Place-Based Redistribution*

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Abstract

Place-based redistribution is ubiquitous but has traditionally enjoyed little support among economists. We study the equity-efficiency tradeoffs that arise when taxes may be indexed to location in addition to labor income. Using a series of stylized spatial equilibrium models, we show that when locational sorting on the basis of income is sufficiently strong – either due to skill-taste correlation or income effects in locational choice – transfers from one region to another can be welfare improving, even in an environment with optimal place-blind income taxes. Efficiency costs dominate equity gains, however, when workers are very mobile and subsidized areas are substantially less productive. A calibration exercise illustrates the relative strength of these forces and concludes that sizable place-based transfers may be optimal.

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1 Introduction

Place-based policies tie economic benefits to geographic locations and are prevalent throughout the world (Bartik, 1991; Glaeser and Gottlieb, 2008; Kline and Moretti, 2014b; Duranton and Venables, 2018). Prominent examples include the U.S. Opportunity Zones, which provide preferential capital gains tax treatment to the poorest 10% of U.S. local areas, and European Union Structural Funds, which provide transfers to poor regions of EU member countries. The espoused rationale for such programs is typically redistributive: because poor people are concentrated in certain places, targeting these areas helps disadvantaged households. However, governments already redistribute to poor places through national income taxes as well as person-based transfer systems, such as Social Security Disability Insurance. Should poor residents of poor places receive an extra transfer, based on their location?

Glaeser (2008) articulates the traditional answer of economists that have studied these programs:

> "Help poor people, not poor places"...is something of a mantra for many urban and regional economists... [place-based] aid is inefficient because it increases economic activity in less productive places and decreases economic activity in more productive places.

In line with this view, academic research on place-based policies has focused almost exclusively on their efficiency costs (e.g., Busso et al., 2013; Suárez Serrato and Zidar, 2016; Fajgelbaum et al., 2018; Gaubert, 2018); with a few studies also considering the potential efficiency benefits these programs might generate, such as the potential to correct market failures by internalizing productivity spillovers (Kline and Moretti, 2014a; Fajgelbaum and Gaubert, 2018). To date, however, little effort has been devoted to systematically weighing the *equity gains* that such policies deliver against their net efficiency costs.

In this paper, we rigorously evaluate conditions under which place-based redistribution (henceforth, PBR) schemes are able to achieve equity goals at lower efficiency cost than corresponding "place-blind" transfers implemented through income taxation. In order to illustrate the potential equity gains of indexing redistribution on place, we begin our analysis by reviewing stylized facts on US income disparities over space. Average incomes vary substantially across US Commuting Zones (CZs): for example, mean income in the New York City CZ is twice as high as mean earnings in the Appalachian CZs of West Virginia. We show that these mean differences yield clear rankings across communities in terms of First Order Stochastic Dominance (FOSD), a theoretically important criterion for ranking income distributions (Atkinson, 1970). For instance the top 90% of CZs ranked in terms of mean earnings stochastically dominate the bottom 10% in terms of both nominal and cost of living adjusted incomes. The distribution of educational attainment in top 90% CZs also stochastically dominates that of the bottom 10% of CZs. These facts strongly suggest the marginal utility of consumption – the traditional metric of equity considerations (Edgeworth, 1897; Mirrlees, 1971) – tends to be higher in areas that are easily identified using standard tax statistics.

To reason through the welfare implications of targeting transfers to poor places, we develop a simplified spatial equilibrium model with two locations: Distressed and Elsewhere. Households decide where to live and how much to work. These decisions are driven by each household's skill level and tastes for the Distressed region, which may differ by skill group. Households inelastically demand shelter and the rental rate of housing is assumed lower in Distressed than Elsewhere. We start by ignoring productivity differences between the two locations, as might be reasonable, for instance, when studying redistribution between two neighborhoods that are geographically close but differ in their residential amenities and cost of living.[1]

To evaluate policies, we consider the problem of a utilitarian social planner who seeks to maximize a weighted average of household utilities (or some concave increasing transformation of those utilities). The planner may use a place-blind income tax to transfer consumption from higher to lower income households. The place-blind income tax helps increase social welfare since resources are more equalily distributed, but it comes at the cost of distorting labor supply decisions, negatively affecting incentives to work and earn income in the first place. This classical equity-efficiency trade-off is at the core of the optimal labor income tax problem. In our setup, the planner may also implement a PBR-scheme. For simplicity, we restrict our attention to lump sum schemes: allowing the planner to institute a place-based transfer to Distressed residents, financed by a small lump-sum tax on others.

Our first result is that, when higher wage households differentially prefer the amenities of Elsewhere ("skill-taste correlation") the planner chooses to use PBR even when the income tax is set optimally. The logic of this result is simple: a small place-based transfer induces some households to move to Distressed without impacting their labor earnings. These moves therefore do not change income tax revenue and induce only a second-order increase in place-based transfers. Hence, PBR improves welfare whenever a dollar is worth more to the average Distressed resident to the average Elsewhere resident. In the presence of an optimal place-blind income tax, this condition is always satisfied when the low-skilled sort into Distressed.

[1] Similarly, we assume away income effects on labor supply that would result in different labor supply of the same individual between the two locations

Under these conditions, PBR leads to a first-order equity gain with no first-order efficiency loss.

Next, we show that the same result regarding the desirability of PBR holds even without skill-taste correlation if locational choice exhibits income effects. In this case, poor households cannot afford the high rent in Elsewhere, which leads them to sort into Distressed, despite its low level of amenities. Hence, income effects generate the necessary skill-based sorting, and a small place-based transfer is again welfare improving even under the optimal income tax.

We then extend this baseline model to generate a more realistic equity-efficiency tradeoff of place-based redistribution. In line with the Glaeser (2008) quotation above, we suppose next that Distressed is less productive than Elsewhere. In this setting, a small place-based transfer generates a first-order efficiency loss, as movers to Distressed earn less and pay lower income taxes. The desirability of PBR now hinges on whether a small place-based transfer reduces tax revenue by more or less than a small, distributionally equivalent, perturbation to the optimal income tax. We derive expressions facilitating this comparison, which reveal four conditions under which a utilitarian planner will tend to utilize PBR in conjunction with income taxes:

1. When the mobility response to place-based transfers is small,
2. When productivity differs little between Distressed and Elsewhere,
3. When labor supply is especially elastic,
4. When high-earners sort disproportionately into Elsewhere and low-earners into Distressed.

In sum, our theoretical analysis reveals that PBR, like income taxation, generates efficiency costs that should be weighed against any equity gains. Because PBR and income-based taxation trigger qualitatively different behavioral responses, PBR may serve as a useful complement to income taxation.

Since PBR's desirability is ultimately a quantitative question, we conclude with a quantitative calibration. Specifically, we analyze a model with labor supply decisions, income effects in locational choice, and skill-taste correlation in preferences for the chosen location. The tax system is approximated as a three bracket system plus a lump-sum transfer (i.e., a "universal basic income"). We calibrate the model so that Distressed corresponds to the bottom 10% of US Commuting Zones in terms of income per capita, with Elsewhere constituting the remaining 90% of CZs.

Solving the model numerically, we find that social welfare rises when giving all Distressed residents a \$1 transfer, funded by the perturbation to the place-blind income tax that maximizes social welfare. The optimal place-based transfer is found to be approximately \$1,500 per resident. The key motive for a transfer of this magnitude is targeting: the households with the highest marginal utility of consumption sort into Distressed, and the optimal PBR scheme allows the planner to target transfers to those households better than the place-blind transfer alone.

The primary message of our paper is that place-based policies can deliver unique targeting benefits that may, in some circumstances, outweigh their efficiency costs. Our analysis has parallels to classic problems in the field of public economics when residential location is viewed as a commodity. A long line of work has identifed conditions under which a differentiated commodity subsidy, such as a subsidy for food, is welfare improving (Corlett and Hague 1953, Diamond 1975, Atkinson and Stiglitz 1976, Mirrlees 1976, Christiansen 1984, Kaplow 2006, Allcott et al. 2019). The key result is that, under an optimal income tax, a commodity subsidy is superfluous if low earners disproportionately consume the good simply because they have low earnings (Saez, 2002).[2] A technical contribution of our analysis is to derive expressions for subsidy desirability when the commodity is binary (residential choice) rather than continuous, and when commodity choice impacts household productivity, making labor and consumption choice inherently non-separable.

This paper is organized as follows. Section 2 presents stylized facts. Section 3 details our baseline model. Section 4 generalizes our analysis. Section 5 solves a calibrated model numerically to obtain an optimal PBR scheme. Section 6 concludes.

2 Geographic disparities in income

The most basic motivation for place-based redistribution is that poor people tend to reside together geographically. The traditional theory of income taxation is based on the idea that dollars should be redistributed to households with high marginal utility of consumption (Edgeworth, 1897; Mirrlees, 1971). Likewise, in the theoretical model we develop below, geographic disparities in the marginal utility of consumption create a motive for place based redistribution. It is therefore useful to review briefly the extent to which observable proxies of the marginal utility of consumption vary across space.

The most basic (inverse) measure of the value of an additional dollar, is the number of dollars that a household currently earns. Figure 1a plots mean adjusted gross income by Commuting Zone in 2016. Adjusted gross income is typically quite close total earnings and is a standard measure of household earnings.

[2] Earlier results calling more generally for differentiated commodity taxes and subsidies did not allow for an optimal income tax (Ramsey 1927, Diamond 1975).

We construct the figure using county-level means released publicly by the Internal Revenue Service. The unit of analysis is the tax filing unit, which is typically a single individual or a married couple. There are 741 Commuting Zones (CZs) in the United States. CZs are collections of counties that share strong communities ties and thus approximate local labor markets.

The figure shows large mean earnings differences across space. The dark areas denote CZs with high mean earnings while the light areas denote CZs with low meanings earnings. The largest coastal cities – New York City, Boston, Philadelphia, Washington, DC, San Francisco, and Los Angeles – as well as the large inland cities of Chicago and Houston enjoy relatively high mean earnings. In contrast, much of the Mid-Atlantic, South, and Great Plains have low mean earnings. For example, mean earnings in the New York City CZ is 2.0 times as high mean earnings in the Appalachian CZs of eastern West Virginia. To control for cost of living differences, we then dividing mean income by a measure of the local price index. Specifically, we use the more aggressive of the two local price indices considered by Moretti (2013) (Local CPI 2). Even when dividing mean income by Local CPI 2, the New York City to Appalachia ratio shrinks to only 1.5.

In principle, these mean differences could be driven by tail behavior that provides a poor approximation to the well-being of a typical resident. A standard criterion for ranking income distributions is first order stochastic dominance (FOSD). If the income distribution in economy A stochastically dominates that of economy B, it is possible for every resident of economy A to give a dollar to a resident of economy B who earns no more than them. Figure 2a plots earnings among the residents of two groups of CZs. Specifically, we use the 2012-2016 5-year American Community Survey (ACS) to compute each household's earnings before taxes and transfers. CZs are then grouped according to whether the mean household earnings of their residents fall below the population-weighted tenth percentile ("the bottom 10%") or above the tenth percentile ("the top 90%"). We then plot the cumulative distribution function of household earnings in the two groups.

The figure shows that the earnings distribution of households residing in the top 90% of CZs first-order stochastically dominates the distribution of those residing in the bottom 10% of CZs. While some low earning households reside in the top 90% of CZs, there is a much larger share of low earning households in the bottom 10% of CZs. Higher income places tend to also be more expensive places, so that differences between places in terms of real income tend to be smaller than those in nominal terms. Nevertheless, Figure 2b shows that when deflating income by Local CPI 2, the top 90% of CZs still FOSD the bottom 10%. Finally, Figure 2c shows that the top 90% of CZs also stochastically dominate the bottom 10% of CZ in years of schooling, a proxy for skill.[3] This evidence strongly suggests communities can be ranked in terms of well-being and presumably also in terms of the marginal value of an additional dollar.

