**Societal Preferences for Tax Progressivity, Government Size, and Redistribution**

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January 2024

Abstract

While the U.S. has a more progressive *tax* system than many other high-income countries, its overall *tax-and-transfer system* induces less redistribution because taxes are lower. We examine how societal preferences might explain these cross-country differences. In our model, the *tax system* consists of a set of nonnegative marginal tax rates applied at each level of income, and the *transfer system* consists of a lump sum transfer funded by the tax system. We allow social planners with different objectives to increase redistribution directly by imposing a more progressive tax system, or indirectly by using a larger tax system (higher taxes across-the-board) to fund the transfer system. We find that planners focusing on the well-being of the lowest-income individuals choose large tax systems with limited progressivity, resulting in highly redistributive tax-and-transfer systems. Planners focusing on the well-being of middle-income individuals choose small, highly progressive tax systems, resulting in less redistributive tax-and-transfer systems.

Keywords: tax progressivity, income redistribution, optimal tax models
JEL codes: H21, D63, D78, H53, I38

We thank Trevor Gallen and Alan Viard for helpful comments, and Aatman Vakil for excellent research assistance.

## I. Introduction

In 2008, the Organisation for Economic Cooperation and Development (OECD) released a report suggesting that the U.S. has one of the most progressive tax systems – defined as the greatest concentration of tax payments, relative to income, at the high end of the income distribution – among member nations. However, the U.S. tax-and-transfer system induces less redistribution (reduction in income inequality) than most other OECD countries (OECD 2008). The intuition behind these results is that the degree of redistribution induced by a tax system depends on its size as well as its progressivity. All else equal, more progressive tax systems induce more redistribution by concentrating tax payments at the upper end of the income distribution. All else equal, larger tax systems can induce more redistribution for two reasons. First, if they are at least mildly progressive, scaling them up directly reduces income inequality. Second, even if they are proportional or regressive, larger tax systems raise more revenue to fund transfer payments on the spending side of the budget. Compared to other OECD nations, the U.S. has a more progressive but smaller tax system. Overall, other countries impose less progressive taxes, but these taxes are higher and fund larger welfare states.[1]

Motivated by these stylized facts, we investigate how alternative societal preferences can give rise to different degrees of tax progressivity, tax system size, and overall redistribution. Our basic model setup comes from the optimal tax framework. In a standard optimal income tax model, along the lines of the classic Mirrlees (1971), a utilitarian planner chooses a tax system for a society subject to certain constraints (e.g., the inability to observe a person's underlying ability to earn income). Optimal tax models are often used to derive normative implications and make policy recommendations (e.g., Diamond and Saez 2011; Mankiw, Weinzierl, and Yagan 2009). But although we start with an optimal tax framework, our aim in this paper is *not* to derive normative results. Rather, in the vein of political

[1] See Slavov and Viard (2016a,b) for further discussion. Lindert (2003) also argues that countries with large welfare states tend to impose relatively efficient taxes, featuring lower rates on capital compared to labor, consumption, and goods that generate negative externalities.

economy analyses like Grossman and Helpman (1994) or Meltzer and Richard (1981), we aim to explain why societies adopt the policies we observe. Instead of explicitly modeling political institutions (e.g., majority rule or lobbying), however, we derive such insights in an optimal tax framework by asking what a social planner's preferences must be to rationalize a particular tax system.[2] More specifically, we show how variation in societies' or policy-makers' preferences can explain stylized facts about the progressivity, size, and degree of redistribution of tax and transfer systems.

To capture the general structure of real-world tax-and-transfer systems, we consider piecewise linear marginal income tax rates with a lump-sum rebate. We also distinguish between the *tax system* and the *transfer system*. The piecewise linear income tax brackets, with nonnegative marginal rates, represent the tax system. Tax payments are therefore never negative.[3] The lump sum rebate represents the transfer system and is also always nonnegative. A multi-bracket system is more restrictive than many optimal tax models, which allow a different marginal tax rate at each level of income. However, it may be a better representation of real-world tax systems, which (presumably due to administrative costs) generally feature piecewise linear, rather than continuous, tax schedules. In our baseline analysis, we consider two-bracket tax systems, but we also show that increasing to four brackets does not fundamentally change our results. The lump-sum transfer captures the fact that real-world transfer programs tend to be highly progressive.[4] In standard optimal tax models, there is no distinction between

[2] As discussed by Saez (2001) and Saez and Stantcheva (2016), an optimal tax framework can be adapted to derive positive results – that is, to understand the societal preferences that might give rise to observed tax and transfer systems.

[3] While we refer to income taxes, these are equivalent to consumption taxes in our static model with only labor income. In this setting, therefore, the tax system could encompass both income taxes and value added taxes.

[4] Under a lump-sum transfer, all individuals receive the same absolute transfer payment. However, the transfer system is progressive because the transfer as a *share* of income is decreasing in income. For example, according to estimates by the Tax Policy Center (2020), the bottom 20 percent of households in the U.S. received 3.7 percent of total before-tax income in 2017. Those households would receive a much larger share – 20 percent – of the benefits of a lump-sum transfer. Distributional estimates for real-world spending programs show that they are highly progressive, although the degree of progressivity varies depending on what spending is counted, whether all households or non-elderly households are considered, and other assumptions. For example, Prante and Hodge (2013) estimate a distribution of U.S. federal spending (including traditional transfer programs and public goods) across all households and find results that are roughly consistent with a lump-sum transfer. They show that, in

taxes and transfers, as transfers are simply negative taxes.[5] However, taxes and transfers are often considered separately in policy discussions, as policymakers often want to understand their separate roles.[6] For example, OECD (2008) distinguishes between the progressivity of taxes and the progressivity of transfer payments and computes the degree of redistribution induced by each of the two parts of the tax-and-transfer system. Moreover, taxes can have different political implications compared to transfers. For example, in the U.S., some lawmakers have signed a pledge to never vote for a tax increase, though they are free to vote for spending cuts.[7] In the two-bracket model, redistribution can be increased either by increasing tax progressivity or by scaling up the entire tax system to fund the highly progressive transfer system.

We solve for the optimal tax systems of planners with different degrees of inequality aversion, as well as planners who place explicit weights on individuals in different parts of the wage distribution, in line with the preferences expressed by some policy makers. In the U.S., for example, some Democratic policy makers have emphasized the welfare of "the 99 percent" – the bottom 99 percent of income earners – relative to the top 1 percent (Stelter 2011), and some Republican policy makers have emphasized the impact of taxes on small business owners, who represent a larger share of income in higher tax brackets (Congressional Research Service 2010). Moreover, both Democrats and Republicans often express particular concern for the welfare of the "middle class." We calculate summary measures

2012, households in the bottom 20 percent received an average of $24,125 of federal spending, and those in the top 20 percent received an average of $21,402 of federal spending. In contrast, the Congressional Budget Office (2013) estimates that, in 2006, the bottom 20 percent of U.S. non-elderly households received roughly half of all federal transfer spending, while the top 20 percent received less than 7 percent. Those estimates suggest a transfer system that is even more progressive than the lump-sum transfer in our model. An even more progressive transfer system would likely strengthen our findings by making transfers (supported by a large tax system) an even more effective way to target the lowest-income households.

[5] Kaplow (2007) makes this point and examines the optimal design of transfer programs, including features like benefit levels and phase-outs.

[6] In practice, researchers make judgments calls about whether to classify a program as a tax or a transfer. For example, the Earned Income Tax Credit is often treated as a tax because it is administered through the tax code even though it results in negative net taxes (transfers) for many of its beneficiaries.

[7] See https://www.atr.org/federal-taxpayer-protection-questions-answers-a6204/.

of progressivity, government size, and redistribution for each planner's preferred policy to understand how they use these aspects of the tax-and-transfer system to achieve their distributive goals.

We find that social planners who exhibit greater inequality aversion choose similarly progressive tax systems compared to planners who exhibit less inequality aversion. However, the more inequality-averse planners choose a larger tax system, resulting in a tax-and-transfer system that induces more overall redistribution. We further show that utilitarian planners and planners who care only about the welfare of the bottom 99, 50, or 10 percent of the wage distribution tend to choose tax systems that are similar in their progressivity. However, the planners who care more about reducing poverty – i.e., who emphasize the welfare of the bottom 10 or 50 percent – choose much larger tax systems than utilitarian planners, resulting in larger amounts of redistribution. In contrast, planners who care about the welfare of individuals in the middle or upper portion of the wage distribution choose more progressive – but smaller – tax systems than utilitarian planners, resulting in less redistribution overall.

The intuition behind these results is as follows. First, the most effective way to redistribute towards those at the bottom of the income distribution is to impose high marginal tax rates across-the-board, using the revenue to increase the size of the highly progressive transfer system. Planners who choose this option reduce the distortive effect of high taxes by imposing less progressive marginal rates. Second, selecting a progressive but small tax system is the most effective way to direct redistribution towards those in the middle of the income distribution. Progressive marginal rates redistribute from the top of the income distribution towards the middle and the bottom. Meanwhile, a small government – which provides a small lump-sum transfer – reduces the amount of (efficiency-reducing) redistribution towards the bottom of the income distribution, leaving the middle relatively better off. Finally, there is sufficient income inequality in our model, which is calibrated to the Mankiw, Weinzierl, and Yagan's (2009) estimate of the U.S. wage distribution, that planners who only care about the top 10 or 50 percent of earners support progressive taxes. While regressive tax rates could potentially redistribute

income upwards to the favored income groups, progressive rates redistribute income downwards *within* the favored group (e.g., from the top 1 percent to the next 9 percent). Downward redistribution within the favored group increases welfare because of the concavity of individuals' utility functions, particularly when wage inequality is large at the high end. However, while progressive rates are optimal, those rates are kept very low to limit the amount of redistribution towards lower income individuals and resulting deadweight loss. (Nonnegativity constraints on marginal tax rates and the lump sum transfer restricts the extent to which high-income planners can redistribute income from other groups to their favored group.)

