume more because of the transfer. Notice, that the welfare gap in partial equilibrium is increasing with the scale, given that under the PBT policy the transfer increases with the scale, while under the MTO policy more people receive the transfer but, as they are progressively richer, their marginal gain is lower.

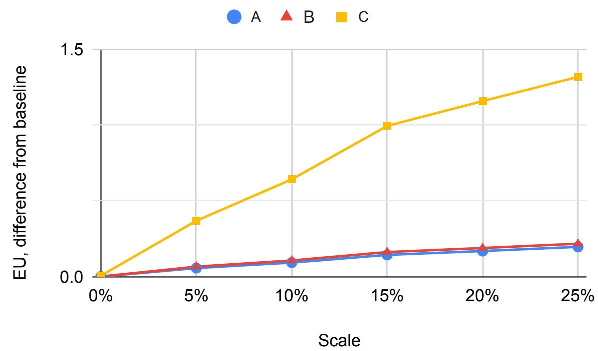
When we move to general equilibrium, both spillovers and rental rates adjust endogenously. In general equilibrium welfare is smaller than in partial equilibrium with both policies and the gap increases even more with the scale. This is because, as we have seen in the previous subsection, with both policies the average future expected income of children in the city declines, but it declines substantially more under the MTO policy relative to the PBT policy. On top of that, the taxes paid by the households to finance the policy are larger the larger is the scale.

Figure 13: Welfare by Neighborhood

(a) MTO



(b) PBT



To better understand the different welfare implications of the two policies, the two panels in Figure 13 also show average welfare by neighborhood of birth respectively for the MTO and the PBT policy.

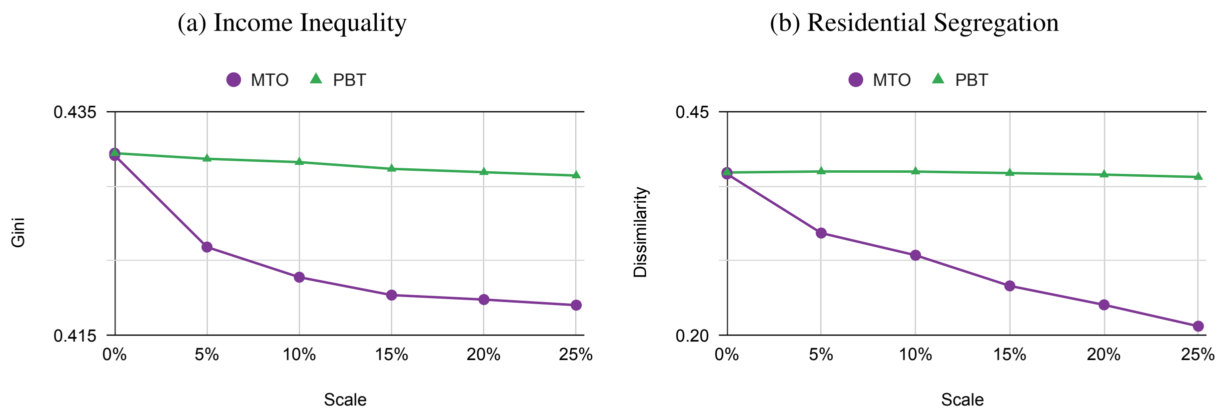
Comparing the left and right panels, it appears that under the MTO policy, there are families in the city who experience large welfare gains, such as the families living in neighborhood C who are targeted for the voucher program, but also families who experience large losses, such as the families who were living in A and now experience a substantial decline in the spillover and increase in rental rates. On the contrary, under the PBT policy, all families experience welfare gains, although they are much larger for the families who live in neighborhood C and receive the transfer.

5.5 City-Wide Policy Effects: Inequality and Segregation

In this section, we compare the implications of the two policies for income inequality and residential segregation by income.

Panel (a) Figure 14 compares the level of income inequality, measured by the Gini coefficient, for the experimental MTO policy (purple line) and the PBT policy (green line). The figure plots the Gini coefficient in the period in which the policy is implemented as a function of the scale of the policy. When the scale of the policy is 0.001, as in the effective MTO experiment, the aggregate effects of the policy are null and inequality is at the same level as if there was no policy. However, as the scale increases all three types of policy are successful in reducing inequality and the more so, the larger is the scale. The figure shows that the PBT policy is the least effective in reducing inequality. This is not surprising, given that we have already seen that the kids' income gain is very small under that type of policy, as we discussed in the

Figure 14: Income inequality and residential segregation



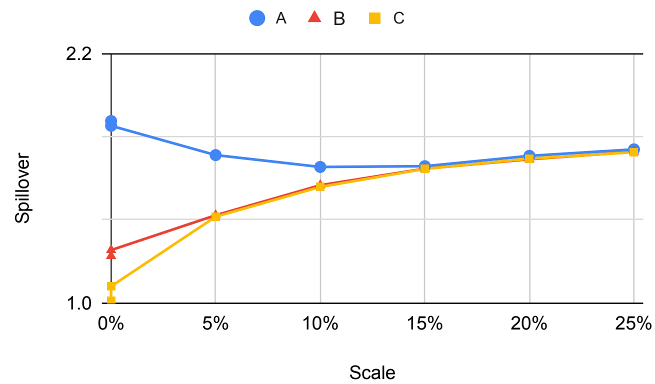
previous subsection.