Of course, place-blind income taxation already redistributes from low income to high income places. For example, Figure 1b plots average federal income tax rates in the public IRS data. Residents of places like New York City pay much higher average federal income tax rates than residents of places like Appalachia. Hence, Appalachians already receive relative subsidies on average through the place-blind income tax and transfer system. The primary question of our paper is whether there is a rational for residents of low income places to receive an extra transfer simply for residing in those places.

3 A first look at place-based redistribution

We begin our theoretical analysis by considering a series of stylized models that allow us to develop some intuition for the special advantages, and disadvantages, of place-based transfers. Through these examples, we show that place-based redistribution towards a location populated with lower-earning households generates equity gains, regardless of the determinants of spatial sorting. When households have the same earnings irrespective of where they locate, place-based redistribution turns out to raise welfare even if place-blind income taxes are set optimally. We then qualify this result: if different location choices yield different earning choices for the same household, PBR generates an efficiency cost provided households are mobile. This trade-off is examined in detail in the general formulation of the model.

3.1 Example with skill-taste correlation

At the heart of our study is the relevance of using place as a tag in the presence of a "place-blind" income tax. Our model therefore features the basic ingredients necessary to highlight the equity-efficiency tradeoffs involved with taxation.

Households differ in their skill θ and face a disutility of working that decreases with skill. Specifically, workers with skill θ generate pre-tax earnings z at a disutility cost $\left(\frac{z}{\theta}\right)^{\nu}$. Income-based taxation will therefore distort labor supply decisions. We amend this textbook public finance setup a minima to feature a location

[3] Years of schooling is computed in the educational attainment variable in the ACS. Years of schooling equals the highest grade of schooling completed, where college years are treated as beginning at grade 13. We adopt IPUMS coding which classifies no one as having completed 15 years of schooling and which top-codes years of schooling at 17 (i.e., all individuals that completed five years or more of college or other post-secondary schooling are coded as attaining 17 years of schooling).

choice. Households choose to live in one of two locations: 0 ("Elsewhere") or 1 ("Distressed"), which differ in their residential amenities and cost of living. Each household must pay a rental fee p_j to live in community j and enjoy its residential amenities. As a normalization, we assume that community 0 has higher housing cost $(p_0 > p_1)$. To capture skill-taste correlation, we assume that a household's preference for the amenities of location j, denoted $a_j(\theta)$, varies with skill, and that the higher skilled value the amenities of city 0 more. This assumption echoes Diamond (2016), who finds that high-skilled individuals are more attracted to the high amenities offered in large cities than lower skilled workers.

Households choose their earnings level z and location j to maximize utility:

$$u(c, z, j; \theta) = c - \left(\frac{z}{\theta}\right)^{\nu} + a_j(\theta), \tag{1}$$

where c is consumption of a homogeneous traded good, and j is community 0 or 1. We normalize preferences for amenities assuming $a_1(\theta) = 0$ and $a_0(\theta) > 0$ with $a_0'(\theta) > 0$. The budget constraint faced by households in location j is:

$$c = z - T(z) - p_j,$$

where earnings z are assumed to be taxed following a place-blind income tax schedule $T(.)$.

It is straightforward to verify that the labor supply and earnings choices of each household θ are identical in the two locations. We denote by z^{θ} the optimal earnings choice of a household with skill θ. We further assume the following regularity condition on $T(.)$:

Assumption 1. *The income tax schedule $T(.)$ does not lead to earnings reversal.*

Under Assumption 1, z^{θ} increases with θ, and so does income net of disutility of working, which we denote:

$$E^{\theta} \equiv z^{\theta} - T\left(z^{\theta}\right) - \left(\frac{z^{\theta}}{\theta}\right)^{\nu}. \tag{2}$$

The location choice of a household with skill θ, denoted j^{θ}, hinges solely on the valuation of amenities in the two locations v.s. the corresponding cost of living:

$$j^{\theta} = 0 \Leftrightarrow a_0(\theta) > p_0 - p_1. \tag{3}$$

A household chooses location 0 if the amenity benefit of living there is higher than the corresponding cost-of-living burden. Provided the problem is non-degenerate (i.e., $\min a_0(.) < p_0 - p_1 < \max a_0(.)$), it follows directly from our assumption on preferences that:

Lemma 1. *There exists a skill threshold $\underline{\theta}$, an earnings threshold $\underline{z}$, and a net earnings threshold $\underline{E}$ such that households above these thresholds choose location* 0*:*

$$\theta > \underline{\theta} \Leftrightarrow z^{\theta} > \underline{z} \Leftrightarrow E^{\theta} > \underline{E} \Leftrightarrow j^{\theta} = 0.$$

We denote with S the share of households who live in community 1. We are now ready to compute the welfare effect of introducing a small, budget-neutral, place-based redistribution scheme. We consider the simplest possible such scheme, one in which the $1-S$ households in location 0 all face a lump-sum tax $\frac{\Delta}{1-S}$ while the S households in community 1 receive a lump sum subsidy $\frac{\Delta}{S}$. The parameter Δ indexes the size of the ex-ante budget-neutral PBR scheme. The planner evaluates allocations subject to a welfare function:

$$SWF = \mathbb{E}\left[G\left(v^{\theta}\right)\right], \text{ subject to } \mathbb{E}\left[T(z^{\theta}) + \Delta \frac{S - j^{\theta}}{S\left(1-S\right)}\right] = R.$$

where v^{θ} is the indirect utility of a household with skill θ, $G(.)$ is a concave function that captures the planner's aversion to inequality, and R is an exogeneous revenue requirement faced by the government.[4] Expectations are taken over the distribution of skills θ. Transfering a dollar to a household of type θ leads to a welfare gain of $G'\left(v^{\theta}\right)$ at a cost of ϕ, where ϕ is the Lagrange multiplier on the governement budget constraint. We define:

$$\lambda^{\theta} \equiv \frac{G'\left(v^{\theta}\right)}{\phi} \tag{4}$$

as the social marginal welfare weight assigned to a household with skill θ by the planner at the initial equilibrium we are considering. It measures the dollar value (in terms of public funds) of increasing consumption of this household by \$1. With this social welfare function, the place-based redistribution scheme leads to the following change in welfare:

$$\frac{dSWF}{d\Delta} = \int_{\theta} \lambda^{\theta} \left(\frac{j^{\theta}}{S} - \frac{1-j^{\theta}}{1-S}\right) dF(\theta) = \bar{\lambda}_1 - \bar{\lambda}_0, \tag{5}$$

where $\bar{\lambda}_j \equiv \mathbb{E}\left[\lambda | j^h = j\right]$ is the average social marginal welfare weight of households located in community j. Evidently, the sole effect of the reform is to transfer utility from households in location 0 to households in

[4]The amount $\mathbb{E}\left[T(z^{\theta})\right]$ is the net fiscal revenue of the place-blind income tax, while $\mathbb{E}\left[\Delta \frac{S-j^{\theta}}{S(1-S)}\right]$ is the net fiscal revenue generated by the PBR scheme.

location 1. We quickly review why no other distortions or fiscal externalities arise. The earnings distribution is left unaffected by the reform because of the lump-sum nature of the transfer and the fact that (1) exhibits no income effects in labor supply. Likewise, households who move do not adjust their earnings either, as wages are invariant to place. Furthermore, starting from an equilibrium with no PBR, migration does not yield a first order impact on government revenues through place-based transfers - these effects are second order. Finally, the utility of households who move is not directly affected, as they were initially indifferent between the two locations. Therefore, this simple place-based redistribution scheme achieves equity gains - so long as households in location 1 have higher social weights, on average, than those in location 0 - without any corresponding efficiency cost.

It remains to verify formally that $\bar{\lambda}_1 > \bar{\lambda}_0$. Recall that

$$\lambda_j^\theta = G'(E^\theta + a_j(\theta) - p_j),$$

where E^θ, a measure of net earnings, increases with θ. By lemma 1, net earnings E^θ are strictly lower in location 1 than in location 0. Moreover, for all households in location 0, the choice equation (3) implies that $a_0(\theta) - p_0 > -p_1$. Therefore, the distribution of $E_0^\theta + a_0(\theta) - p_0$ in location 0 first order stochastically dominates the distribution of $E_1^\theta - p_1$ in location 1. Because $G'(.) < 0$, the distribution of λ_1^θ must stochastically dominate the distribution of λ_0^θ (Atkinson, 1970), which yields the following result:

Lemma 2. $\bar{\lambda}_1 > \bar{\lambda}_0$. *Implementing a small transfer from location 0 to location 1 is welfare improving.*

The conclusion that a simple lump-sum place-based transfer scheme is unambiguously welfare improving relies on two features of this simple setup. First, location choice is correlated with earnings ability, which provides the planner with an equity motive for spatial targeting. Second, the equity gain stemming from transferring from the rich to the poor location comes at no efficiency cost.

We now show that if the planner had sought to achieve the same equity gain with only the income tax at her disposal, this equity gain would come with some efficiency cost. Hence, PBR is an efficient complement to the income tax. To establish this result, we assume that the planner has implemented the optimal place-blind income tax schedule $T^*(z)$ in this economy. We then compute the welfare effect of implementing a small reform of the place-blind income tax that delivers the same equity gain as the PBR scheme above.

Specifically, consider the income tax perturbation $T^*(z) + d\tilde{T}(z)$ where:

$$d\tilde{T}(z) = \begin{cases} -\frac{d\Delta}{S} & \text{if } z \leq \underline{z} \\ \frac{d\Delta}{1-S} & \text{if } z > \underline{z} \end{cases}$$

This reform targets exactly the same households as PBR, and, absent behavioral responses of households, imposes the same tax and subsidies as the PBR scheme. Therefore, by construction, this reform is ex ante budget neutral and delivers an equity gain of $\bar{\lambda}_1 - \bar{\lambda}_0$, just as PBR does. In contrast to PBR, however, this reform generates a behavioral response. Specifically, households with initial income in the range $[\underline{z}, \underline{z} + dz_{\tilde{T}}]$ will bunch at earnings level $\underline{z}$ to avoid this tax.[5] By reducing their earnings, they generate a fiscal loss for the government that we denote $\frac{dB_T}{d\Delta} < 0$. Given that we are considering a reform of the optimal tax system, this reform cannot (assuming the planner's objective is differentiable at the optimum) yield a first order effect on welfare:

$$\bar{\lambda}_1 - \bar{\lambda}_0 + \frac{dB_T}{d\Delta} = 0.$$

This reasoning makes clear that the welfare gains from a PBR $\bar{\lambda}_1 - \bar{\lambda}_0$ are positive, even starting at the optimal income tax, because PBR delivers equity gains without an efficiency loss, strictly dominating an income tax reform.

3.2 Sorting shaped by income effects

The derivations above illustrate that PBR can deliver equity gains if households sort across locations such that $\bar{\lambda}_1 > \bar{\lambda}_0$. In the previous example, this sorting was driven by a correlation between preferences for location and skill. We show here that similar results ensue if the sorting is shaped, instead, by non-homothetic preferences - i.e., only richer households can afford to live in the high quality / high price location. We defer the discussion of a last possible source of sorting – comparative advantage of the higher-skilled in jobs offered in community 0 – to the next section, when we consider productivity differences between locations.