## II. **Significance and Contribution**

Our work is significant in light of economists' growing interest in understanding preferences for redistribution (e.g., Weinzierl 2014; Alesina and Giuliano 2011 Stantcheva 2021; Londoño-Vélez 2022; Charité, Fisman and Kuziemko 2015; Kuziemko et al. 2015). As Weinzierl (2014) shows, individuals' preferences often do not reflect the utilitarianism assumed in economic models, a finding that potentially has implications for optimal tax problems. While many papers on this topic use surveys or experiments to document people's preferences for redistribution, our contribution is theoretical. We utilize both a simple and intuitive analytical model, as well as a richer, more rigorous computational model, to derive predications about the relationship between redistributive preferences and observed tax-and-transfer systems. Our findings can inform future empirical studies of redistributive preferences, which can in turn be used to test the predictions of the model.

Closely related papers include work by Christiansen and Jansen (1978) and Ahmad and Stern (1984), who examine the societal preferences behind indirect taxes in Norway and India, respectively. More recently, Jacobs, Jongen, and Zoutman (2017) examine the societal preferences behind the tax policy proposals of Dutch political parties, concluding that all parties appear to give greater welfare

weight to middle-income earners than low-income earners. Bourguignon and Spadaro (2012) examine the societal preferences that rationalize the French tax and transfer system, finding that these preferences may involve negative welfare weights on the highest-income individuals. Relative to these papers, our contribution is to examine how societal preferences can explain differences in tax policy across high-income countries.

Our work also contributes to the broader literature on optimal tax problems, beginning with Mirrlees (1971). Within that literature, various authors have considered social welfare functions that exhibit differing degrees of inequality aversion. Saez (2001) derives optimal marginal tax rate schedules for both utilitarian and Rawlsian social planners (who care only about the well-being of the lowest-income individual). He finds that, compared to utilitarian planners, Rawlsian planners choose relatively high marginal tax rates at low incomes. While their preferred marginal tax rate schedules are less progressive, Rawlsian planners choose higher levels of taxes, resulting in a larger lump sum transfer payment to those with zero income. Boadway and Jacquet (2008) similarly show that Rawlsian planners choose marginal tax rates that decline with income. Tuomala and Weinzierl (2020) consider inequality aversion parameters ranging from utilitarian to Rawlsian. They show that higher levels of inequality aversion result in more regressive marginal rates, but more progressive average rates inclusive of any transfers.[8]

Relative to these papers, we consider a broader range of planner objectives. In addition to differing degrees of inequality or poverty aversion, which derive from theories of distributive justice (such as utilitarianism and Rawlsianism), we consider planners with more explicitly political objectives, who may place weight on the welfare of middle-income or even high-income individuals. Thus, relative to these earlier papers, our work is intended to provide a positive – rather than normative – analysis

[8] In another related paper, Saez and Stantcheva (2016) consider optimal tax models with generalized welfare weights, which they show can capture a broader range of societal objectives than the utilitarianism that is implicit in standard models.

that can explain the political preferences underlying certain observed tax systems. We also relate the optimal tax systems that arise under different welfare objectives to formal measures of progressivity, government size, and redistribution. Thus, we make predictions about how policy makers use both the progressivity and size of a tax system to achieve their distributional objectives.

Another set of papers in the optimal tax literature has considered piecewise linear tax systems, arguing that they better reflect real-world policy constraints.[9] In one of the earlier papers in this group, Slemrod et al. (1994) consider two-bracket tax systems and planners with varying degrees of inequality aversion. They find that optimal marginal tax rates are mildly regressive under the assumption of a lognormal wage distribution with parameters that reflect data from Stern (1976). Apps et al. (2014) argue that a Pareto distribution for wages provides a more accurate representation of reality, particularly given the recent rise in inequality towards the top of the distribution. They find strongly progressive tax rates in the two-bracket model under that assumption.[10] In this paper, as a baseline, we consider the two-bracket model of Slemrod et al. (1994). However, we update the wage distribution assumption using Mankiw, Weinzierl, and Yagan's (2009) approximation to the U.S. wage distribution. That approximation is lognormal at lower incomes but has a Pareto right tail. As a robustness check, we consider four-bracket systems and find that additional brackets do not alter our conclusions.[11] We also show that our conclusions remain largely unchanged with Slemrod et al.'s (1994) original model and parameterization.

## III. **Analytical Results**

[9] These papers include Sheshinki (1989); Slemrod, Yitzhaki, Mayshar, and Lundholm (1994); Hsu and Yang (2013); Apps, Long, and Rees (2014); Apps and Rees (2016); Andrienko, Apps, and Rees (2016); and Bastani, Blomquist, and Micheletto (2019).

[10] Andrienko et al. (2016) further show that increases in income inequality generally result in more progressive optimal rate structures.

[11] Along these lines, Andrienko et al. (2016) find that adding brackets to the piecewise linear model has only modest social welfare gains.

To motivate and provide the basic intuition behind our results, we derive some analytical results in a simplified model. Consider an economy with three individuals, denoted $H$, $M$, and $L$, who are capable of earning incomes of $w_H$, $w_M$, and zero, respectively. We assume $w_H > w_M > 0$. There is no labor supply decision. The tax system imposes an average tax rate of $0 \leq t_M \leq 1$ on the middle-income individual and an average tax rate of $0 \leq t_H \leq 1$ on the high-income individual; that is, the middle-income individual pays a tax of $t_M w_M$ and the high-income individual pays a tax of $t_H w_H$. The tax system is progressive if $t_M < t_H$ and regressive if $t_M > t_H$.

In the model, taxes potentially distort economic outcomes in two ways. First, the revenue collected by the tax is less than the mechanical impact of applying the tax rate to the individual's income. We assume that the revenue collected from individual $M$ is $t_M w_M - \gamma w_M t_M^2$. The first term is the mechanical effect of applying tax rate $t_M$ to individual $M$'s income; it is the hypothetical revenue that would be collected if the individual did not change their behavior in response to the tax. The second term represents the "leaky bucket" of Okun (1975): because taxes distort incentives and create administrative costs, a portion of the hypothetical, no-distortion revenue "leaks" out on its way to the government, leaving a smaller amount available for redistribution. The amount of revenue that leaks from the bucket is convex with respect to the size of the tax: the higher the tax, the greater the additional loss from an incremental increase in the tax. Second, there is private information: while the government can observe individuals' earned income, it cannot observe their underlying type. While there is no labor supply in this simple model, it is still possible for higher-income individuals to imitate lower-income individuals by throwing income away (assuming free disposal). Preventing this form of tax avoidance imposes an incentive compatibility constraint: after-tax income must be increasing in before-tax income. This approach to modeling the inefficiency of taxes is clearly oversimplified, but we adopt it in this section in order to derive intuitive, analytical results. In the following section, we consider a

richer, more realistic model – solved computationally – in which inefficiency arises endogenously in equilibrium from a labor supply decision.

In this model, revenue collected from individual $M$ is maximized at the top of the Laffer curve, where $t_M \equiv t^* = \frac{1}{2\gamma}$. Revenue collected from individual $H$ is analogously assumed to be $t_H w_H - \gamma w_H t_H^2$, with the top of the Laffer curve occurring where $t_H \equiv t^* = \frac{1}{2\gamma}$. We assume that $\gamma \geq 1$, which implies that as the tax rate continues to increase beyond the peak of the Laffer curve, revenue falls and reaches zero before the tax rate reaches 100 percent. Total revenue collected is $R = t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2$. This revenue funds a transfer system in which each individual receives $g = \frac{R}{3}$ as a lump sum. Therefore, the three individuals have after-tax-and-transfer incomes of

$$z_H = w_H(1 - t_H) + g$$

$$z_M = w_M(1 - t_M) + g$$

$$z_L = g$$

As noted above, incentive compatibility requires that after-tax-and-transfer income be increasing in before-tax-and-transfer income. That is, incentive compatibility requires:

$$w_M(1 - t_M) + g \geq g$$

$$w_H(1 - t_H) + g \geq w_M(1 - t_M) + g$$

The first constraint, which requires the middle-income individual to receive at least as much after-tax-and-transfer income as the low-income individual, is nonbinding since $t_M \leq 1$. The second constraint, which requires the high-income individual to receive at least as much after tax-and-transfer income as the middle-income individual, can be rearranged as follows:

$$t_H \leq 1 - \frac{w_M}{w_H} + \frac{w_M}{w_H} t_M$$

Figure 1 shows the feasible set for $t_H$ and $t_M$ – the feasible set is bounded by the solid, bold lines. The slope of the line defining the upper boundary for the feasible set is $\frac{w_M}{w_H}$. Note that the top of the Laffer curve for individuals $H$ and $M$— labeled $t^*$ in the diagram— is within this feasible set, as

$$\frac{1}{2\gamma} < 1 - \frac{w_M}{w_H} + \frac{w_M}{w_H}\left(\frac{1}{2\gamma}\right) \leftrightarrow \frac{1}{2\gamma} < 1$$

This point on each axis is labeled $t^*$ in Figure 1.

Let $U(z)$ denote an individual's utility from after-tax-and-transfer income $z$. We can use this utility function to derive each individual's preferences over policy parameters and represent them as a set of indifference curves. The high-income individual's indifference curve associated with utility level $U'_H$ is given by

$$U'_H = U(w_H(1 - t_H) + g)$$

Substituting for $g$, this expression can be rewritten as

$$U'_H = U\left(w_H(1 - t_H) + \frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$

$$= U\left(w_H - \frac{2}{3} w_H t_H - \gamma \frac{w_H}{3} t_H^2 + \frac{1}{3} t_M w_M - \gamma \frac{w_M}{3} t_M^2\right)$$

In Figure 1, these indifference curves have slope

$$\frac{dt_H}{dt_M} = \frac{w_M(1 - 2\gamma t_M)}{2w_H(1 + \gamma t_H)}$$

This slope is positive and less than $\frac{w_M}{w_H}$ when $t_M < t^* = \frac{1}{2\gamma}$. It is negative when $t_M > t^* = \frac{1}{2\gamma}$. In either case, utility increases towards the south, as $t_H$ decreases. Two representative indifference curves are depicted as $U'_H$ and $U''_H$, with $U''_H > U'_H$. Utility is maximized when $t_M = t^*$ and $t_H = 0$. Thus, a planner who favors the highest-income individual chooses a regressive tax system.