To confirm this intuition, panel (b) of Figure 14 compares for the same policies the level of residential segregation by income in the period in which the policy is implemented, measured by the dissimilarity index, where we define the rich as the parents in the 80th percentile of the distribution. Similarly to inequality, when the scale of the policy is 0.001, residential segregation is at the same level as if there was no policy. However, as the scale increases, the MTO policy is successful in reducing residential segregation. This is because the MTO policy impose voucher receivers to move to the best neighborhood and this has two effects: it implies that their kids are exposed to the highest spillover, but also implies that neighborhood A becomes more mixed. On the contrary, the PBT policy is not successful in this dimension and, if anything, it causes a slight increase in residential segregation. There are two opposing forces behind this result. On the one hand, the PBT policy reduces segregation because neighborhood C attracts richer families from other neighborhoods and becomes more mixed, but, on the other hand, neighborhood A becomes more selective and segregated. This second effects seems to dominate.

6 Place-Based Investment Policy

We now consider the effects of the PBI policy, where the same finances are used to directly invest into improving the spillover of the neighborhood, i.e. investment in public school, crime reduction, information diffusion.

Figure 15: Neighborhood Spillovers under the PBI Policy



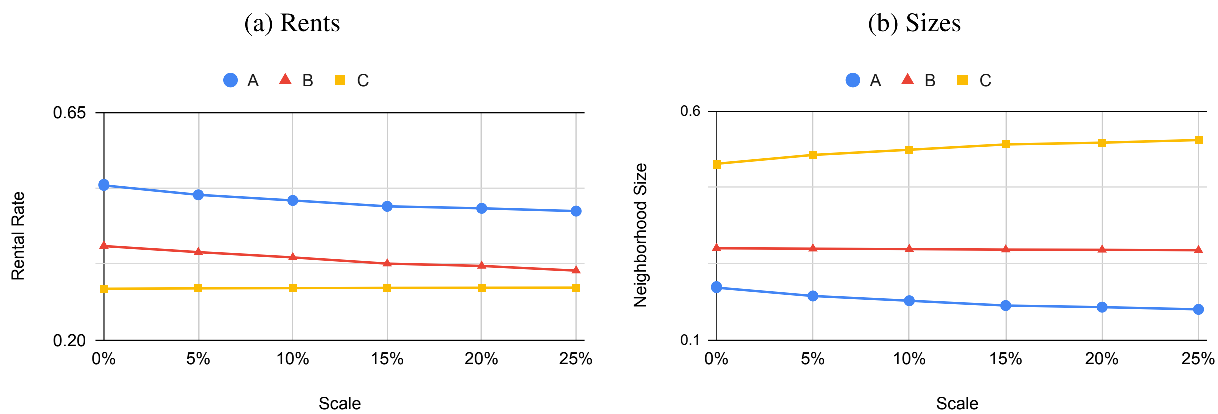
In particular, for each scale of the MTO policy, we compare a place-based investment policy that uses the same total finances by taxing families in the whole city proportionally to their income. The funds are used in part to pay for some basic level of education for families living in C and with income in the lowest $10th$ percentile.[33] The remaining resources are used to increase the spillover in the high poverty neighborhood S_C until it reaches S_B; any remaining resources are then used to increase both spillovers until they reach S_A. After that, resources are distributed across the three spillovers so to keep the effective spillovers $S*$ in the three neighborhoods equalized. This implies a larger share of the resources going to neighborhoods C and B to compensate for the lower amenities in those neighborhoods which dampen the endogenous spillovers. Figure 15 shows the resulting spillover level for the three neighborhoods for various policy scales.

Similarly to the PBT policy, this policy is also making neighborhood C more attractive. Families move from A and B into C in response to the higher spillover. This pattern is visible in Figure 16, which shows that the rental rate (panel (a)) and the size of neighborhood C (panel (b)) increase in response to the policy. As families move out of B and A the rental rate in these neighborhoods declines and their sizes shrink.