Consider households who make their location and earnings decisions by maximizing the following utility function:

$$u(c, z, j; \theta) = g\left(c - \left(\frac{z}{\theta}\right)^{\nu}\right) + a_j, \tag{6}$$

where $g(.)$ is an increasing and concave function. Utility still depends on consumption c, disutility of labor $\left(\frac{z}{\theta}\right)^{\nu}$, and local residential amenities a_j, but we have assumed that all households agree on their valuations of

[5] The parameter $dz_{\tilde{T}}$ that controls the number of households who bunch increases with $d\Delta$.

community j: a_j is not indexed by θ anymore. We assume $a_0 > a_1$ and maintain the assumption that $p_0 > p_1$: in short, location 0 is a high amenity-high cost of living community. We show next that heterogeneous cost-of-living across places, rather than heterogeneous valuation of amenities, now drive sorting. The indirect utility function of skill θ in j is:

$$v_j(\theta) = g\left(z - T(z) - \left(\frac{z}{\theta}\right)^{\nu} - p_j\right) + a_j.$$

Taking the first order condition of the earnings maximization problem, we first note that the optimal earnings choice of a household with skill level θ does not depend on its location j, and that E^{θ} (as defined in (2)) does not depend on j either. Under Assumption 2, both z^{θ} and E^{θ} increase with θ. The discrete choice of location is then governed by the following relationship:

$$j^{\theta} = 0 \Leftrightarrow a_0 - a_1 > g(E^{\theta} - p_1) - g(E^{\theta} - p_0).$$

In words, a household chooses location 0 if the amenity benefit of living there is higher than the corresponding consumption disutility due to high cost of living. From the concavity of $g(.)$, the function $g(E^{\theta} - p_1) - g(E^{\theta} - p_0)$ is increasing in θ: only higher skilled households are willing to pay the higher cost of living in high amenity locations. Therefore, Lemma (1) still applies: above a certain skill and income thresold, all households live in location 0. What is the welfare impact of our PBR scheme? By the same reasoning as above, it is given by expression (5), and PBR is therefore desirable if and only if $\bar{\lambda}_1 > \bar{\lambda}_0$.

It is not immediately obvious when the above inequality holds. Recall that for a welfarist planner, $\lambda^{\theta} = g'(E^{\theta} - p_j)/\phi$, with $g'(\cdot)$ non-increasing. Net earnings E^{θ} in city 1 are all strictly lower than in city 0, which is a force that pushes toward $\bar{\lambda}_1 > \bar{\lambda}_0$. On the other hand, the cost of living difference $p_0 > p_1$ makes households poorer in community 0 conditional on E^{θ}, which is a force that pushes toward $\bar{\lambda}_1 < \bar{\lambda}_0$. The following Lemma shows that when the optimal place-blind income tax is in place, the first effect dominates the second, and PBR turns out to be welfare improving.

Lemma 3. *When sorting is due to income effects, the inequality $\bar{\lambda}_1 > \bar{\lambda}_0$ will hold at the optimal income tax when $\Delta = 0$. A small place-based transfer $d\Delta > 0$ is therefore welfare enhacing.*

Proof. Suppose the opposite, i.e. $\bar{\lambda}_0 \geq \bar{\lambda}_1$. Now consider an income tax reform that subsidizes high earners - specifically, households whose income is above the threshold $\underline{z}$, and hence are located in community 0 -

while taxing low earners as follows:

$$d\tilde{T}(z) = \begin{cases} -\frac{d\Delta}{1-S} & \text{if } z < \underline{z} \\ +\frac{d\Delta}{S} & \text{if } z \geq \underline{z} \end{cases}$$

This reform generates an equity gain proportional to $\bar{\lambda}_0 - \bar{\lambda}_1 \geq 0$. It also triggers a behavioral response: households with initial income in $\underline{z} - dz, \underline{z}^-$ now bunch at $\underline{z}$ to benefit from a subsidy rather than a tax, which leads to them increasing their earnings, hence a fiscal *benefit*. Consequently, the income tax reform generates a net benefit, which cannot be true given that we are at the *optimal* place-blind income tax. We conclude that $\bar{\lambda}_1 > \bar{\lambda}_0$. From (5) a small place based transfer $d\Delta > 0$ is therefore welfare improving. □

Taking stock, whether locational sorting is driven by preference heterogeneity for location, or by non-homotheticities in preferences, we find that a simple place-based transfer that redistributes to the low-income community is desirable, over and above redistribution made with the income tax. Of course, this result relies on an important assumption - that location choice does not impact earnings. Though this assumption seems reasonable when thinking of neighborhoods within a given city, it is likely to fail when studying where to locate *across* cities. We now relax this assumption.

3.3 Differential earnings across cities

To study the impact of differential earnings across cities, we return to the case with linear utility (equation 1) but now assume that the productivity of households is higher in location 0. To capture this notion, we model a location-specific productivity shifter Θ_j such that households' wages depend not only on their own skill, but also on their location:

$$w_j(\theta) = \theta\Theta_j, \tag{7}$$

with $\Theta_0 > \Theta_1$. Specifically, the indirect utility of household θ in city j is:

$$v_j(\theta) = z - T(z) - \left(\frac{z}{\theta\Theta_j}\right)^{\nu} - p_j + a_j(\theta).$$

Contrary to our previous examples, we now find from the first order condition on earnings choice that

$$z_1^\theta \leq z_0^\theta \text{ and } E_1^\theta \leq E_0^\theta,$$

where z_j^θ and E_j^θ are the earnings and net earnings of skill θ when in location j. We assume that the income tax schedule is such that both z_j^θ and E_j^θ are increasing in θ, conditional on j. Locational choice obeys:

$$j^\theta = 0 \Leftrightarrow E_0^\theta - E_1^\theta + a_0(\theta) > p_0 - p_1.$$

Note that productivity differences make it more attractive for households to choose city 0 compared to the earlier case with no productivity differences, because locating in city 0 generates a productivity boost. In this setup, the welfare effect of PBR now involves an efficiency cost: in response to the transfer, households move from community 0 to community 1 where their earnings are lower, generating a negative fiscal externality. Denoting $S(\Delta)$ the share of households located in 1 when a PBR of size Δ is in place, and $\mathcal{M}$ the set of skill types induced to move by the transfer, the efficiency cost of movers is:

$$\mathbb{E}\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) | \theta \in \mathcal{M}\right] \frac{dS}{d\Delta} < 0,$$

where we condition the efficiency loss on the set of households incentivized to move by the PBR reform.

Lemma 4. *The first order impact of a PBR is:*

$$\frac{dSWF}{d\Delta} = \bar{\lambda}_1 - \bar{\lambda}_0 - \frac{dS}{d\Delta}\mathbb{E}\left[T\left(z_0^\theta\right) - T\left(z_1^\theta\right) | \theta \in \mathcal{M}\right]$$

Whether the efficiency or the equity effect dominates is a priori ambiguous.

This lemma characterizes in a simple case the equity-efficiency trade-off faced by place-based redistribution. Targeting redistribution towards a low income area generates equity gains that have to be traded-off against losses generated by households who move to this area in response to the transfers, and thereby adjust their earnings downwards. Before establishing this result in more generality and comparing the equity-efficiency trade-off faced by a PBR-scheme to the one faced by a labor income tax, we briefly discuss the main takeaway of this analysis.

3.4 Discussion

The basic equity-efficiency tradeoff in place-based redistribution relates to the equity-efficiency tradeoff in the optimal commodity tax literature (Corlett and Hague, 1953; Diamond, 1975; Atkinson and Stiglitz, 1976). The settings are different: PBR is a non-linear tax policy in an environment where wages can be a function of locational choice, while commodity taxes are a necessarily linear policy (because of the possibility of resale) in an environment where wages are invariant to commodity choice. Yet as in the commodity tax literature, we find that skill-taste correlation can give rise to desirable taxation based on consumption (location) choice (Mirrlees, 1976). In apparent contrast to the commodity tax literature, we find that income effects in city choice can give rise to desirable taxation based on consumption choice, even without preference heterogeneity. However, the income effect in locational choice introduced in (6) is intrinsically linked to a complementarity between leisure and residence in the high amenity location – just as higher income households prefer the high price-high amenity location, households with identical incomes but more leisure will prefer the high price-high amenity location. This type of consumption-leisure complementarity gives rise to desirable commodity taxation (Christiansen, 1984; Saez, 2002). In clear contrast to the commodity tax literature, commodity taxes yield efficiency costs by distorting labor supply, whereas PBR in our basic models does not distort labor supply per se. Instead, PBR yields efficiency costs only to the extent that productivity varies by city choice.

Finally, note that in our non-homothetic preferences case, a utilitarian planner has a motive to redistribute from households living in Distressed to households living in Elsewhere with the same income. This is because Elsewhere residents pay higher rents, leading to a higher marginal utility of consumption than Distressed residents at the same level of income. By contrast, in the skill-taste correlation case, the opposite is true: the planner has a motive to redistribute from households living in Elsewhere to households living in Distressed who have the same income, as high amenity locations command higher utility conditional on income. Such redistributive motives are typically absent from utilitarian optimal policy analysis, which often assumes that the marginal utility of consumption simply declines monotonically in skill, and hence income. Keeping with this tradition, we also examine in the next section alternative specifications of social preferences that do not feature any within-income redistributive motive (e.g., Saez 2002).

4 General Results

We now consider a more general model with the aim of characterizing the fundamental equity-efficiency trade-off faced by place-based redistribution. Redistributing to places where lower incomes are over-represented enhances equity. The cost of doing so comes from migration responses to the policy: some households move to places where their output is lower. The optimal place-based redistribution scheme balances the equity advantages of redistributing across place with the efficiency costs of doing so. We then compare this trade-off with the one implied by redistribution based only on income, and establish conditions under which place-based redistribution yields an improvements in the equity-efficiency frontier.

4.1 Preferences

Household preferences We consider two locations $j = \{0, 1\}$, collectively inhabited by a continuum of households h of measure 1, indexed by $h \in [0, 1]$. Households differ in two dimensions: their skill type θ^h and their idiosyncratic tastes ε_j^h for location j. This taste heterogeneity generates a motive for some workers of each ability type to reside in each community, preventing perfect skill segregation. The utility of household h who lives in j, consumes c and has leisure ℓ is

$$u^h(c, \ell, j) = U(c, \ell, a_j) + \varepsilon_j^h,$$

where a_j summarizes the amenities of community j over which all households agree. To reside in location j, households must pay rental fee p_j for a unit of housing. In what follows, we make the assumption that $a_0 > a_1$ and $p_0 > p_1$. Although the price of housing is taken as exogenous in this partial equilibrium analysis, the higher cost of living in community 0 should be understood as reflecting a more desirable location, for which demand has pushed up housing prices relative to the other location. Beyond differing in their level of amenities and cost of housing, locations may also differ in their intrinsic productivity. A households's wage rate in a given location depends positively on its own skill θ^h as well as on a local productivity shifter Θ_j, as follows:

$$w_j^h = w\left(\theta^h, \Theta_j\right),$$

where $\frac{\partial w}{\partial \theta} > 0$. Labor income z^h is taxed through a "place-blind" non-linear income tax $T(.)$that is identical in the two communities. When locating in community j, a household therefore faces the budget constraint:

$$c + p_j = z - T(z). \tag{8}$$

Each household has a pair of potential earnings $\left(z_1^h, z_0^h\right)$ that would maximize utility if they were to live in community 1 or 0 respectively. Households choose the residence that delivers the highest level of utility:

$$\begin{aligned} z_j^h &\equiv \arg\max_z \left\{ U\left(z - T(z) - p_j, \frac{z}{w_j^h}, a_j\right)\right\}, \\ j^h &\equiv \arg\max_j \left\{ U\left(z_j^h - T\left(z_j^h\right) - p_j, \frac{z_j^h}{w_j^h}, a_j\right) + \varepsilon_j^h\right\}, \end{aligned}$$

In this model, z_1^h may be different from z_0^h, for three different reasons. First, because the wage rate of a given household varies across locations . Second, a household's marginal utility of leisure is potentially shaped by the quality of local amenities (a_j), which may differ across locations. This effect could go both ways. On the one hand, high quality amenities and entertainment options may encourage more leisure time; on the other hand, low quality of life places may be conducive to working less if they lead to poor health, for instance. A third reason why earnings may differ across places for the same household is through income effects on labor choice: the housing price differential in the two locations acts as a wealth effect, which may trigger a different labor/leisure choice. Through this effect, higher price locations induce longer working hours, all else equal.