Similarly, the middle-income individual's indifference curve associated with utility level $U'_M$ is given by

$$U'_M = U\left(w_M(1-t_M) + \frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$

$$\rightarrow U'_M = U\left(w_M - \frac{2}{3}t_M w_M - \frac{\gamma}{3}w_M t_M^2 + \frac{1}{3}w_H t_H - \frac{\gamma}{3}w_H t_H^2\right)$$

These indifference curves have slope

$$\frac{dt_H}{dt_M} = \frac{2w_M(1+\gamma t_M)}{w_H(1-2\gamma t_H)}$$

The slope is positive and greater than $\frac{w_M}{w_H}$ for $t_H < t^*$ and negative for $t_H < t^*$. Utility increases to the west, as $t_M$ falls. Two representative indifference curves are given by $U'_M$ and $U''_M$, with $U''_M > U'_M$. If $1 - \frac{w_M}{w_H} < t^*$ (the case depicted in Figure 1), then utility is maximized when $t_M = 0$ and $t_H = 1 - \frac{w_M}{w_H}$. Otherwise, utility is maximized when $t_M = 0$ and $t_H = t^*$ . Thus, a planner favoring the middle class chooses a progressive tax system that keeps middle-class taxes at zero. This progressivity can come at a cost. In the case depicted in Figure 1, the tax rate imposed on the high-income individual is not as high as it could be. Going all the way to the top of the Laffer curve for the high-income individual violates incentive compatibility (i.e., it reduces the high-income individual's after-tax-and-transfer income below that of middle-income individuals) unless taxes on middle-income individuals are also increased. In other words, a middle-class planner may need to sacrifice size in exchange for progressivity, taxing the high-income individuals at lower than the revenue maximizing rate in exchange for not taxing the middle-income individual at all.

Next, the low-income individual's indifference curve associated with utility level $U'$ is given by

$$U' = U\left(\frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$

These indifference curves are elliptical with an unconstrained bliss point at $t_M = \frac{1}{2\gamma}$ and $t_H = \frac{1}{2\gamma}$. Two representative indifference curves are depicted as $U'_L$ and $U''_L$, with $U''_L > U'_L$. Thus, a planner favoring the low-income individual chooses a tax system that is as large as possible (at the top of the Laffer curve

for the other two individuals). However, the tax system is proportional, which minimizes its deadweight loss. Compared to the middle-class planner, the low-income planner chooses a larger tax system, sacrificing progressivity for size.

In contrast to these "special-interest" planners, a standard utilitarian planner maximizes the sum of the three individuals' utilities:

$$W(t_H, t_M) = U\left(w_H(1-t_H) + \frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$
$$+ \ U\left(w_M(1-t_M) + \frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$
$$+ U\left(\frac{t_M w_M + t_H w_H - \gamma w_M t_M^2 - \gamma w_H t_H^2}{3}\right)$$

The derivatives of this social welfare function with respect to $t_H$ and $t_M$ are:

$$\frac{\partial W}{\partial t_H} = -U'(z_H)\left(\frac{2}{3}w_H(1+\gamma t_H)\right) + U'(z_M)\left(w_H\left(\frac{1}{3}-\frac{2}{3}\gamma t_H\right)\right) + U'(z_L)\left(w_H\left(\frac{1}{3}-\frac{2}{3}\gamma t_H\right)\right)$$

$$\frac{\partial W}{\partial t_M} = U'(z_H)\left(w_M\left(\frac{1}{3}-\frac{2}{3}\gamma t_M\right)\right) - U'(z_M)\left(\frac{2}{3}w_M(1+\gamma t_M)\right) + U'(z_L)\left(w_M\left(\frac{1}{3}-\frac{2}{3}\gamma t_M\right)\right)$$

The first expression, $\frac{\partial W}{\partial t_H}$, is negative when $t_H = t^* = \frac{1}{2\gamma}$, suggesting that social welfare is maximized before the top of the Laffer curve is reached for the high-income individual. A similar argument suggests that at an optimum, $t_M < t^* = \frac{1}{2\gamma}$. Thus, a utilitarian planner chooses a smaller tax system than the low-income planner, as well as a lower tax rate on the middle class compared to the high-income planner. Compared to the middle-class planner, the utilitarian planner imposes a higher tax rate on the middle-income individual. However, the tax rate the utilitarian planner imposes on the high-income individual may be higher or lower. If the middle-class planner is not constrained by incentive compatibility and chooses a tax rate of $t_H = t^*$, then the utilitarian planner's optimal tax on the high-income individual is lower. If the middle-class planner is constrained by incentive compatibility and imposes a tax rate of $1 -$

$\frac{w_M}{w_H}$ on high-income individuals, then the utilitarian planner's tax rate on this group may be higher or lower in comparison. In contrast with the utilitarian planner (who considers the welfare of all groups), each special interest planner acts like a "leviathan" with respect to the other groups. Since a special interest planner's favored group derives no benefit from lowering the tax rate on other groups, it is in the planner's interest to maximize revenue from the other groups.

To draw conclusions about progressivity, we need to compare the optimal values of $t_M$ and $t_H$. When $t_H = 0$, the first expression reduces to

$$\frac{\partial W}{\partial t_H} = \left[\left(U'(z_M) + U'(z_L)\right) - 2U'(z_H)\right]\left(\frac{1}{3}w_H\right)$$

Due to the concavity of the utility function, $U'(z_M) + U'(z_L) > 2U'(z_H)$, suggesting that $\frac{\partial W}{\partial t_H}(t_M, 0) > 0$ and the optimal $t_H$ is positive.

When $t_M = 0$, the second expression reduces to $\frac{\partial W}{\partial t_M} = \left[\left(U'(z_H) + U'(z_L)\right) - 2U'(z_M)\right]\left(\frac{1}{3}w_M\right)$. Depending on the size of $U'(z_H) + U'(z_L)$ compared to $U'(z_M)$, the optimal $t_M$ may be either zero (if the expression is weakly negative) or strictly positive (if the expression is strictly positive). Thus, compared to the middle-income planner, the utilitarian planner chooses a tax system that is either equally progressive (high-income individuals bear the entire tax burden) or less progressive (middle-income individuals bear some share of the total tax burden).

Overall, therefore, we can conclude that, compared to utilitarian planners, low-income planners choose tax systems that are larger, achieving more redistribution by scaling up the tax system. These larger tax systems may be either more progressive or less progressive; in the simulations that follow, they are similarly progressive. Compared to low-income planners, middle-income planners choose tax systems that are more progressive. Compared to utilitarian planners, middle-income planners choose tax systems that are weakly more progressive.

## IV. **Computational Model**

Next, we turn our attention to a richer model with many agents. We continue to assume that while the government observes each person's realized income, the underlying ability to earn income is private information. However, we now introduce a labor supply decision. Thus, there is no longer a need for an ad hoc "leaky bucket" term to capture the inefficiency of taxation. Deadweight loss arises endogenously in equilibrium due to distortion of the labor supply decision. The multi-bracket structure of the tax system ensures that after-tax income is increasing in before-tax income, so there is no incentive to throw away income. While we cannot derive analytical results for this richer model, we can solve the model computationally for plausible parameter values that are in line with the optimal tax literature.

### *a. Model Setup*

Let $T(y_i)$ the net tax paid by an individual with a pre-tax income of $y_i$. Each individual, $i = 1, \dots, N$, chooses consumption, $c_i \geq 0$, leisure, $z_i \geq 0$, and labor supply, $l_i \geq 0$, to maximize

$$U_i(c_i, l_i) = \log\left(c_i - \frac{l_i^k}{1+k}\right) \tag{1}$$

subject to the budget constraint $c_i = w_i l_i - T(w_i l_i)$, where $w_i$ is the individual's exogenous wage (reflecting their ability to earn income), and $k$ is a preference parameter that is common across all individuals. This utility function is used in Saez's (2001) numerical simulations. Because it is a monotonic transformation of a quasilinear utility function, there are no income effects, and the compensated and uncompensated labor supply elasticities are both equal to $\frac{1}{k}$.

We assume individuals are ordered from lowest to highest ability-to-earn; that is, $w_1 \leq w_2 \leq \cdots \leq w_N$. We assume that ability-to-earn is private information. The government observes (and can tax) only realized income. Net taxes are determined by a two-bracket system with a lump-sum transfer as follows:

$$T(w_i l_i) = \begin{cases} -g + t_1 w_i l_i & if \quad w_i l_i \leq \bar{y} \\ -g + t_1 \bar{y} + t_2 (w_i l_i - \bar{y}) & if \quad w_i l_i > \bar{y} \end{cases} \tag{2}$$

In this equation, $t_1$ is the marginal tax rate that applies to income in the lower bracket, $t_2$ is the marginal tax rate that applies to income in the upper bracket, $\bar{y}$ is the threshold between the brackets, and $g$ is the lump sum transfer. We denote the optimal values of consumption and labor supply for individual $i$ by $c_i^*(t_1, t_2, \bar{y}, g)$ and $l_i^*(t_1, t_2, \bar{y}, g)$ and the maximized utility function as $V(t_1, t_2, \bar{y}, g) \equiv U(c_i^*(t_1, t_2, \bar{y}, g), l_i^*(t_1, t_2, \bar{y}, g))$.

The planner chooses $t_1 \in [0,1], t_2 \in [0,1], \bar{y} \in [0, w_N]$ , and $g \geq 0$ to maximize a social welfare function

$$\sum_{i=1}^{N} \theta_i \left(\frac{1}{v}\right) U_i[c_i^*(t_1, t_2, \bar{y}, g), l_i^*(t_1, t_2, \bar{y}, g)]^v \tag{3}$$

subject to the government budget constraint $\sum_{i=1}^{N} T_i[w_i l_i^*(t_1, t_2, \bar{y}, g)] = 0$. In this equation, $v$ is a parameter that captures the planner's aversion to inequality, and $\theta_i$ is the explicit welfare weight that the planner places on individual $i$'s utility, potentially reflecting a political preference for individuals in a particular part of the wage distribution. Because before-tax income is weakly increasing in wage for all tax systems we consider, the $\theta_i$'s can be interpreted as welfare weights that vary based on an individual's rank in both the wage and before-tax income distributions. The nonnegativity constraints on the tax rates and the transfer payment ensure that after-tax income (consumption) is always nonnegative.