Since under this policy funds are directly invested in public goods that increase kids' returns to education, like schooling, crime reduction, and so forth, welfare gains are realized only through gains in children's future income and are conditional on investing in education. Figure 17 (panel (a)) compares the expected future income of children of recipient-families under the the three policies. The figure shows that, for small scales, the MTO policy is more effective because the gap between spillovers in the poorest and richest neighborhood is large but, as the scale increases, the general equilibrium effect progressively reduces the

[33] In this exercise we set the basic level of education to 0.12, which is a bit below the average of the other families in the city.

Figure 16: Neighborhood Rental Rates and Sizes under the PBI Policy



size of the spillover in the richest neighborhood, to the point that the gain becomes larger under the PBI policy. As we have shown, the gains in expected income for children under MTO are large but concentrated to a small fraction of the population. On the other hand, gains under PBT are small but obtained by all the families living in C. The PBI policy realizes sizable income gains for the children of receiver families that are also enjoyed by all families in C. However, this policy is less effective in increasing overall welfare on impact as shown in Figure 17 (panel (b)).

Families living in C can only take advantage from a higher spillover by increasing their investment in their children's education and reducing current consumption. Conversely, under PBT, parents living in C could use the transfer to increase their own consumption. Similarly, under MTO, the recipient families have more resources for consumption as they receive a housing voucher. This differential impact on current and future generations has interesting dynamic implications.

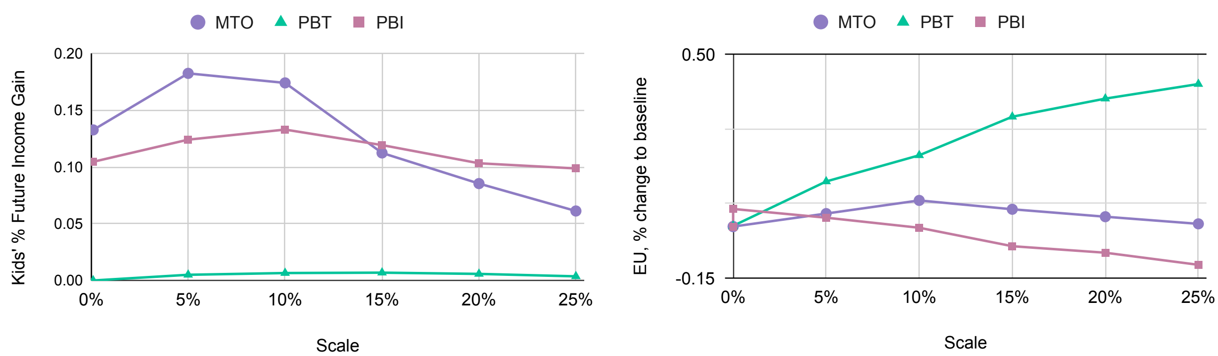
7 Dynamic Implications

Panel (a) in Figure 18 compares the city-wide welfare gains over time under the different policies for the 5% MTO scale. For this scale the spillovers in B and C are equalized under PBI.

The figure shows that the PBT policy generates significantly higher welfare gain on impact (period 1) compared to the other two policies. However, already in period 2, the PBI policy generates the largest

Figure 17: Income Gain and Welfare across policies

(a) Income Gain (b) Welfare



gains. This is due to the fact that the new generation of parents have more resources for consumption and investment as they received more education and were exposed to a higher spillover when growing up under the policy. Moreover, the overall welfare under this policy keeps increasing over time as more talented kids from other neighborhoods move to C and parents in C increase the educational investment of their children to take advantage of the higher spillover, generating further increases over time in the endogenous component of the spillover. It follows that welfare increases generation after generation.

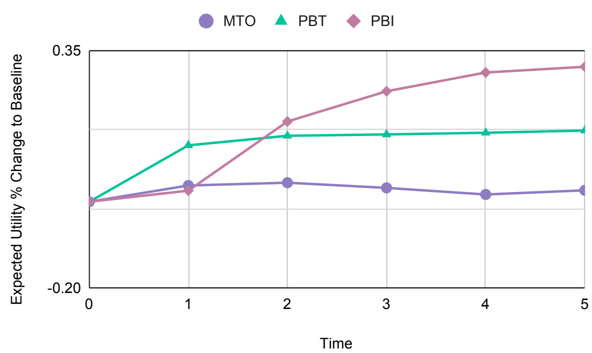
On the other hand, PBT only realizes static welfare gains as most of the transfer is used for consumption of the parents' generation and does not translate into more resources for future generations. The spillover in C initially increases as families from other neighborhoods, on average richer than those in C, move to the neighborhood to enjoy the transfer. However, since the transfer is mostly used to increase current generation's consumption, the policy does not translate in sustained dynamic gains.