This more general formulation of the model can be applied to study place-based transfers between locations at various levels of aggregation, for instance across cities within a country, or across neighborhoods within a city. Model assumptions can be adapted to the context. For instance, the empirical literature has established that earnings for a given worker type do vary across cities (Glaeser and Mare, 2001; Baum-Snow and Pavan, 2011; Dauth et al., 2018), which suggests employing assumptions that generate $z_1^h < z_0^h$. When thinking about place-based redistribution between neighborhoods of a given city, however, it might be reasonable to instead invoke primitives that yield $z_1^h = z_0^h$. To fix ideas, we frame the discussion below focusing on the case where $z_1^h \leq z_0^h$ for all households, but the formulas we derive apply more generally. To simplify exposition, we assume that the utility function features no income effect on labor supply, as this complication yields few insights in itself. We consider the case of income effects on labor supply in the Appendix.

Assumption 2. *There is no income effect on labor supply, i.e.* $\frac{\partial z_j^h}{\partial I} = 0$ *where* I *is unearned income.*

Planner's problem As in the previous section, a benevolent planner values allocations according to the social welfare function

$$SWF \equiv \mathbb{E}\left[\omega^h G\left(v^h\right)\right], \tag{9}$$

under the constraint of maintaining an exogeneous revenue requirement R. The notation λ^h denotes the social marginal welfare weight assigned to household h by the planner at the initial equilibrium we are considering, as defined in (4).

4.2 Welfare Gains of Place-Based Redistribution

PBR design We consider again a very simple place-based redistribution scheme: one that taxes lump-sum the inhabitants of location 0, and redistributes lump-sum to the inhabitants of location 1. As discussed in the previous section, the place-based tax faced by household h is

$$\frac{S(0) - j^h}{S(0)(1 - S(0))}\Delta. \tag{10}$$

This case is simple, yet we will see that it is rich enough to highlight the key tradeoffs that characterize place-based redistribution. In practice, such a lump-sum transfer would broadly mimic a place-based federal tax deduction because the U.S. tax-and-transfer system is relatively flat (Piketty et al., 2018). Of course, if redistribution that takes this simple form is desirable, then further efficiency gains can be achieved by fully indexing the income tax schedule to place.

Welfare impact This reform generates a net transfer of utility from inhabitants of community 0 to those of community 1, measured by:

$$\bar{\lambda}_1 - \bar{\lambda}_0. \tag{11}$$

Expression 11 is the equity gain from the transfer: PBR generates an equity gain so long as the social marginal welfare weight of inhabitants of 1 is higher than in 0. This equity gain has to be weighed against an efficiency loss, as this tax reform comes at a fiscal cost. Although the tax reform is *ex ante* budget neutral, there are potentially two types of behavioral responses to the small PBR which generate fiscal externalities. First, some households change their location, which may generate earnings responses. Second, households who do not move may adjust their labor earnings in response to the tax reform. However, given that taxes are lump-sum from the perspective of households who do not move, there is no such adjustment under our maintained Assumption 2. To compute the impact of movers on social welfare, we define the share of skill-θ households who live in community 1 under when the transfer is of size Δ as:

$$S^\theta(\Delta) \equiv \mathbb{E}\left[j^h(\Delta) | \theta^h = \theta\right].$$

At each skill level, the number of movers to community 1, $\frac{dS^\theta(0)}{d\Delta} \geq 0$, is related to the density of households initially indifferent between the two communities, and therefore depends on the distribution of their preference draws. However, conditional on moving, movers to community 1 generate a fiscal loss that only depends on their skill θ. Hence, the overall fiscal cost of movers is:

$$\mathbb{E}_\theta \left\{ \frac{dS^\theta(0)}{d\Delta} \left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) \right] \right\}, \tag{12}$$

where we have denoted by z_j^θ the potential earnings of a skill θ worker when located in j and the expectation is taken over the distribution of skill types. (Conditional on j, these earnings do not depend on locational preference heterogeneity.) The fiscal cost of movers depends on the density of movers in response to the tax change $\left(\frac{dS^\theta(0)}{d\Delta}\right)$, which may vary by skill level, and on the revenue losses of the government for each mover $\left(T\left(z_1^\theta\right) - T\left(z_0^\theta\right)\right)$, which are driven by the productivity gap or difference in labor supply behavior between the two locations. The following result summarizes the equity-efficiency tradeoff in place-based redistribution:

Lemma. *Under Assumption 2, the first order effect on welfare of a small PBR reform starting from a place-blind system is:*

$$\frac{dSWF}{d\Delta}(0) = \bar{\lambda}_1 - \bar{\lambda}_0 + \mathbb{E}_\theta \left\{ \frac{dS^\theta(0)}{d\Delta} \left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) \right] \right\} \tag{13}$$

It is clear from this expression that PBR is unambiguously desirable when the second (negative) term is zero. This condition is easily verified in a few specific cases: first, if there are no marginal households indifferent between locations, we have $\frac{dS^\theta(0)}{d\Delta} = 0$; second, if earnings do not differ across locations for households, then $T\left(z_1^\theta\right) - T\left(z_0^\theta\right) = 0$; third, if movers are a selected sample of households for whom there is no earnings differences across locations then $\frac{dS^\theta(0)}{d\Delta}\left(T\left(z_1^\theta\right) - T\left(z_0^\theta\right)\right) = 0$. Hence, PBR is more likely to be beneficial when mobility responses are low, productivity differences between locations are limited, or mobility responses are dominated by households for which earnings differences across space are small.

Optimal PBR The same sort of reasoning allows us to derive a formula for the optimal PBR scheme, noting that a small place-based reform will have no first order effect on welfare starting at an optimal Δ^*. Compared to the reasoning above, there is an additional fiscal externality to take into account when starting at an optimal Δ^*: movers from community 0 to community 1 lead to a fiscal loss per capita of $\frac{\Delta^*}{S(1-S)}$ as they go from being net contributors to becoming net beneficiaries of the PBR. Equating $\frac{dSWF}{d\Delta}(\Delta^*)$ to zero leads to the following formula for the optimal place-based transfer Δ^*:

Proposition 1. *The optimal place based transfer Δ^* obeys:*

$$\Delta^* = \frac{\bar{\lambda}_1 - \bar{\lambda}_0 + \mathbb{E}_\theta \left\{ \frac{dS^\theta(\Delta^*)}{d\Delta} \left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) \right] \right\}}{\frac{1}{S(1-S)} \mathbb{E}_\theta \left\{ \frac{dS^\theta(\Delta^*)}{d\Delta} \right\}}$$

The size of optimal PBR increases with how unequal communities 0 and 1 are, as measured by the difference in the average social marginal welfare weight of their inhabitants. All else equal, the optimal transfer is larger if the two communities are of roughly similar size, and if mobility is low or earnings responses to migration are small.

4.3 When can PBR complement an optimal place-blind tax?

We have established conditions under which using place as a "tag" for redistribution leads to welfare gains. Can the same equity goals be achieved at a lower efficiency cost using place-blind tools only? To answer this question, we turn to devising an income tax reform that achieves equity goals comparable to our simple PBR scheme, and compute the corresponding efficiency cost.

Place-blind tax reform design We consider an equilibrium where the planner has implemented some income tax $T(.)$ and place-based transfer Δ_0, and consider a small perturbation of the tax schedule in the direction $\mathring{T}(z)$:

$$\tilde{T}(z,q) = T(z) + q\mathring{T}(z), \tag{14}$$

with $q \ll 1$. The tax schedule $\mathring{T}(z)$ is designed to mimic the place-based redistribution reform in terms of equity gain. Given that the PBR scheme imposes a net tax proportional to $\frac{S(\Delta_0)-j^h}{S(\Delta_0)(1-S(\Delta_0))}$ on household h (see (10)), it is natural to define the perturbation as:

$$\mathring{T}(z) = \mathbb{E}\left[\frac{S(\Delta_0) - j^h}{S(\Delta_0)(1 - S(\Delta_0))} | z^h = z\right].$$

Denoting $\rho(z) \equiv \Pr\left(j^h = 1 | z^h = z\right)$ the conditional probability of choosing community 1 conditional on income, the tax perturbation is simply:

$$\mathring{T}(z) = \frac{S(\Delta_0) - \rho(z)}{S(\Delta_0)(1 - S(\Delta_0))}. \tag{15}$$

We note that in the empirically relevant case where $\rho(z)$ is monotone decreasing with income, there exists an income threshold $\underline{z}$ such that the tax reform is a subsidy for $z \leq \underline{z}$ and a tax for $z > \underline{z}$. We also note that this tax perturbation is ex-ante budget neutral, as is the proposed PBR scheme.

Welfare impact For a small tax perturbation in the direction $\mathring{T}(z)$, the direct impact of the reform on household welfare is positive for those for whom the reform is a subsidy, and negative for households for whom $\mathring{T}(z)$ is a tax. Overall, the corresponding impact on the social welfare function is $-\mathbb{E}\left(\lambda^h \frac{S(\Delta_0)-\rho(z^h)}{S(\Delta_0)(1-S(\Delta_0))}\right)$, which differs slightly from the equity impact from the PBR reform denoted $\frac{dU}{d\Delta}$. The equity gains of the income tax perturbation are:

$$\frac{dU}{dq} = \frac{dU}{d\Delta} - \mathbb{E}_z\left[cov\left(\lambda^h, j^h | z^h\right)\right] \tag{16}$$

Before analyzing this difference further, we establish the fiscal cost of the income tax reform. Behavioral responses to the tax reform are twofold. First, the change in the tax schedule leads to a change in potential earnings in the two locations, hence a change in their relative utilities. As a result, some households switch communities, leading to a change in earnings and a corresponding fiscal cost $\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) - \frac{\Delta_0}{S(1-S)}\right]$ for households who move from location 0 to 1.[6] Second, the change in marginal tax rates generates earnings responses for households who do not change location, through a substitution effect (recall that Assumption 2 assumes away income effects). Taken together, we show in the Appendix that the fiscal cost of the income tax reform is:

$$\underbrace{\mathbb{E}\left\{T'(z)\,\rho'(z)\,\mathbb{E}\left[\frac{Z_c(\theta,j)}{1+Z_c(\theta,j)T''(z)}|z_j^\theta = z\right]\right\}}_{\text{substitution effect}} + \underbrace{\mathbb{E}_\theta\left\{\frac{dS^\theta}{dq}\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) - \frac{\Delta_0}{S(1-S)}\right]\right\}}_{\text{movers response}}, \tag{17}$$

where $Z_c(\theta, j) = \frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta > 0$ denotes the compensated labor earnings response. Putting together (13),(16) and (17), the benefit of using PBR over an income tax reform hinges on the sign of

$$\begin{aligned}\frac{dSWF}{d\Delta} - \frac{dSWF}{dq} = {} & \mathbb{E}_z\left[cov\left(\lambda^h, j^h|z^h\right)\right] + \mathbb{E}_\theta\left\{\left(\frac{dS^\theta(\Delta_0)}{d\Delta} - \frac{dS^\theta(\Delta_0)}{dq}\right)\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) - \frac{\Delta_0}{S(1-S)}\right]\right\} \\ & - \mathbb{E}\left\{T'(z)\,\rho'(z)\,\mathbb{E}\left[\frac{Z_c(\theta,j)}{1+Z_c(\theta,j)T''(z)}|z_j^\theta = z\right]\right\}\end{aligned} \tag{18}$$

We discuss these terms in turn. The discussion focuses on the case where $\rho'(z) < 0$, i.e. the probability of living in community 1 decreases with income. In this case, the last term is unambiguously positive - the income tax reform corresponds to an increase in the marginal tax rate at all levels of income, distorting labor supply responses for all infra-marginal households. This term is absent from the place-based reform, which only acts upon marginal households indifferent between the two communities. The net cost of these movers