While this model allows individuals to avoid tax by working less, it does not allow for the possibility of tax evasion. That is, individuals are not given the opportunity to misreport their realized income. Introducing tax evasion into the model would require modeling features like government monitoring and enforcement, which are themselves policy parameters (see Slemrod and Kopczuk 2002). Thus, a full treatment of tax evasion is beyond the scope of this paper. If features like enforcement are held constant, then in our model, tax evasion would provide another margin, in addition to labor supply,

along which people can adjust behavior. This possibility would likely increase the deadweight loss from taxation (e.g., Gillman 2020) and make higher taxes less attractive to planners of all types.[12] If high-income individuals have a greater propensity to engage in tax evasion (e.g., Alstadsæter, Johannesen, and Zucman 2019), then highly progressive taxes may become less attractive to all types of planners. However, we would not expect these changes to qualitatively alter our findings about the relative policy preferences of planners with different objectives.

*b. Model Calibration*

Following the approach in Slemrod et al. (1994), we consider 1,000 individuals such that the $i$-th individual's wage corresponds to a cumulative probability of $0.0005 + .001(i - 1)$ in the wage distribution. That is, the first individual's wage corresponds to a cumulative probability of 0.0005, the second individual's wage corresponds to a cumulative probability of 0. 0015, and so on. The 1,000th individual's wage corresponds to a cumulative probability of 0.9995. The wage distribution is based on Mankiw et. al's (2009) approximation to the 2007 U.S. wage distribution from Current Population Survey data. The fitted distribution is lognormal for hourly wages below $42.50 but has a Pareto right tail for wages above that amount. It also includes a mass of 5 percent of "disabled" workers at the low end of the distribution with hourly wages of $0.01. Mankiw et al.'s (2009) replication code and data allow us to reconstruct their discretized version of this probability distribution, in which wages are binned into increments of $3.50. The code produces the probability mass in each wage bin, which is then used to construct the cumulative distribution function. We use this distribution to simulate wages for our 1000-

[12] Feldstein (1999) argues that the deadweight loss of taxation ultimately depends on the compensated elasticity of taxable income with respect to the tax rate. This parameter captures all margins along which individuals may alter their behavior in response to a tax, including labor supply, saving, and income reporting. Chetty (2009) argues that in many real-world settings, deadweight loss depends on the elasticities of both taxable and earned income. In either case, providing additional opportunities to adjust behavior should increase deadweight loss.

person population. In the individual utility function (1), we follow Saez (2001) and consider labor supply elasticities of 0.25 and 0.5 (corresponding to $k = 4$ and $k = 2$).

In the social welfare function (3), we first consider a utilitarian planner with $\theta_i = 1$ for all $i$. For these utilitarian planners, we consider $v = 1$ and $v = -2$; the latter case corresponds to greater inequality aversion. Second, we consider cases where $\theta_i = 1$ for $i \leq m$ and $\theta_i = 0$ for $i > m$. That is, the planner cares only about the bottom $m$ individuals. We set $m = 990, 500$, and $100$. When $m = 990$, the planner cares only about the welfare of the bottom 99 percent of the wage distribution. When $m = 500$, the planner cares only about the bottom 50 percent of the wage distribution. When $m = 100$, the planner cares only about the bottom 10 percent of the wage distribution. Third, we consider cases in which the planner sets $\theta_i = 1$ for $(1000 - m) \geq i \geq m$, and 0 for all other $i$. We choose $m = 100, 200$, and $300$, corresponding to planners who care about individuals in the middle 80 percent, 60 percent, and 40 percent of the wage distribution. Finally, we consider cases in which the planner sets $\theta_i = 1$ for $i \geq m$ and $\theta_i = 0$ for $i < m$. That is, the planner only cares about higher wage earners. We choose $m = 10, 100$, and $500$, corresponding to planners who care only about the top 1 percent, 10 percent, and 50 percent, respectively. For all cases where $\theta_i \neq 1$ for any $i$ (i.e., the planner favors a subset of individuals), we set $v = 1$.

When $\theta_i$ varies across individuals, the planner's preferences reflect two redistributive goals. First, due to concavity of the utility function, the planner wants to redistribute income downward within the favored group. Second, the planner wants to redistribute income away from any non-favored groups. These goals push in the same direction for a planner who favors lower or middle-and-lower income individuals. Such a planner wants to redistribute income downwards within the favored group and downwards from higher-income individuals to the favored group. A planner who favors middle-income individuals wants to redistribute income downwards within this group and downwards from higher-income to middle-income individuals; however, the planner also wants to redistribute income

upwards from lower-income individuals. A planner who favors high-income individuals wants to redistribute income downwards within this group but upwards from the non-favored groups.

We solve for the values of the tax parameters that maximize social welfare using MATLAB's patternsearch algorithm, which is based on calculating the objective function value at a mesh of points around a starting point. If an improvement is found, the starting point is updated to the new optimal point and the size of the mesh is expanded. If an improvement is not found, the size of the mesh is reduced. The algorithm thus finds a sequence of points converging to a local optimum.[13] For each set of tax parameters considered, we solve (using MATLAB's nonlinear equation solver, fsolve) for the value of $g$ that balances the government budget under the assumption that individuals maximize utility (considering both interior and corner solutions for labor supply), given the tax parameters. To ensure that we find a global rather than a local optimum, we select a grid of equally spaced starting points and take the maximum value of social welfare across the set of solutions. To further refine the solution, we consider a finer grid of equally spaced starting points around that optimum and repeat the procedure.[14,15]

*c. Progressivity, Redistribution, and Efficiency Measures*

We utilize several alternative measures of tax progressivity, redistribution, and economic efficiency. In calculating these measures, we draw a distinction between the *tax system* and the *transfer system*. The distinction between taxes and transfers is arbitrary in theory, as transfers are simply negative taxes and therefore irrelevant for solving an optimal tax model. Thus, our approach contrasts

[13] See https://www.mathworks.com/help/gads/how-pattern-search-polling-works.html.
[14] Additional details and MATLAB code are available upon request.
[15] The income thresholds that define the tax brackets have upper bounds of infinity. In choosing starting values, we set the upper bounds for these thresholds to the maximum realized income in an economy with no taxes. Our computational approach replicates the two-bracket solutions of Slemrod et al. (1994), who use a grid search to solve the model. While a grid search is more systematic, the patternsearch algorithm is more efficient, particularly for the four-bracket version of the problem.

with much of the optimal tax literature. However, this distinction has budgetary, empirical, and policy relevance. For example, widely cited estimates of the distribution of U.S. federal taxes either do not include, or separate out, the distributional impact of transfer payments (Tax Policy Center 2020; Congressional Budget Office 2013; OECD 2008). Empirical studies have also examined the progressivity of tax systems alone, or the separate effects of taxes versus transfers (e.g., Splinter 2020; Guillaud, Olckers, and Zemmour 2017; Saez and Zucman 2020). In this body of work, the tax system typically includes income, payroll, corporate, estate, and other taxes. The transfer system includes social insurance payments, such as public pension and unemployment benefits, as well as means-tested transfers. The arbitrariness of the distinction between taxes and transfers can be illustrated by the fact that – while tax payments are *usually* nonnegative – refundable credits, like the earned income tax credit, may result in negative tax liability. Moreover, the tax system may include tax expenditures, which lower tax liability for certain individuals and could legitimately considered spending rather than taxes. But as these provisions are administered through the tax code, they are generally classified as taxes. Nonetheless, programs are in practice divided into taxes or transfers, and policy discussions often refer to their progressivity and distributional impact of these categories separately.

We define the tax system as the two nonnegative marginal rates, $t_1$ and $t_2$, as well as the income threshold between the brackets, $\bar{y}$. Consistent with the discussion above, the tax system does *not* include the lump sum transfer, which we treat separately. A standard indicator of progressivity is whether average tax rates rise with income, and we present results that employ this measure. With only two brackets, average rate progressivity is equivalent to marginal rate progressivity.[16] While rising average tax rates can be used to identify progressive tax systems, they do not allow us to rank tax systems by their *degree* of progressivity. For that, we use the Kakwani (1976) index, a summary of the

[16] To see this, note that for individuals in the bottom bracket, the average tax rate is $t_1$, which is constant with income. For individuals in the top bracket, the average tax rate is $\frac{[t_1\bar{y}+t_2(y-\bar{y})]}{y} = t_2 - (t_2 - t_1)\left(\frac{\bar{y}}{y}\right)$, which is equal to $t_1$ for $y = \bar{y}$ and increasing with $y$ if and only if $t_2 > t_1$.

overall progressivity of the tax system. While the Kakwani index is not without flaws, it is often used in empirical studies and policy discussions (see e.g., Creedy 1999; Creedy et al. 2008; Splinter 2020; OECD 2008; Guillaud, Olckers, and Zemmour 2017), and therefore it is useful to examine how this statistic might vary depending on society's redistributive goals.[17]

To define the Kakwani index, let $y_i$ denote the pre-tax income of individual $i$, and let $T_i$ denote the tax burden of individual $i$. Individuals are assumed to be ranked from lowest to highest by income. Define $\mu_i \equiv \frac{y_i}{\sum_{j=1}^{N} y_j}$ and $\lambda_i \equiv \frac{T_i}{\sum_{j=1}^{N} T_j}$. Thus, $\lambda_i$ represents the share of society's total taxes paid by individual $i$, and $\mu_i$ represents the share of society's total income earned by individual $i$. The Kakwani index is defined as follows:

$$2\sum_{k=1}^{N}\frac{1}{N}\left(\frac{k}{N}-\sum_{i=1}^{k}\lambda_i\right)-2\sum_{k=1}^{N}\frac{1}{N}\left(\frac{k}{N}-\sum_{i=1}^{k}\mu_i\right) \quad (4)$$

The second term in this equation is the Gini coefficient for pre-tax income, with each term in parenthesis representing the deviation of the income share of the bottom $k$ individuals from the share those individuals would earn if income were distributed perfectly equally ($\frac{k}{N}$). The first term in the equation is the concentration coefficient for taxes, with each term in parenthesis representing the deviation of the tax share of the individuals with the $k$ lowest incomes from the share those individuals would pay if taxes were distributed perfectly equally. It is analogous to a Gini coefficient for taxes, except for the fact that individuals are ranked by pre-tax income rather than taxes paid.