Panel (b) in Figure 18 shows the dynamic implications for residential segregation of the different policies. Under the PBT policy, segregation increases over time as the poorest families from the richer neighborhoods move to C to receive the transfer. This makes the selection of people in A even richer and increases segregation. Under the PBI policy, the spillovers in B and C are equalized, reducing the incentive to segregate by income between them and generating a level of segregation that is close to the one obtained under the MTO policy.

Figure 19 shows the dynamics of inequality and intergenerational mobility under the three policies. Under the PBT policy, inequality and inter-generational mobility are very close to the benchmark similarly to

Figure 18: Welfare and Segregation Dynamics

(a) Welfare



(b) Segregation

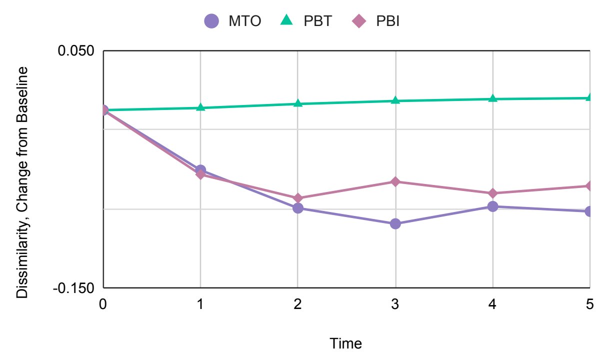
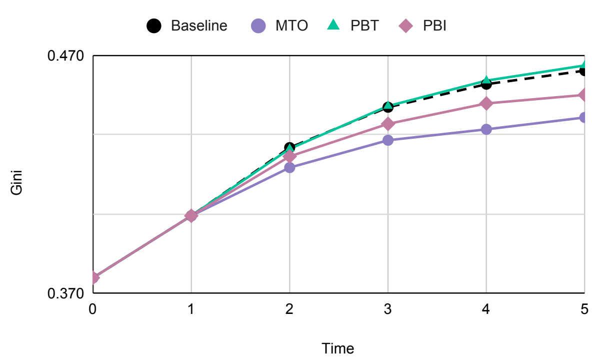
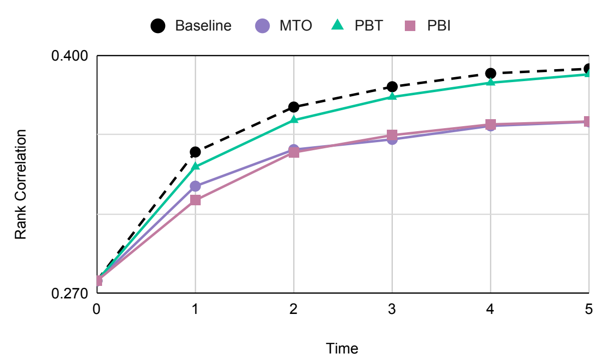


Figure 19: Inequality and Intergenerational Mobility Dynamics

(a) Inequality



(b) Intergenerational Mobility



the dynamics of segregation. This is due to the dynamic relationship between segregation and future inequality. On the other hand, MTO and PBI are more effective in reducing segregation and this translates in lower inequality and higher inter-generational mobility relative to the benchmark.

8 Concluding Remarks

US cities have become progressively more segregated by income over time generating large differences in opportunities for children growing up in different neighborhoods. Recent literature has shown that MTO policies can be effective in improving the long term income of children as they move from high to low poverty neighborhoods. However, this experiment involved a small number of families.

In this paper we develop a general equilibrium model with residential choice and endogenous local spillovers, to explore the effects of scaling up the MTO. We show that, as the scale of the policy increases, general equilibrium effects reduce the gain from the policy. Moreover, the MTO generates welfare gains for the recipient families, but also significant welfare losses for all the other families as the spillover changes endogenously and poor people move to low poverty neighborhoods.

We compare this policy to a PBT policy that, using the same finances, provides transfers to families living in the poor neighborhood. We find that this policy generates larger welfare gains overall as, on average, families in all neighborhoods gain from the policy: either directly through the transfer or indirectly through the general equilibrium effects. However these policies have very different implications for segregation and inequality: while the MTO policy reduces income segregation by moving poor families to low poverty neighborhoods, the PBT policy induces more segregation as poor families from richer neighborhoods move to poor neighborhood to take advantage of the transfer.

We next explore a PBI policy, that directly invests in local public goods to reduce the gap in spillovers across neighborhoods. This type of policy is less effective in increasing welfare in the short run, as it does not increase current resources available (as transfers and housing vouchers do). However, it generates a strong incentive to invest in the education of children, increasing resources available to the next generation and improving the spillover over time. As the spillover accumulates, welfare gains also accumulate, and the policy becomes more successful over time both in terms of increasing welfare and in terms of reducing segregation and improving the opportunities for the poor to experience the American dream.

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