[6] At a given level of skill, movers either all move from 1 to 0 or from 0 to 1. If moves are from 1 to 0, they result in a fiscal benefit $-\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) - \frac{\Delta_0}{S(1-S)}\right]$

(net of the corresponding movers cost of the tax reform) is the second term in expression (18). This term is unambiguously negative: there are more movers from 0 to 1 – leading to larger fiscal costs – in response to the PBR than in response to the income tax reform, as PBR directly acts upon the relative attractiveness of the two cities.[7]

Finally, the sign of the first covariance depends on the planner's preferences, and on how location impacts marginal utility of income. Conditional on income, marginal utility will be lower in city 0 because the cost of living is higher there. This force inflates the marginal welfare weights in community 0, conditional on income. Conversely, conditional on income, marginal utility can be higher in city 0 if the level of amenities impacts the marginal utility of consumption. To illustrate this force, consider again the simple utility function of section 3.1 amended to allow imperfect sorting by skill: $u^h(c, \ell, j) = c - \ell^\nu + a_j\left(\theta^h\right) + \varepsilon_j^h$, where high skill preference for city 0 is captured by $a_0'(\theta) > 0$ and ε_j^h capture idiosyncratic preferences for community 0 (we normalize $a_1 = 0$ and $\varepsilon_1^h = 0$). In this case, summarizing the planner's preferences for redistribution with a concave function $G(.)$, we get:

$$\lambda^h = G'\left(E\left(z^h\right) - p_j + a_j\left(\theta^h\right) + \varepsilon_j^h\right).$$

Households choose 0 whenever $-p_0 + a_0\left(\theta^h\right) + \varepsilon_0^h > -p_1$. Therefore, even conditional on income, $E(z) - p_0 + a_0\left(\theta^h\right) + \varepsilon_0^h$ for a household observed to live in location 0 is higher than $E(z) - p_1$. In turn, given $G'(.)$ is decreasing:

$$\lambda_1(z) = \mathbb{E}\left[\lambda^h | z, j^h = 1\right] > \lambda_0(z) = \mathbb{E}\left[\lambda^h | z, j^h = 0\right]$$

Welfare weights in this case are higher in city 1, conditional on income. PBR delivers an additional equity gain compared to a similar income tax reform. Note that this result depends on the utility function. If sorting and planner's preferences are instead like in section 3.2, welfare weights are higher in the expensive city 0 conditional on income. Overall, we conclude that the sign of the covariance term $\mathbb{E}_z\left[cov\left(\lambda^h, j^h | z^h\right)\right]$ in equation 18 is ambiguous, and depends in particular on what drives the sorting of heterogeneous incomes across space. The analysis above suggests that the sign of this term may depend on whether sorting is driven by taste for amenities or shaped by cost of living differences.

An interesting middle route between the two examples discussed above is to make the following assumption:

[7] We show in the Appendix that under the assumptions invoked by Saez (2002) on the distribution of these income effects in labor supply conditional on pre-tax earnings, the PBR scheme and the income tax reforms would have the same impact on stayers. Consequently, adding income effects on labor supply to the analysis yields limited additional insight.

Assumption 3. *The motive of redistribution is z, i.e. $\lambda^h = \lambda\left(z^h\right)$ where $\lambda\left(.\right): \mathbb{R}_{\geq 0} \to \mathbb{R}_{\geq 0}$ is a monotone decreasing function*

Assumption 3 can be thought of as a horizontal equity constraint: the planner treats households with the same pre-tax earnings equally. Positing these social preferences avoids a number of well-known dilemnas that arise in the face of preference heterogeneity, such as whether to reallocate from households with a taste for cheap goods to those with a taste for expensive goods (see Kaplow 2008 for discussion). The assumption that $\lambda\left(.\right)$ is decreasing with income captures the vertical equity motive that leads the planner to redistribute from higher earning to lower earning households. Invoking this assumption, we get that:

$$cov\left(\lambda^h, j^h | z^h\right) = 0.$$

Therefore, if the planner's preferences obey horizontal equity constraints, the horse race between place-based redistribution and income tax hinges only on the behavioral responses they trigger. Consequently, place-based redistribution will be desirable in conjunction with an optimally chosen income tax whenever substitution effects dominate the earnings responses of movers:

Lemma. *Under Assumptions 2 and* (3)*, place-based redistribution is desirable in the presence of an optimally chosen income tax iff:*

$$\underbrace{-\mathbb{E}_\theta\left\{\left(\frac{dS^\theta\left(\Delta_0\right)}{d\Delta} - \frac{dS^\theta\left(\Delta_0\right)}{dq}\right)\left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right) - \frac{\Delta_0}{S\left(1-S\right)}\right]\right\}}_{\text{earnings effect on marginal households}} < \underbrace{-\mathbb{E}\left\{T'\left(z\right)\rho'\left(z\right)\mathbb{E}\left[\frac{Z_c(\theta, j)}{1 + Z_c(\theta, j)T''\left(z\right)} | z_j^\theta = z\right]\right\}}_{\text{earnings effect on infra-marginal households}} \quad (19)$$

Hence, in settings where migration rates and productivity differences between places are limited, PBR is likely to be a desirable complement to the income tax. This will also be the case in empirical settings where compensated labor supply responses are large. We turn now to a calibration exercise to investigate whether in the empirical context of the U.S., PBR is likely to be desirable.

5 Quantification

The most general version of our model reveals that the welfare impacts of PBR are theoretically ambiguous. Hence, the desirability of PBR is ultimately a quantitative question. We therefore conclude with a quantitative calibration that considers a lump-sum place-based transfer to the poorest 10% of local areas (similar to U.S. Opportunity Zones).

We follow Saez (2001) in analyzing household preferences without income effects in labor supply. As in

(6), locational tastes are modeled additively. Specifically, we consider household preferences of the form:

$$U^h(c,\ell,j) = \frac{\left(c-\frac{\ell^{1+\eta}}{1+\eta}\right)^{1-\gamma}}{1-\gamma} - j\mu + \varrho_{j1}\theta^h + \varrho_{j2}\left(\theta^h\right)^2 + \frac{1}{\kappa}a_j^h$$

where γ governs the strength of income effects in residential choice, η governs the labor supply elasticity, μ gives the mean level of aversion to Distressed among the lowest skill type, ϱ_{j1} and ϱ_{j2} govern skill-taste correlation by indexing the degree to which the high-skilled have a stronger relative taste for city j, a_j^h is an Extreme Value Type I distributed taste shock, and κ is a scale parameter. Households maximize utility subject to the budget constraint:

$$c + p_j\left(\theta^h\right) = \Theta_j\theta^h\ell - T\left(\Theta_j\theta^h\ell\right) + j\Delta$$

where Θ_j denotes city j's relative productivity and $p_j\left(\theta^h\right)$ is a city-type-specific rent level, meant to approximate in a simple way the idea that higher skilled workers will demand more expensive residences. We specify $p_j\left(\theta^h\right)$ as follows to ensure approximately equal budget shares of housing across skill types within cities while also allowing lower average rents in Distressed:

$$\ln p_j\left(\theta^h\right) = C - \beta j + \frac{1+\eta}{\eta}\ln\left(\theta^h\right).$$

Social preferences are utilitarian:

$$SWF = \mathbb{E}\left[v^h\right]$$

with zero exogenous revenue requirement as in, for example, Kleven et al. (2009):

$$\mathbb{E}\left[T(z^\theta) + \Delta\frac{S-j^\theta}{S(1-S)}\right] = 0.$$

For computational simplicity, we restrict the social planner to a place-blind tax system $T(z)$ that has only three brackets with annual earnings thresholds at \$30,000 and \$100,000.[8] The planner chooses a lump-sum transfer $T(0)$ that everyone receives (i.e., a "universal basic income") and three marginal tax rates that previal between earnings ranges $[0, 30,000)$, $[30,000, 100,000)$, and $[100,000, \infty)$. Because the time interval of our setup need not be annual, we follow Mankiw et al. (2009) in dividing our tax bracket thresholds and PBR amounts by a scaling factor such that the 95^{th} percentile of the annual earnings distribution

[8] See Fajgelbaum et al. (2018) for a closely related approach. Future versions of this paper will consider more flexible tax systems.

approximately equals the actual 2007 value of $\$96,250$.

We use the wage distribution from Mankiw et al. (2009), which is a lognormal fit to the 2007 wage distribution in the Current Population Survey, with a Pareto tail with Pareto parameter 2 as in Saez (2001) appended above the 95th percentile. We choose $\gamma = 2$ as in Kleven et al. (2009), which under our utilitarian social welfare criterion corresponds to a middle ground of curvature between the log and Rawlsian social preferences of Saez (2001). We choose $\eta = 2$ so that the Frisch labor supply elasticity is 0.5 as in Mankiw et al. (2009). We choose $\kappa = 1.1$ so that the elasticity of the share of households in Distressed with respect to the mean utility difference between the two communities is one. Distressed productivity ($\theta_1 = 0.9$) is set 10% lower than Elsewhere productivity ($\theta_0 = 1$), which is close to fixed effects estimates of the wage gap between dense and non-dense metropolitan areas (Glaeser and Mare, 2001; Baum-Snow and Pavan, 2011; Autor, 2019). Preferences for Distressed do not vary by type: $\varrho_{11} = \varrho_{12} = 0$. We choose the remaining taste parameters $\mu = 1.4$, $\varrho_{01} = 0.02$, and $\varrho_{02} = 0.0005$ to closely approximate empirical patterns of income sorting found in the 2012-2016 ACS. At $\Delta = 0$ (no PBR), 10% of households overall, 15% of the bottom 20% of earners, and 4% of the top 20% of earners live in Distressed, which matches sorting into the 10% lowest-mean-earnings CZs in the 2012-2016 ACS. Finally, we impose $\beta = 0.2$ which implies that Distressed rent for each type is 20% lower than Elsewhere rent, and we choose $C = -1.8$ so that at $\Delta = 0$ (no PBR), the average ratio of rent to earnings in the economy is 0.2.[9]

We compute social welfare at Δ values ranging from $\$0$ to $\$3,000$ in $\$50$ increments while allowing the place-blind tax system to optimally adjust. At $\Delta = 0$, the universal lump-sum transfer is approximately $\$15,000$, which is close to the actual implied lump-sum transfer in America when one includes Medicaid and other in-kind transfers (Piketty et al., 2018) and somewhat smaller than the approximately $\$23,000$ universal lump-sum transfer estimated to be optimal in Mankiw and Weinzierl (2010). The three marginal tax rates, ordered from the lowest bracket to the highest, are 36%, 47%, and 53%.

We find that social welfare is rising in PBR up to $\$1,550$ where social welfare reaches a maximum. Under a flat income tax of 30%, which roughly approximates the U.S. tax system (Piketty et al., 2018), a \$1,550 transfer to Distressed residents would be equivalent to an additional \$5,200 refundable tax deduction for Distressed residents; current standard deductions in the federal income tax system are \$12,000 for single

[9] A cost of living difference of 20% is towards the upper end of the estimates reported in Baum-Snow and Pavan (2011) who contrast metropolitan areas of different sizes. Albouy et al. (2016) reports an array of estimates of the budget share of housing, which has been trending up in recent years.

filers and $24,000 for married filers.

Figures 3a and 3b provide intuition for the result by plotting the distribution of marginal social welfare weights λ^h in each community at $\Delta = 0$ and at the optimum ($\Delta = \$1,550$), respectively. At $\Delta = 0$, marginal social welfare weights in Distressed first-order stochastically dominate those in Elsewhere. Hence, $\Delta > 0$ is optimal if migration elasticities and productivity differences are modest enough, as we find in our simulation. At the optimal value of Δ, marginal social welfare weights in Distressed no longer FOSD those in Elsewhere, as poverty in Distressed has been alleviated. Future versions of this paper will report how the results change when considering marginal social welfare weights obeying Assumption 3 and under alternative values of γ, which influences the planner's tastes for redistribution.