Intuitively, the Kakwani index measures the degree to which tax payments are concentrated at the top of the income distribution relative to the degree to which income is concentrated at the top of the income distribution. A higher Kakwani index implies greater tax progressivity. A proportional tax system – in which each person's tax share is the same as his or her income share – would result in a

[17] See Slavov and Viard (2016a) for additional discussion, examples, and references related to the Kakwani index and other concepts in this section.

Kakwani index of zero. A progressive tax system – in which tax payments are more concentrated at the top than incomes – would have a positive Kakwani index. A regressive tax system – in which tax payments are less concentrated at the top than incomes – would have a negative Kakwani index. One property of the Kakwani index is that scaling up any given tax system by increasing tax burdens across-the-board leaves individuals' tax shares, and therefore the index, unchanged. It is important to note that the Kakwani index is only meaningful if the tax system is treated separately from the transfer system. If taxes and transfers are combined, then total taxes (taxes plus transfers) are zero.

We summarize the degree of redistribution in the tax, transfer, or overall tax-and-transfer system with the Reynolds-Smolensky index (Reynolds and Smolensky 1977). The Reynolds-Smolensky index is defined as the difference between the Gini coefficient for before-tax income and the Gini coefficient for (as appropriate) after-tax, after-transfer, or after-tax-and-transfer income. While the Reynolds-Smolensky index provides a summary measure of redistribution, an alternative indicator for the redistribution induced by the overall tax-and-transfer system would be the degree to which average *net* tax rates – i.e., taxes net of transfers, as a share of income – rise with income. Increasing average net tax rates would indicate the presence of redistribution from high-income individuals to low-income individuals.

Define the size of government (or the tax system) as follows:

$$S = \left( \frac{\sum_{i=1}^{N} T_i}{\sum_{i=1}^{N} y_i - \sum_{i=1}^{N} T_i} \right) \tag{5}$$

That is, $S$ represents total taxes as a share of total after-tax income. Kakwani (1984) shows that the Kakwani index ($K$) and Reynolds-Smolensky index ($R$) for a tax system are related as follows:

$$R = S \cdot K \tag{6}$$

Thus, the amount of redistribution induced by a tax system (the Reynolds-Smolensky index) is equal to the product of its progressivity (the Kakwani index) and its size.[18] According to this equation, even though scaling up a progressive tax system does not increase the Kakwani index (i.e., it leaves progressivity unchanged), it does induce more income redistribution (i.e., it results in a larger reduction in the Gini coefficient). Thus, all else equal, larger tax systems – if they are even slightly progressive – induce more redistribution than smaller tax systems. For example, if the entire tax burden was placed on the person with the highest income, the system would be extremely progressive. However, if only one dollar of tax revenue was raised, there would be almost no reduction in inequality. Intuitively, the progressivity of the tax system measures the amount of redistribution achieved per dollar of tax collected. Multiplying by the size of the tax system then yields the total amount of redistribution induced by the tax system.

The relationship between progressivity and size is depicted in Figure 2 for progressive tax systems (i.e., $K > 0$). Because the level of redistribution is determined jointly by progressivity and size, each point in the $K - S$ plane lies on an iso-redistribution curve, and the level of redistribution increases as we move further away from the origin. The arrow shows that planners may choose a larger tax system to achieve a particular distributional objective and move up to a higher iso-redistribution curve. As they do this, they may need to mitigate the distortive effect by lowering the progressivity of the tax system.

Equation (6) and Figure 2, which link a tax system's Kakwani and Reynolds-Smolensky indices, do not consider the redistributive effect of the transfer system. All else equal, a larger tax system can fund a larger transfer system, which can further reduce income inequality. Given that transfers tend to be

[18] See also Creedy (1999) and Creedy, Enright, Gemmell, and McNabb (2008) for further discussion. This formulation assumes that the tax system does not result in a reranking of individuals, whereby one individual may have higher before-tax income but lower after-tax income than another individual. Reranking does not occur in the two-bracket system considered here. If reranking occurs, a reranking term (Atkinson 1980; Plotnick 1981) must be subtracted from the right-hand-side of the equation.

highly progressive, even regressive taxes (such as the value added taxes that are common outside the U.S.) can result in more redistribution than progressive taxes if they are large enough.

To measure efficiency loss from the redistribution, for each individual, $i$, we calculate the compensating variation ($CV_i$) of a tax system with parameters $(t_1, t_2, \bar{y}, g)$ by solving

$$V(t_1, t_2, \bar{y}, g + CV_i) = V(0,0, \bar{y}, -T_i^*), \tag{7}$$

where, $T_i^* \equiv T(w_i l_i^*(t_1, t_2, \bar{y}, g))$. Intuitively, $CV_i$ is the additional lump-sum transfer that must be provided to equate utility under the tax system represented by $(t_1, t_2, \bar{y}, g)$ with utility in a system in which the same amount of net tax is collected as a lump sum. We represent the aggregate efficiency loss by summing the compensating variation amounts across individuals and dividing it by GDP.

We calculate the measures discussed in this section for each optimal tax solution in our model. We note that these measures are not the only way (and not necessarily even the best way) to capture the underlying concepts of progressivity, government size, redistribution, and economic efficiency. However, they are representative of measures that policy analysts use to evaluate tax systems and make cross country comparisons (e.g., OECD 2008). Thus, they allow us to connect theory and practice.

## V. **Results**

Table 1 presents the tax rates ($t_1$ and $t_2$) and lump sum transfers ($g$ as a share of average income or per-capita GDP) selected by planners with alternative social welfare objectives. The table also shows the fraction of individuals who are in the top tax bracket. The top panel of the table shows results for a labor supply of elasticity of 0.5, while the bottom panel shows results for a labor supply elasticity of 0.25. When the elasticity of labor supply is 0.5, the top panel of Table 1 suggests that utilitarian planners choose regressive marginal tax rates. However, the top tax rate – close to zero – applies only to the highest earner (consistent with Mirrlees 1971), with a flat rate applying to everyone else. When the elasticity of labor supply is 0.25, utilitarian planners with less inequality aversion choose progressive

marginal rates, while utilitarian planners with more inequality aversion choose regressive marginal rates (with the zero top bracket rate applying only to the highest earners). For both values of elasticity, marginal rates are regressive for planners favoring the bottom 50 percent or 10 percent. They are progressive for planners favoring the top 10 or 50 percent, or middle-income individuals.

The top panel of Figure 3 shows the average tax rate (taxes as a share of pre-tax income) at each wage level for a labor supply elasticity of 0.5. Recall that the average tax rate measure includes only the tax system – i.e., the two marginal rates and the threshold between the brackets. For presentation purposes, we show results only the two utilitarian planners, the planner who favors the bottom 10 percent, and the planner who favors the middle 60 percent; the full set of results is available upon request. These results suggest that utilitarian planners generally choose a tax system with (almost) flat average rates, although an increase in inequality aversion results in higher average tax rates across the board (which in turn fund a larger transfer). The planner favoring the bottom 10 percent selects regressive average rates, but taxes are relatively high and fund a generous transfer system. The planner favoring the middle 60 percent selects progressive (but relatively low) average rates. The bottom panel of Figure 3 depicts the average *net* tax rate – that is, taxes minus transfers as a share of pre-tax income. Average net tax rates are progressive for all planners (although the degree of progressivity varies), suggesting that all tax-and-transfer systems redistribute from high-income to low-income individuals. Figure 4 shows that results are similar for a labor supply elasticity of 0.25.

To summarize the relationship between progressivity, size, and redistribution more succinctly, the top panel of Figure 5 presents a scatterplot of the Kakwani index of progressivity (equation 4) versus the size of government (equation 5) for the optimal tax systems shown in Table 1. The panel therefore represent the relationship between two policy levers for inducing redistribution. The bottom panel of Figure 5 shows a scatterplot of the Reynolds-Smolensky index of redistribution (reduction in the Gini coefficient) versus the efficiency loss (compensating variation derived from equation 7) for the same

planners' optimal tax-and-transfer systems. Therefore, the panel depicts the relationship between redistribution and efficiency loss (i.e., the equality-efficiency tradeoff). The results presented in Figure 5 are for a labor supply elasticity of 0.5. Figure 6 shows corresponding results for a labor supply elasticity of 0.25.

The bottom panel of Figure 5 suggests that that planners who favor the bottom 10 percent or bottom 50 percent – whose primary aim is to reduce poverty – choose substantially more redistribution, at the cost of greater efficiency loss, than planners with equal weights. The top panel of Figure 5 suggests that this redistribution is induced primarily by scaling up the size of government rather than by increasing progressivity. A similar finding applies to utilitarian planners with greater inequality aversion ($v = -2$) compared to planners with less inequality aversion ($v = 1$), with the former planner inducing additional redistribution by scaling up the size of government rather than increasing progressivity. In contrast, the top panel of Figure 5 suggests that planners who favor the middle 40, 60, or 80 percent, as well as planners who favor the top 50 or 10 percent, choose substantially more progressive, but smaller, tax-and-transfer systems than planners with equal weights. The bottom panel of Figure 5 suggests that these "middle class" planners induce slightly less overall redistribution than utilitarian planners, although the efficiency cost of their preferred tax systems is similar or higher. Planners who favor the bottom 99 percent select similar tax-and-transfer systems to utilitarian planners, while planners who favor the top 1 percent select zero taxes (shown only in the bottom panel, as the Kakwani index is undefined when taxes are zero).