6 Conclusion

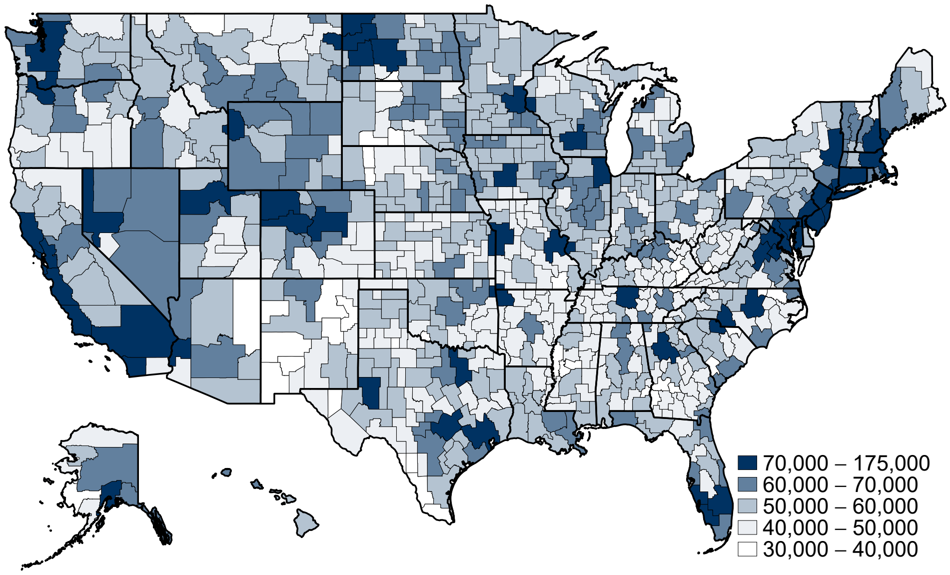
We have studied the equity rationale for place-based policies. We found that place-based redistribution is always desirable in standard urban and trade economics models, as long as low earners tend to have a relative taste for the subsidized area. In more general models, PBR may or may not be desirable depending on how the efficiency costs of place based transfers compare to those of the optimal place-blind income tax. PBR will tend to be desirable when spatial transfers induce few moves, when productivies are similar across place, when labor supply is especially elastic, and when there is strong sorting across place based on earnings. A quantitative calibration reveals that the optimal lump sum transfer for the poorest 10% of U.S. regions may be sizable.

Readers may wonder whether transfers should be conditioned on more than residential location. For example, height also correlates with earnings, so analogous models suggest that height should be taxed (Mankiw and Weinzierl, 2010). We study place because, unlike height and almost all other potential "tags" (Akerlof, 1978), governments around the world actually conditional transfers on place.

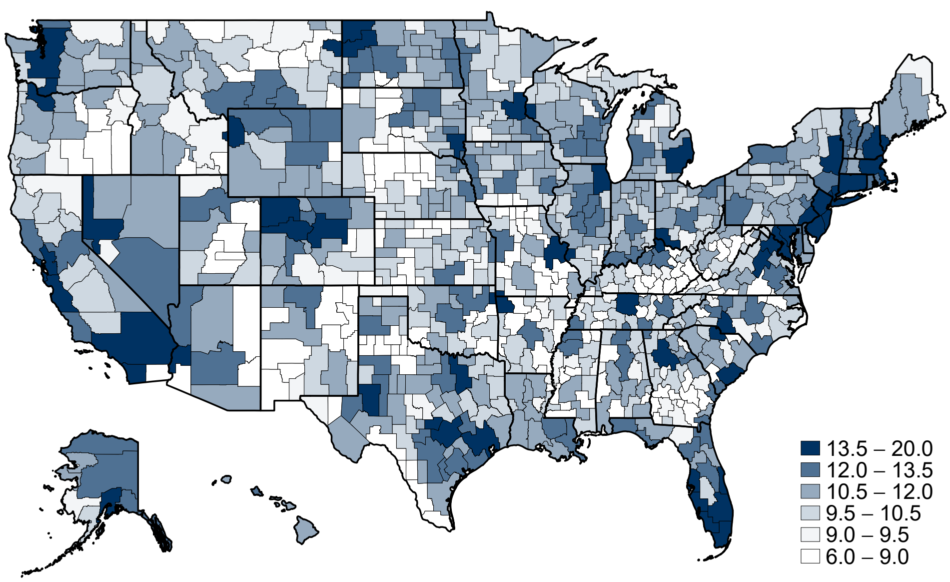
Future work can develop our results in at least three ways. First, our quantitative calibration will soon allow for a non-linear income tax rather than simply a linear tax. Second, natural experiment evidence could be provided to test for skill-taste correlation. Third, new natural experiment evidence could improve our calibration of optimal PBR magnitude.

FIGURE 1: Variation in Income and Taxes across Place

A. Mean Earnings Disparities across Place

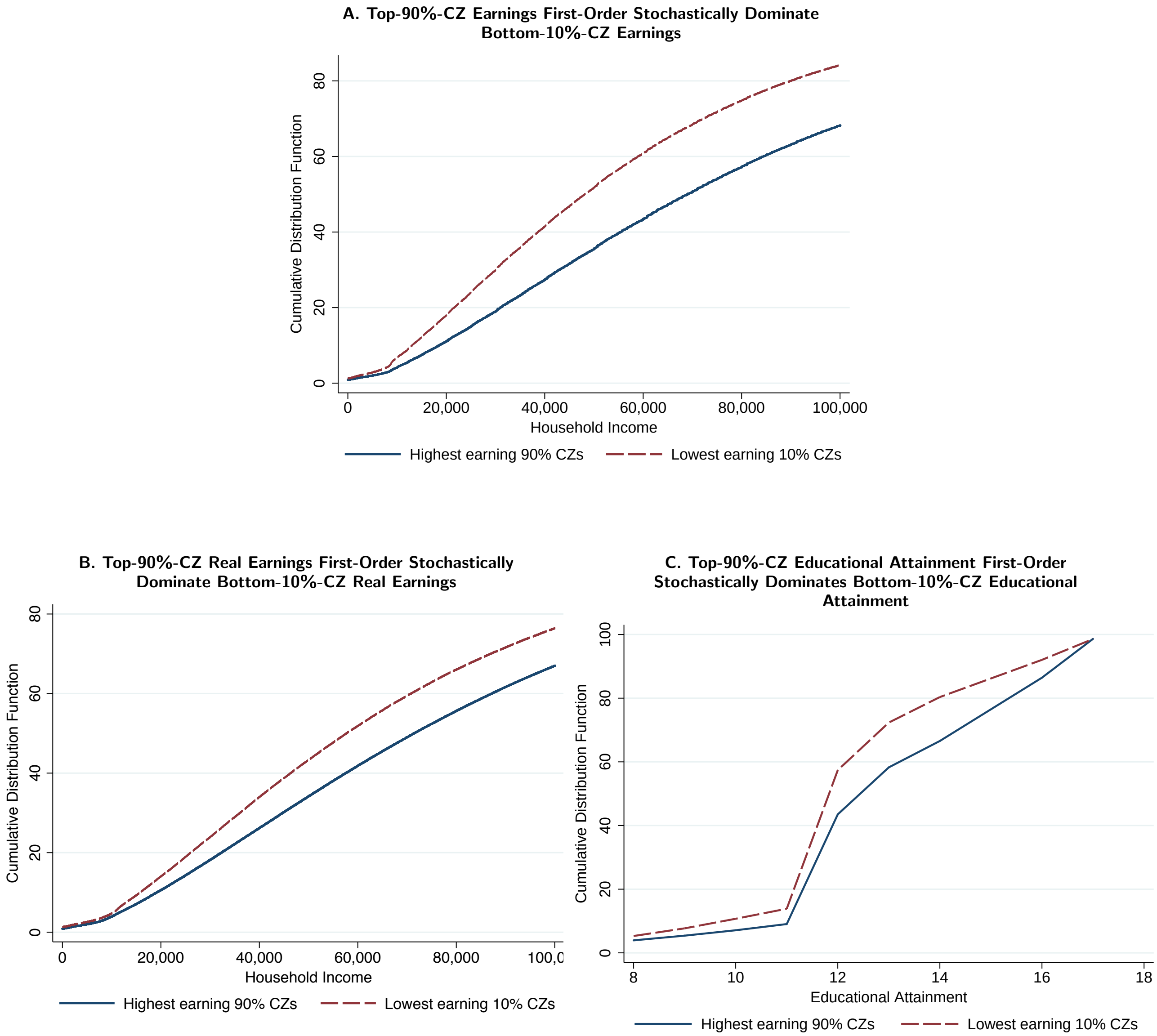


B. Mean Federal Income Tax Rate Disparities across Place



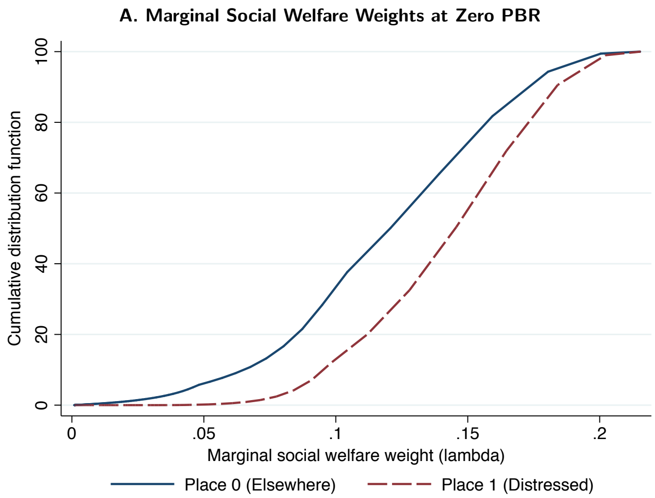
Notes: Panel A uses Internal Revenue Service aggregates to plot mean Adjusted Gross Income by Commuting Zone in 2016. Panel B uses those same data to plot mean federal income tax rates by Commuting Zone. In each panel, the unit of analysis is the tax filing unit.

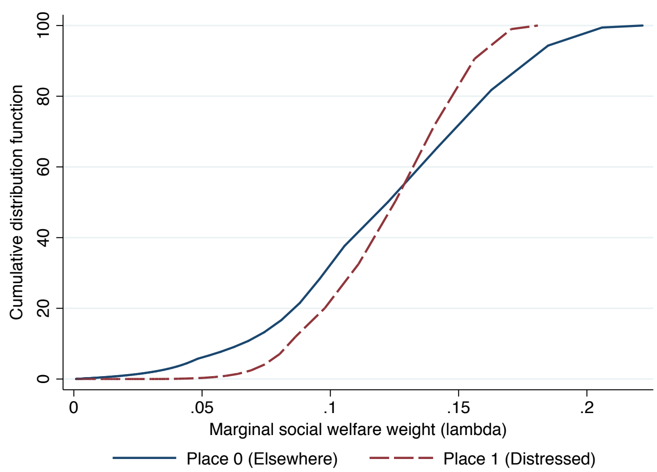
FIGURE 2: First-Order Stochastic Dominance in Income and Education across Place



Notes: Panel A uses the 2012-2016 5-year American Community Survey (ACS) to plot cumulative distribution functions of household earnings (before taxes and transfers) in "Distressed" and "Elsewhere". Distressed comprises the 10% poorest Commuting Zones (CZs): the CZs with the mean household earnings below the population-weighted tenth percentile. Elsewhere comprises the remaining 90%. Panel B uses Moretti's (2013) Local CPI 2 to locally deflate earnings in each CZ. Panel C uses years of educational attainment in the ACS. Panel C repeats Panel A when using years of educational attainment rather than earnings.

FIGURE 3: Place-Based Redistribution Alleviates Poverty in Distressed Areas





Notes: This figure plots the distribution of marginal social welfare weights λ in Elsewhere and Distressed in our calibration, under zero place-based redistribution (Panel A) and under the optimal place-based redistribution (Panel B). Panel A shows that, under zero PBR, poverty is disproportionately concentrated in Distressed: the distribution of marginal social welfare weights in Distressed first order stochastically dominates the distribution of marginal social welfare weights in Elsewhere. Panel B shows that, under the optimal PBR, poverty is alleviated in Distressed: a smaller share of Distressed than of Elsewhere has high marginal social welfare weights.

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A Theory Appendix

A.1 Equity gains from a PBR scheme

We consider a general utility function:

$$U\left(z - T\left(z\right) - p_j - \frac{S-j}{S\left(1-S\right)}\Delta, \frac{z}{w_j^h}, a_j\right)$$

Derivations apply both the simple examples of section 3, and to the general model of section 4. Taking into account the resource constraint, the social welfare function is:

$$\mathcal{L} = \int \omega^h G\left(v^h\right) dh - \phi \int T\left(z^h\right) dh$$

The total welfare effect of a PBR scheme expressed in terms of the value of public funds is:

$$U(\Delta) - U(0) = \frac{1}{\phi}\int_{stayers} \omega^h \left[G\left(v_{j^h}^h\left(\Delta\right)\right) - G\left(v_{j^h}^h\left(0\right)\right)\right] dh + \frac{1}{\phi}\int_{movers} \omega^h \left[G\left(v_1^h\left(\Delta\right)\right) - G\left(v_0^h\left(0\right)\right)\right] dh$$

where $v_{j^h}^h\left(\Delta\right)$ is the indirect utility of household h under PBR Δ. As $\Delta \to 0$, the first order effect of the reform on the utility of movers is 0, as movers in response to an infinitesimal PBR are initially indifferent between the two communities: for them, $G\left(v_1^h\left(\Delta\right)\right) \underset{\Delta\to 0}{\longrightarrow} G\left(v_0^h\left(0\right)\right)$. Second, the number of movers is infinitesimal:

$$\begin{aligned}\int_{v_0^h(0)>v_1^h(0), v_0^h(\Delta)<v_1^h(\Delta)} dh &= F_\xi\left(U_1^h\left(\Delta\right) - U_0^h\left(\Delta\right)\right) - F_\xi\left(U_1^h\left(0\right) - U_0^h\left(0\right)\right) \\ &\sim \Delta f\left(U_1^h\left(0\right) - U_0^h\left(0\right)\right)\frac{dU_1 - dU_0}{d\Delta}|_{\Delta=0} \\ &= O\left(\Delta\right)\end{aligned}$$

Therefore, the integration of the sayers term can be done on all households, irrespective of whether they move or not. Taking the appropriate limits, the first order effect of a PBR simplifies to:

$$\frac{dU}{d\Delta} = \frac{1}{\phi}\int \omega^h G'\left(v^h\right)\left(-\frac{\partial U}{\partial c}\frac{S-j}{S\left(1-S\right)} + \left(\frac{\partial U}{\partial c}\frac{\partial c}{\partial z} + \frac{\partial U}{\partial z}\right)\frac{\partial z^h}{\partial \Delta}\right) dh$$

We then use another envelope result: for each stayer, $\frac{\partial U}{\partial c}\frac{\partial c}{\partial z} + \frac{\partial U}{\partial z} = 0$ as income is chosen optimally. Therefore:

$$
\begin{aligned}
\frac{dU}{d\Delta} &= \frac{1}{\phi}\int \omega^h G'\left(v^h\right)\frac{\partial U}{\partial c}\frac{j^h - S}{S\left(1-S\right)}dh \\
&= \int \lambda^h \frac{j^h - S}{S\left(1-S\right)}dh. \\
&= \bar{\lambda}_1 - \bar{\lambda}_0.
\end{aligned}
$$

A.2 Movers in response to a PBR

A.2.1 Density of movers

The density of movers in response to a PBR is:

$$
\begin{aligned}
M\left(\Delta\right) &= \int_{v_0^h(0)>v_1^h(0), v_0^h(\Delta)<v_1^h(\Delta)} dh \\
&= \iiint_{v_0^h(0)>v_1^h(0), v_0^h(\Delta)<v_1^h(\Delta)} dF_{\xi|\theta}(\xi)dF_\theta(\theta) \\
&= \int_\theta \left[F_{\xi|\theta}\left(V_1^\theta\left(\Delta\right) - V_0^\theta\left(\Delta\right)\right) - F_{\xi|\theta}\left(V_1^\theta\left(0\right) - V_0^\theta\left(0\right)\right)\right]dF_\theta(\theta) \\
dM\left(\Delta\right) &= \int_\theta \left[f_{\xi|\theta}\left(V_1^\theta\left(0\right) - V_0^\theta\left(0\right)\right)\left(\frac{dV_1^\theta}{d\Delta}|_{\Delta=0} - \frac{dV_0^\theta}{d\Delta}|_{\Delta=0}\right)d\Delta\right]dF_\theta(\theta),
\end{aligned}
$$

where the last line is a Taylor series expansion to the first order of the previous one. Dividing by Δ and taking the limit $\Delta \to 0$, we get the density of movers at 0 PBR:

$$
\frac{dM_\theta}{d\Delta}\left(0\right) = \mathbb{E}_\theta\left\{f_{\xi|\theta}\left(V_1^\theta\left(0\right) - V_0^\theta\left(0\right)\right)\left(\frac{1-S}{S\left(1-S\right)}\frac{\partial U_1}{\partial c} + \frac{S}{S\left(1-S\right)}\frac{\partial U_o}{\partial c}\right)\right\}
$$

where we have the notation shortcut $\frac{\partial U_j^\theta}{\partial c}$ to indicate that the partial derivative is evaluated at the initial bundle of consumption in community j, and differ by skill θ that is:

$$
\frac{\partial U_j^\theta}{\partial c} = \frac{\partial U}{\partial c}\left(c_j^\theta, \ell_j^\theta, a_j\right)
$$

and we have used as above that:

$$
\frac{dV_j^h}{d\Delta}|_{\Delta=0} = -\frac{\partial U_j^\theta}{\partial c}\frac{S-j}{S\left(1-S\right)}
$$

by the envelope theorem.

It will be useful to define:

$$\frac{dM_\theta}{d\Delta}(\Delta) = f_{\xi|\theta}\left(V_1^\theta(\Delta_0) - V_0^\theta(\Delta_0)\right)\left(\frac{1}{S}\frac{\partial U_1^\theta}{\partial c} + \frac{1}{1-S}\frac{\partial U_0^\theta}{\partial c}\right) \tag{20}$$

the density of movers with respect to a change in PBR, starting at PBR Δ_0, conditional on skill θ. In particular, we have: $\frac{dM}{d\Delta}(0) = \mathbb{E}_\theta\left\{\frac{dM_\theta}{d\Delta}(0)\right\}$.

Lemma. *The density of movers in response to a PBR is*

$$\frac{dM}{d\Delta}(0) = \mathbb{E}_\theta\left\{f_{\xi|\theta}\left(V_1^\theta(0) - V_0^\theta(0)\right)\left(\frac{1}{S}\frac{\partial U_1^\theta}{\partial c} + \frac{1}{1-S}\frac{\partial U_0^\theta}{\partial c}\right)\right\}. \tag{21}$$

A.2.2 Impact of movers on government revenues and SWF

We decompose the behavioral response on fiscal revenues into their effect on the fiscal revenue coming from PBR, and the ones coming from the income tax. $dB = dB_{PBR} + dB_T$. We first compute the dB_{PBR} term.

Assume that the initial equilibrium has a budget neutral PBR of $\frac{S(\Delta_0)-j}{S(\Delta_0)(1-S(\Delta_0))}\Delta_0$. Fiscal revenues from PBR are 0. The fiscal effect of movers, comes from (1) a loss in revenues in city 0 and (2) a subsidy to be paid in city 1:

$$dB_{PBR} = \left(S(\Delta_0+\Delta) - S(\Delta_0)\right)\frac{\Delta_0}{S(\Delta_0)\left(1-S(\Delta_0)\right)}$$

Starting at a PBR of 0, we get that this term is 0. Otherwise,

$$\frac{dB_{PBR}}{d\Delta} = -\frac{\Delta_0}{S(\Delta_0)\left(1-S(\Delta_0)\right)}S'(\Delta_0)$$

where $S'(\Delta_0) = \frac{dS}{d\Delta}|_{\Delta_0}$ is the density of movers in response to a change in the PBR, starting at a PBR Δ_0. It is computed in (21).

Lemma. *The first order effect on B_{PBR} of a small PBR is:*

$$\frac{dB_{PBR}}{d\Delta} = 0 \tag{22}$$

starting at $\Delta_0 = 0$. Else,

$$\frac{dB_{PBR}}{d\Delta} = -\frac{\Delta_0}{S(\Delta_0)\left(1-S(\Delta_0)\right)}S'(\Delta_0),$$

where $S'(\Delta_0)$ is given in (21).

We now compute the effect of the PBR on the fiscal revenues, as households move hence change their income as a response to the PBR. Each mover moves necessarily to community 1, if the PBR is positive. This entails a revenue change per mover $T\left(z_1^\theta\right) - T\left(z_0^\theta\right)$ where we used the notation z_j^θ rather than z_j^h to underscore that, conditional on city j, income is only a function of skill, not of preference heterogeneity. Similar to the computation of the number of movers above (paragraph 21), the change in fiscal revenues due to movers, in response to a PBR Δ, starting at no PBR, is:

$$B_{T,movers}\left(\Delta\right) - B_{T,movers}\left(0\right) = \iint_{v_0^h(0)>v_1^h(0), v_0^h(\Delta)<v_1^h(\Delta)} \left(T\left(z_1^\theta\right) - T\left(z_0^\theta\right)\right) dF_{\xi|\theta}(\xi) dF_\theta(\theta)$$

which leads to:

$$\begin{aligned}
\frac{dB_{T,movers}(\Delta)}{d\Delta} &= \mathbb{E}_\theta \left\{ f_{\xi|\theta}\left(V_1^\theta\left(0\right) - V_0^\theta\left(0\right)\right) \left(\frac{1}{S}\frac{\partial U_1^\theta}{\partial c} + \frac{1}{1-S}\frac{\partial U_0^\theta}{\partial c}\right) \left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right)\right] \right\} \\
&= \mathbb{E}_\theta \left\{ S_\theta'\left(0\right) \left[T\left(z_1^\theta\right) - T\left(z_0^\theta\right)\right] \right\}
\end{aligned}$$

where $S_\theta'\left(0\right)$ is the density of movers at skill θ, starting from 0 PBR, as defined in (20).

A.3 Welfare impact of an Income Tax reform

A.3.1 Effect on utility

The total welfare effect of the income tax perturbation expressed in terms of the value of public funds is:

$$U(q) - U(0) = \frac{1}{\phi}\int_{stayers} \omega^h \left[G\left(v^h\left(q\right)\right) - G\left(v^h\left(0\right)\right)\right] dh + \frac{1}{\phi}\int_{movers} \omega^h \left[G\left(v_{-j}^h\left(q\right)\right) - G\left(v_j^h\left(0\right)\right)\right] dh.$$

Taking the appropriate limits like we did for the case of the PBR above, the first order effect of the pertubation is:

$$\begin{aligned}
\frac{dU}{dq} &= -\frac{1}{\phi}\int \omega^h G'\left(v^h\right)\frac{\partial U}{\partial c}\mathring{T}\left(z^h\right) dh \\
&= -\int \lambda^h \mathring{T}\left(z^h\right) dh \\
&= -\int \lambda^h \left(\frac{S - \rho\left(z^h\right)}{S\left(1-S\right)}\right) dh
\end{aligned}$$

Adding and substracting the PBR effect:

$$\begin{aligned}\frac{dU}{dq} &= -\int \lambda^h \left(\frac{S-\rho\left(z^h\right)}{S\left(1-S\right)}\right) dh - \int \lambda^h \left(\frac{j^h - S}{S\left(1-S\right)}\right) dh + \frac{dU}{d\Delta} \\ &= \mathbb{E}\left[\lambda^h \left(\frac{\rho\left(z^h\right)-j^h}{S\left(1-S\right)}\right)\right] + \frac{dU}{d\Delta} \\ &= -\mathbb{E}_z\left[cov\left(\lambda^h, j^h|z\right)\right] + \frac{dU}{d\Delta}\end{aligned}$$

A.3.2 Effect on government resources

There are conceptually two distinct effects. First, households who do not move get a hit by a simple income tax reform change. Second, households who do move also adjust their labor supply. We compute these two terms in turn.