Overall, Figure 5 suggests that planners with high inequality aversion, as well as planners wishing to induce greater redistribution towards the low end of the income distribution, find it optimal to do so by choosing relatively large, but not particularly progressive, tax systems compared to planners with more utilitarian or less inequality-averse preferences. For these inequality- and poverty-averse planners, scaling up the transfer system is the most effective way to redistribute income towards low-

income individuals. In contrast, planners wishing to induce redistribution towards middle-income individuals find it optimal to do so by choosing highly progressive, but relatively small, tax systems compared to planners with more utilitarian preferences. For these middle-class planners, progressive tax systems allow for downward redistribution within the favored group (desirable due to the concavity of individuals' utility functions), as well as away from higher-income earners, while small government limits redistribution towards lower-income individuals. Planners favoring the top 10 or 50 percent prefer progressive taxes for their ability to increase social welfare by redistributing downwards within the favored group; the degree of income inequality at the high end of the income distribution makes progressive rates more attractive than the regressive rates that might enable some upward redistribution. Figure 6 shows that these conclusions are not altered by assuming a lower labor supply elasticity of 0.25.

These results have implications for public debates about the tax rates that the highest income earners should face, a debate that is often informed by the optimal tax literature investigating the optimal top tax rate (see, e.g., Piketty, Saez, and Stantcheva 2014; Diamond and Saez 2011; Mankiw, Weinzierl, and Ferris 2009; Andrienko et al. 2016). While public debates tend to equate a higher top tax rate with greater progressivity (e.g., high-income individuals paying their "fair share"), Table 1 suggests that this does not necessarily need to be the case. The top tax rate depends on both the size and the progressivity of the tax system. Progressivity in turn depends upon the relative levels of the two tax rates, as well as the fraction of people in each bracket. For example, Table 1 shows that for both values of the labor supply elasticity, planners favoring the bottom 10 percent choose a higher top tax rate than planners with equal weights. However, Figures 5 and 6 show that the tax systems chosen by planners favoring the bottom 10 percent are more regressive (but larger) than those chosen by the planners with equal weights. The increase in regressivity is driven by higher marginal rates on middle-income

individuals relative to high-income individuals, as more middle-income individuals are in the top bracket under the optimal tax-and-transfer systems of the planners favoring the bottom 10 percent.

To check for robustness to the two-bracket assumption, we consider a system with four brackets. Table 2 presents analogous results to Table 1, and Figures 7 and 8 present analogous results to Figures 5 and 6, for the four-bracket system. The top panel of Table 2 suggests that when the elasticity of labor supply is 0.5, the additional flexibility of the four-bracket system leads utilitarian planners to choose progressive marginal rates for most people; the exception is that a zero rate applies to the highest-earning individual (again consistent with Mirrlees 1971). When the elasticity of labor supply is 0.25, utilitarian planners choose relatively high marginal tax rates in the bottom bracket, followed by progressive marginal rates across the next two brackets (consistent with Saez 2001); a relatively low rate applies to the highest-earning individual. However, the general conclusions about progressivity and redistribution are largely unaltered by the additional brackets. Middle class planners choose more progressive, smaller tax systems (top panels of Figures 7 and 8), resulting in a similar reduction in the Gini coefficient but a greater efficiency loss (bottom panels of Figures 7 and 8), compared to utilitarian planners. More inequality-averse planners and planners favoring the bottom 10 or 50 percent choose more redistribution (and greater efficiency loss) compared to less inequality-averse or utilitarian planners (bottom panels of Figures 7 and 8). This additional redistribution is primarily achieved by scaling up the tax system rather than increasing progressivity (top panels of Figures 7 and 8). Planners favoring the top 10 percent or 50 percent select progressive, but very small tax systems.

As an additional robustness check, we solve the two-bracket problem using the original parameterization of Slemrod (1994), which features a lognormal wage distribution (with substantially less inequality than the distribution considered in the main results) and a CRRA utility function with elasticity of substitution between consumption and leisure of 0.2, 0.4, or 1.0. For each elasticity of substitution, the weight on consumption is selected such that the median wage individual's labor supply

is 0.67. The conclusions are largely similar. Figures A1-A3 in the appendix present results analogous to Figures 5 and 6, but for elasticities of substitution of 0.2, 0.4, and 1.0 respectively. Table A1 in the appendix presents results analogous to Table 1. Our conclusions regarding progressivity and redistribution remain largely unchanged, although the lower degree of income inequality results in planners who favor high-income individuals selecting (very small) regressive tax systems that redistribute income upwards.

## VI. Discussion and Conclusion

In this paper, we have presented computational solutions to a tax model with two- or four brackets and lump sum redistribution. This model captures important features of real-world tax-and-transfer systems, including piecewise linear tax schedules, a highly progressive transfer system, and a separation of the tax system from the transfer system. We have examined how different social welfare functions can give rise to differing degrees of tax progressivity, government size, and overall income redistribution. Our results suggest that smaller, more progressive tax systems are consistent with more emphasis on the well-being of either the middle class or higher (but not the highest) earners. Larger, less progressive tax systems – which also carry out more overall redistribution – are consistent with more emphasis on poverty reduction (the well-being of the bottom 10 percent). These differences arise because scaling up the transfer system (while limiting efficiency losses by making taxes less progressive) is the most effective way to direct resources towards the lowest-income individuals. In contrast, making the tax system more progressive (while limiting efficiency losses by keeping taxes low) is the most effective way to direct resources towards middle- and higher-income individuals. These results could help to explain the varying levels of tax progressivity and redistribution observed across countries.

More specifically, the model makes several testable predictions. First, societies that choose large tax systems with limited progressivity place greater weight on improving the well-being of those at

the bottom of the income distribution. Second, societies that choose small, highly progressive tax systems are more focused on improving the well-being of middle-income individuals. These predictions can be tested using cross-country surveys. For example, de Bresser and Knoef (2022) develop a survey approach to elicit respondents' distributional preferences at all levels of the income distribution, incorporating behavioral responses to taxation. They present results for one country – the Netherlands. However, comparing responses to such a survey across countries could provide an empirical test of the model's predictions. While performing such an empirical test is beyond the scope of this paper, evidence from the Pew Research Center (Table 3) suggests that, when asked what issues they feel pessimistic about, Americans express less concern than Europeans about income inequality and the availability of well-paying jobs relative to the way their political system works. While not definitive, concern about income inequality can be interpreted as a greater societal aversion to inequality, while concern about the availability of well-paying jobs can be interpreted as greater weight on the welfare of the bottom 10 percent of the wage distribution.

It is also worth noting that our findings are related to an argument made by Slavov and Viard (2016b), who analyze cross-country measures of progressivity and redistribution based on data in OECD (2008). They suggest that the U.S. tax-and-transfer system may be the result of Democrats' emphasis on high-end inequality (e.g., the bottom 99 percent versus the top 1 percent) and high-income individuals paying their "fair share" of taxes, combined with Republicans' focus on low taxes (versus more efficient but higher taxes). A compromise between those two positions may have resulted in a small, progressive tax system. Consistent with that argument, we have formally shown that an emphasis on high-end inequality (the welfare of the bottom 99 percent) does predict a smaller (and perhaps slightly less progressive) tax system than an emphasis on low-end inequality (the welfare of the bottom 10 percent). Favoring the middle class or the top 10 or 50 percent of the wage distribution results in an even smaller, more progressive tax system. However, we have not modeled the political compromises that give rise to

a set of social preferences. In follow-up research, we will explore this question by adding a political economy dimension to the model.

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**Figure 1: Feasible Average Tax Rates**

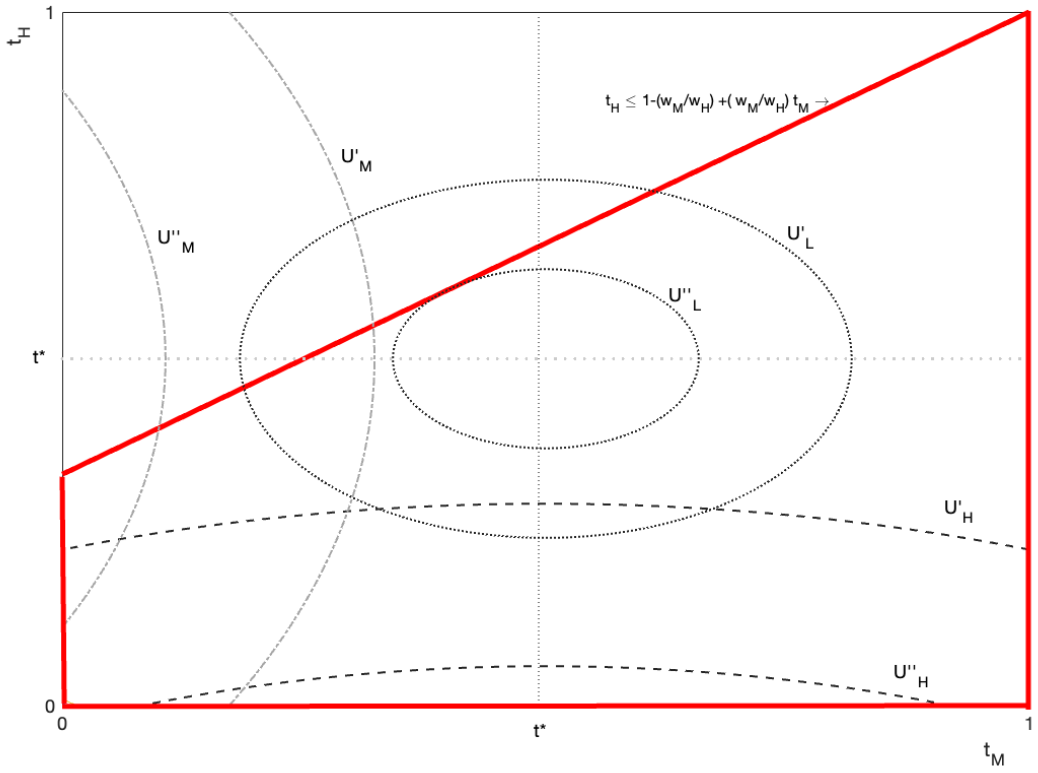


**Figure 2: Relationship Between Progressivity and Size of Tax System**

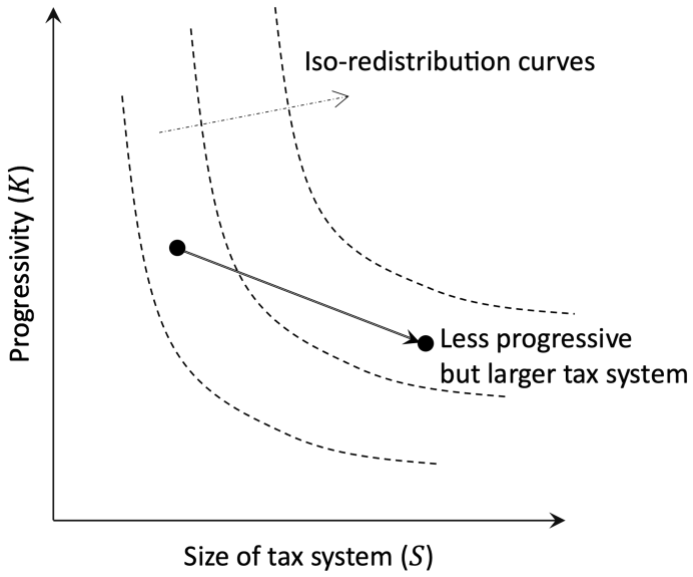
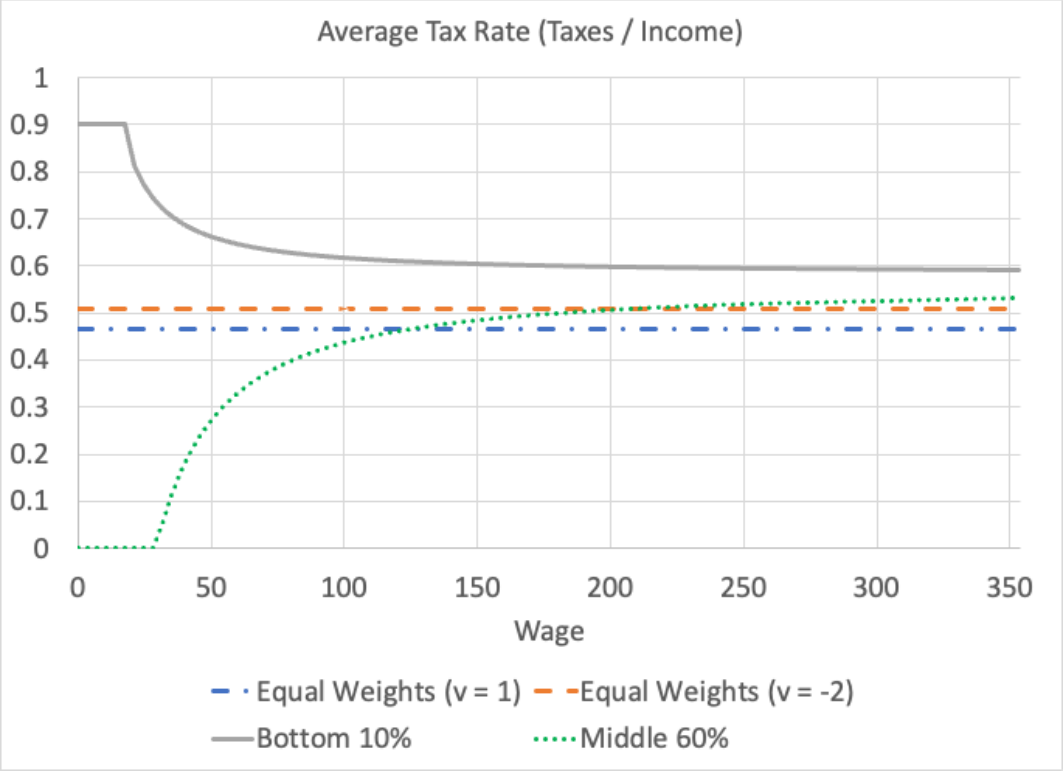


**Figure 3: Average Tax Rates and Average Net Tax Rates by Wage (two brackets, labor supply elasticity = 0.5)**



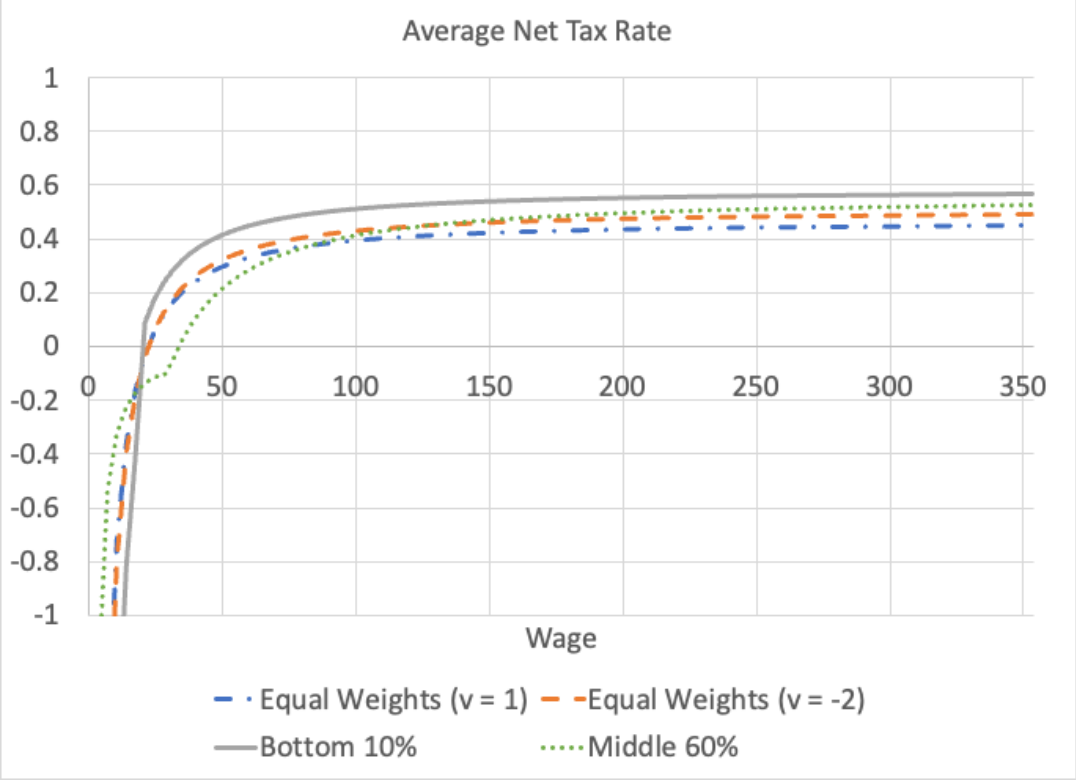
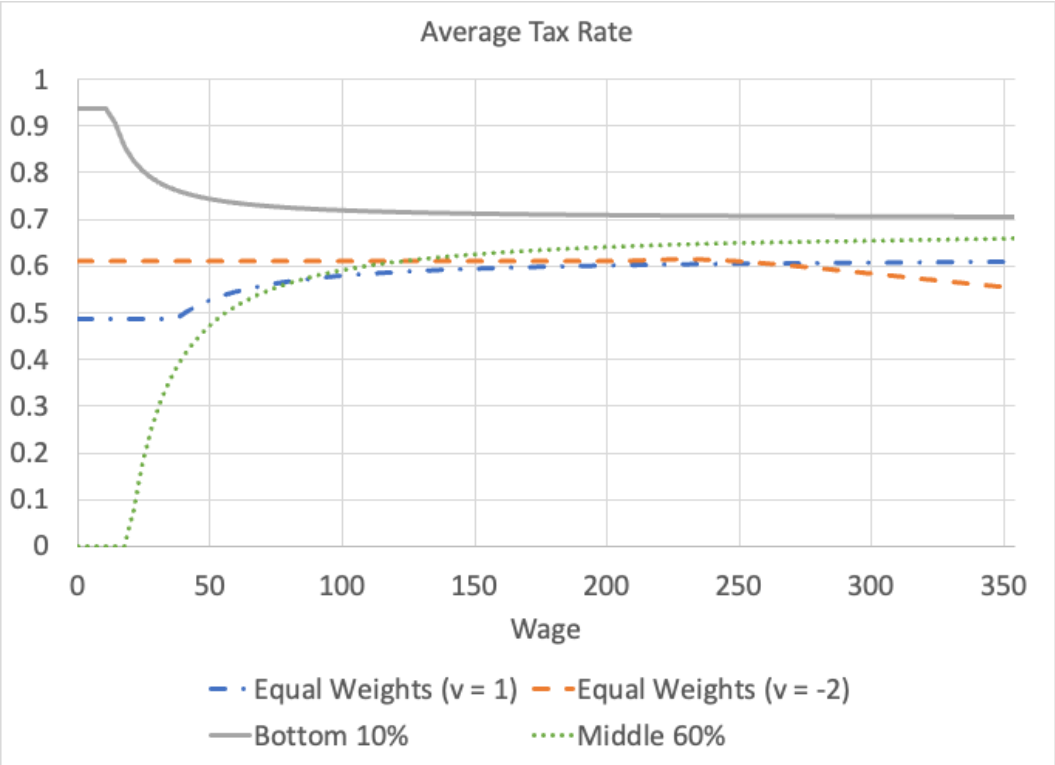