Assumption. *The income tax schedule $T(.)$ is smooth and $T'(z) > 0$.*

Stayers Term The loss in tax revenue due to the behavioral response to the income tax change, for households who do not move, comes from them adjusting their earnings z_j^θ. We write dz_j^θ this adjustment. The revenue change per stayer is $T\left(z_j^\theta + dz_j^\theta\right) - T\left(z_j^\theta\right) = T'\left(z_j^\theta\right) dz_j^\theta$ to the first order, so that the first order loss is tax revenue is:

$$\frac{dB_T}{dq} = \mathbb{E}\left\{T'\left(z_j^\theta\right) \frac{dz_j^\theta}{dT'\left(z_j^\theta\right)} \frac{dT'\left(z_j^\theta\right)}{dq}\right\}.$$

A change in the tax schedule affects earnings z through income and substitution effects. For a given household with skill θ located in city j, we denote by $z_j^\theta(1-\tau, I)$ the earnings they would supply with a linear budget constraint with tax rate τ and virtual income I. An arbitrary small income tax change $\mathring{T}\left(z\right) dq$ produces a change in earnings:

$$dz_j^\theta = -\frac{\partial z_j^\theta}{\partial\left(1-\tau\right)} d\tau + \frac{\partial z_j^\theta}{\partial I} dI.$$

The change in marginal tax rate $d\tau$ is equal to:

$$d\tau = \mathring{T}'\left(z_j^\theta\right) dq + T''\left(z_j^\theta\right) dz_j^\theta,$$

where the first term comes from the direct change in the tax rate and the second one comes from the fact that z adjusts and that the initial tax schedule has some curvature, leading to a change in marginal rate when z change. The virtual income shock is :

$$dI - z_j^\theta d\tau = -\mathring{T}\left(z_j^\theta\right) dq.$$

Hence:

$$\begin{aligned}
dz_j^\theta &= -\frac{\partial z_j^\theta}{\partial(1-\tau)} d\tau + \frac{\partial z_j^\theta}{\partial I}\left[-\mathring{T}\left(z_j^\theta\right) dq + z_j^\theta d\tau\right]. \\
dz_j^\theta &= -\left(\frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta\right)\left[\mathring{T}'\left(z_j^\theta\right) dq + T''\left(z_j^\theta\right) dz_j^\theta,\right] - \frac{\partial z_j^\theta}{\partial I}\mathring{T}\left(z_j^\theta\right) dq \\
dz_j^\theta &= \frac{-\left(\frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta\right)\mathring{T}'\left(z_j^\theta\right) dq - \frac{\partial z_j^\theta}{\partial I}\mathring{T}\left(z_j^\theta\right) dq}{1 + \left(\frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial R} z_j^\theta\right) T''\left(z_j^\theta\right)},
\end{aligned}$$

where the first term in parenthesis is the substitution effect. We now apply this computation to the tax perturbation that mimics a PBR scheme. To do so, we make the following assumption:

Assumption 4. *The function $\rho(z)$ is differentiable in z.*

Under this assumption, we get:

$$\frac{dz_j^\theta}{dq} = \frac{\left(\frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta\right)\rho'\left(z_j^\theta\right) - \frac{\partial z_j^\theta}{\partial I}\left(S - \rho\left(z_j^\theta\right)\right)}{1 + \left(\frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta\right) T''\left(z_j^\theta\right)}$$

Denote the substitution effect and income effect as follows:

$$\begin{aligned}
Z_c(\theta, j) &= \frac{\partial z_j^\theta}{\partial(1-\tau)} - \frac{\partial z_j^\theta}{\partial I} z_j^\theta \\
Z_I(\theta, j) &= \frac{\partial z_j^\theta}{\partial I}
\end{aligned}$$

Then

$$\frac{dz_j^\theta}{dq} = \frac{Z_c(\theta, j)\rho'\left(z_j^\theta\right) - Z_I(\theta, j)\left(S - \rho\left(z_j^\theta\right)\right)}{1 + Z_c(\theta, j) T''\left(z_j^\theta\right)}$$

The loss in tax revenue from the income tax reform is therefore equal to:

$$\frac{dB_T}{dq} = \mathbb{E}\left\{T'\left(z_j^\theta\right)\frac{Z_c(\theta, j)\rho'\left(z_j^\theta\right) - Z_I(\theta, j)\left(S - \rho\left(z_j^\theta\right)\right)}{1 + Z_c(\theta, j) T''\left(z_j^\theta\right)}\right\}.$$

Without income effects on labor supply, it is simply:

$$\frac{dB_T}{dq} = \mathbb{E}\left\{T'\left(z_j^\theta\right)\frac{Z_c(\theta, j)\rho'\left(z_j^\theta\right)}{1 + Z_c(\theta, j) T''\left(z_j^\theta\right)}\right\}.$$

Movers Term We count here the fiscal revenue changes due to movers. As seen above, movers can move to community 1 or to community 0. The revenue change per mover is $T\left(z_{-j}^{\theta}\right)-T\left(z_{j}^{\theta}\right)$ where we used the notation z_{j}^{θ} rather than z_{j}^{h} to underscore that, conditional on city j, income is only a function of skill, not of preference heterogeneity; and where j is the city choice at the baseline equilibrium. Similar to the computation of the number of movers above, the change in fiscal revenues due to movers in response to the income tax perturbation is:

$$\frac{dB_{T,movers}(q)}{dq}=\mathbb{E}_{\theta}\left\{f_{\xi|\theta}\left(V_{1}^{\theta}\left(0\right)-V_{0}^{\theta}\left(0\right)\right)\left\{\frac{\partial U_{o}^{\theta}}{\partial c}\left(S-\rho\left(z_{0}^{\theta}\right)\right)-\frac{\partial U_{1}^{\theta}}{\partial c}\left(S-\rho\left(z_{1}^{\theta}\right)\right)\right\}\left[T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)\right]\right\},$$

in which for some skills the term inside $\{\}$ can be negative, hence $dB_{T,movers}^{\theta}$ can be positive: if the behavioral response induces a move from 1 to 0, it leads to increased tax revenues for the government. Overall:

$$\frac{dB_{T,movers}(q)}{dq}=\mathbb{E}_{\theta}\left\{\frac{dS^{\theta}}{dq}\left[T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)\right]\right\},$$

A.4 Comparison between PBR and Income Tax reform

A.4.1 Net movers term

We compare the movers term of PBR to the one of the Income Tax reform that mimics it.

$$\begin{aligned}
\frac{dB_{movers}^{\theta}}{d\Delta}-\frac{dB_{movers}^{\theta}}{dq}&=f_{\xi|\theta}\left(V_{1}^{\theta}\left(0\right)-V_{0}^{\theta}\left(0\right)\right)\left(S\frac{\partial U_{0}^{\theta}}{\partial c}+\left(1-S\right)\frac{\partial U_{1}^{\theta}}{\partial c}+\right)\left[T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)\right]\\
&-f_{\xi|\theta}\left(V_{1}^{\theta}\left(0\right)-V_{0}^{\theta}\left(0\right)\right)\left(\frac{\partial U_{o}^{\theta}}{\partial c}\left(S-\rho\left(z_{0}^{\theta}\right)\right)-\frac{\partial U_{1}^{\theta}}{\partial c}\left(S-\rho\left(z_{1}^{\theta}\right)\right)\right)\left[T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)\right]\\
&=f_{\xi|\theta}\left(V_{1}^{\theta}\left(0\right)-V_{0}^{\theta}\left(0\right)\right)\left(\rho\left(z_{0}^{\theta}\right)\frac{\partial U_{0}^{\theta}}{\partial c}+\left(1-\rho\left(z_{1}^{\theta}\right)\right)\frac{\partial U_{1}^{\theta}}{\partial c}+\right)\left[T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)\right]
\end{aligned}$$

Which is clearly <0 since the first two terms are positive and $T\left(z_{1}^{\theta}\right)-T\left(z_{0}^{\theta}\right)<0$. We conclude that:

$$\frac{dB_{movers}^{\theta}}{d\Delta}-\frac{dB_{movers}^{\theta}}{dq}<0$$

A.4.2 Adding income effects on labor supply

We assume here that the utility function displays income effects on labor supply, i.e., $\frac{\partial z_{j}^{\theta}}{\partial I}<0$. All of the effects computed in the main text remain unaffected. An additional behavioral response to tax reform emerges, which we discuss here.

Income Effect Impact of a PBR Scheme Households who do not move in response to the PBR now adjust their earnings in response to the lump-sum PBR. We write dz_j^θ this adjustment. The revenue change per stayer is $T\left(z_j^\theta + dz_j^\theta\right) - T\left(z_j^\theta\right) = T'\left(z_j^\theta\right) dz_j^\theta$ to the first order, so that the first order loss is tax revenue is:

$$\frac{dB_{T,stayers}}{d\Delta} = \mathbb{E}\left\{T'\left(z_j^\theta\right)\frac{dz_j^\theta}{d\Delta}|stayers\right\} = \mathbb{E}\left\{T'\left(z_j^\theta\right)\frac{dz_j^\theta}{d\Delta}\right\}.$$

since the number of movers is infinitesimal, so that we can integrate over all households as if they did not move. Note that we make the assumption here that $T'(z) > 0$ for every z; and that $T(z)$ is smooth. A lump sum transfer affects earnings z only through income effects. For a given household with skill θ located in city j, we denote by $z_j^\theta(1-\tau, I)$ the earnings they would supply with a linear budget constraint with tax rate τ and virtual income I. An arbitrary small income tax change $\mathring{T}(z)\,dq$ produces a change in earnings:

$$dz_j^\theta = \frac{\partial z_j^\theta}{\partial I}\frac{S-j}{S(1-S)}d\Delta.$$

Writing $Z_I(\theta, j) = \frac{\partial z_j^\theta}{\partial I}$ the substitution effect (as below), we get that the change in tax revenue from the PBR reform (through behavioral effect on z for stayers) is:

$$\frac{dB_T}{d\Delta} = -\mathbb{E}\left\{T'(z)\,\mathbb{E}\left[\frac{1}{S(1-S)}\frac{Z_I(\theta,j)(S-j)}{1+Z_c(\theta,j)T''(z)}|z_j^\theta = z\right]\right\}.$$

Income Effect Impact of an Income Tax reform The computation were made above. We get:

$$\frac{dB_T}{dq} = -\mathbb{E}\left\{T'(z)(S-\rho(z))\,\mathbb{E}\left[\frac{Z_I(\theta,j)}{1+Z_c(\theta,j)T''(z)}|z_j^\theta = z\right]\right\}$$

The second line is the income effect.

Comparing the two income effects Consider the following assumption:

Assumption 5. *Conditional on each income level, behavioral response $Z_I(\theta, j)$ is independent of where the household lives.*

Under Assumption 5, we get that that the behavioral responses to PBR and and the equivalent income tax reform coming through the income effect are equal.