**Figure 4: Average Tax Rates and Average Net Tax Rates by Wage (two brackets, labor supply elasticity = 0.25)**



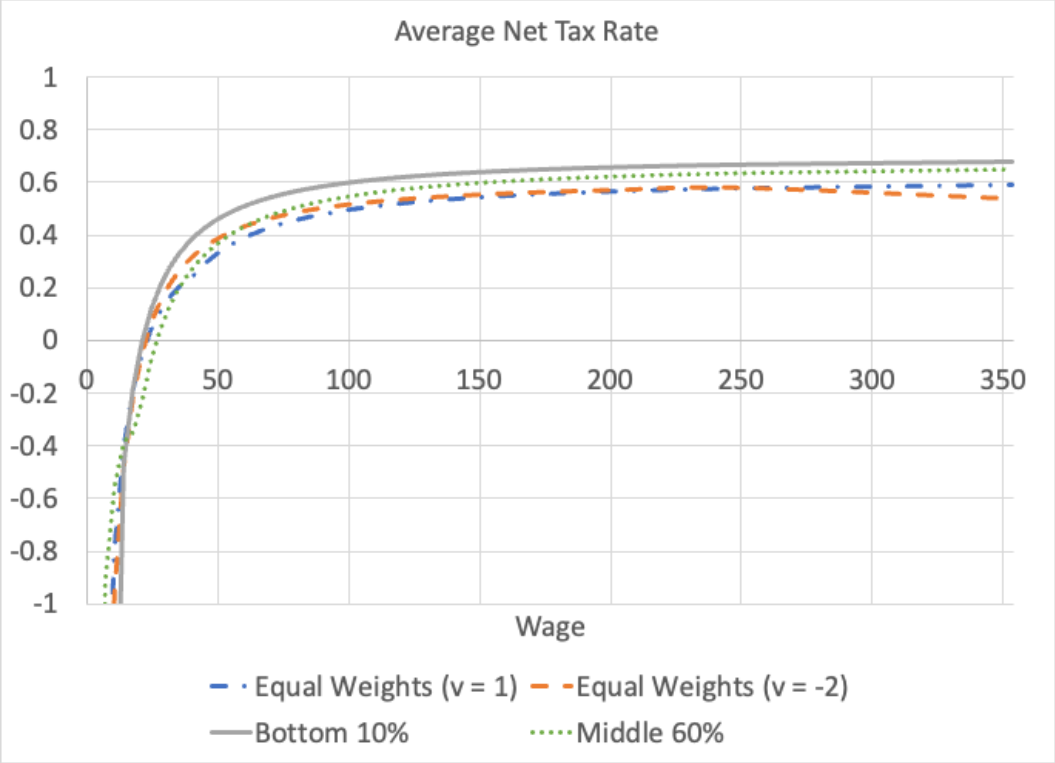



**Figure 5: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (two brackets, labor supply elasticity = 0.5)**

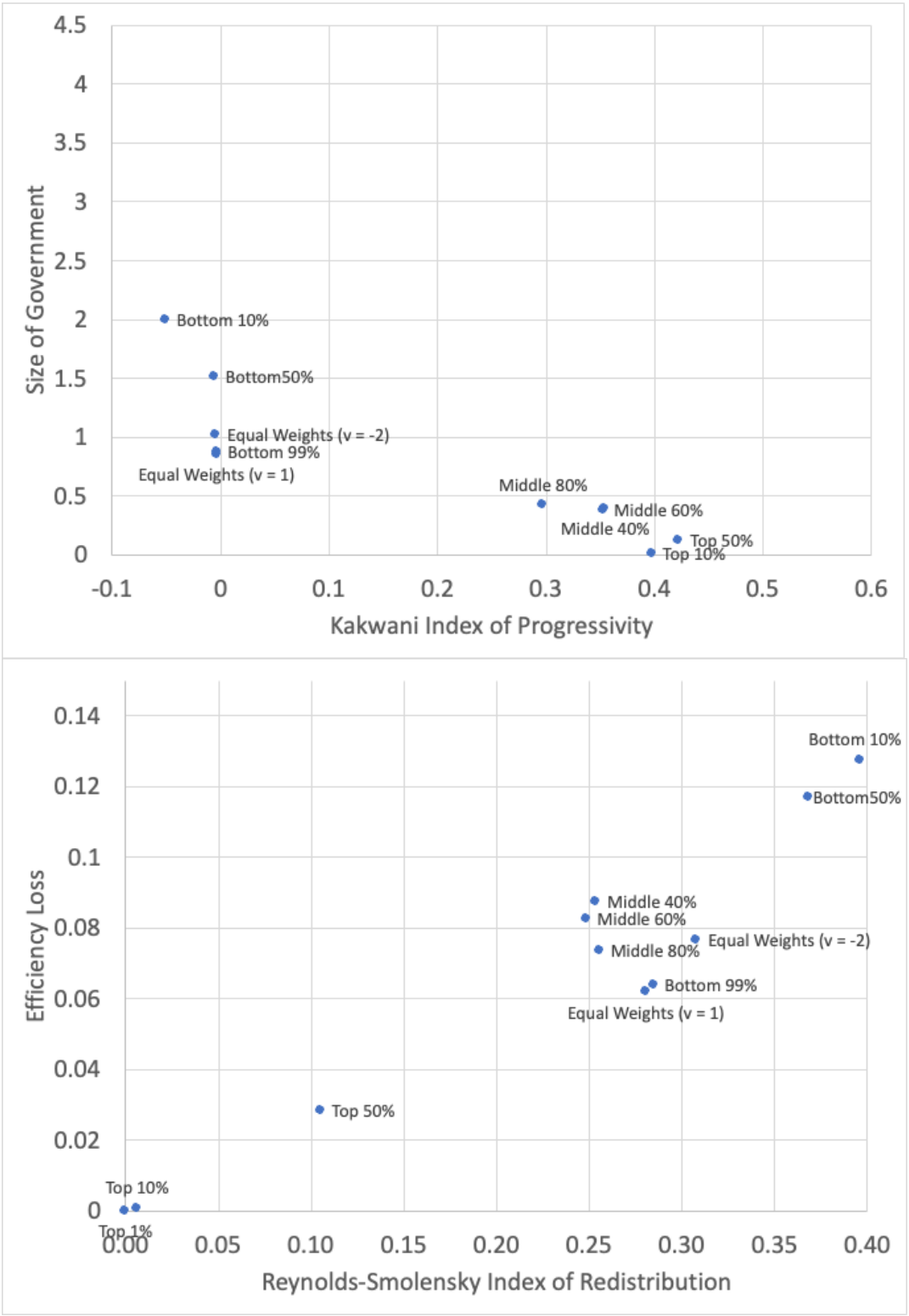


**Figure 6: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (two brackets, labor supply elasticity = 0.25)**

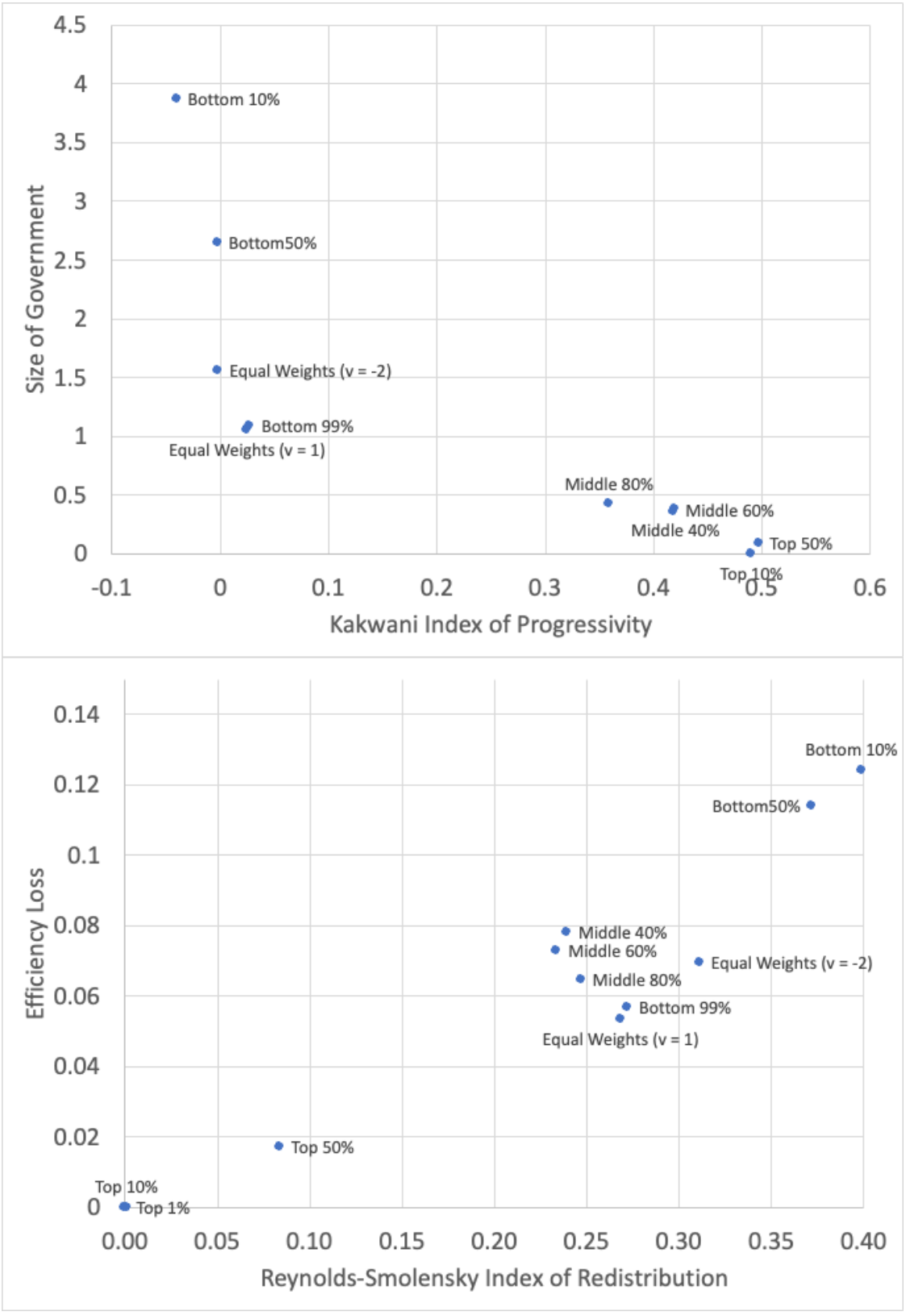
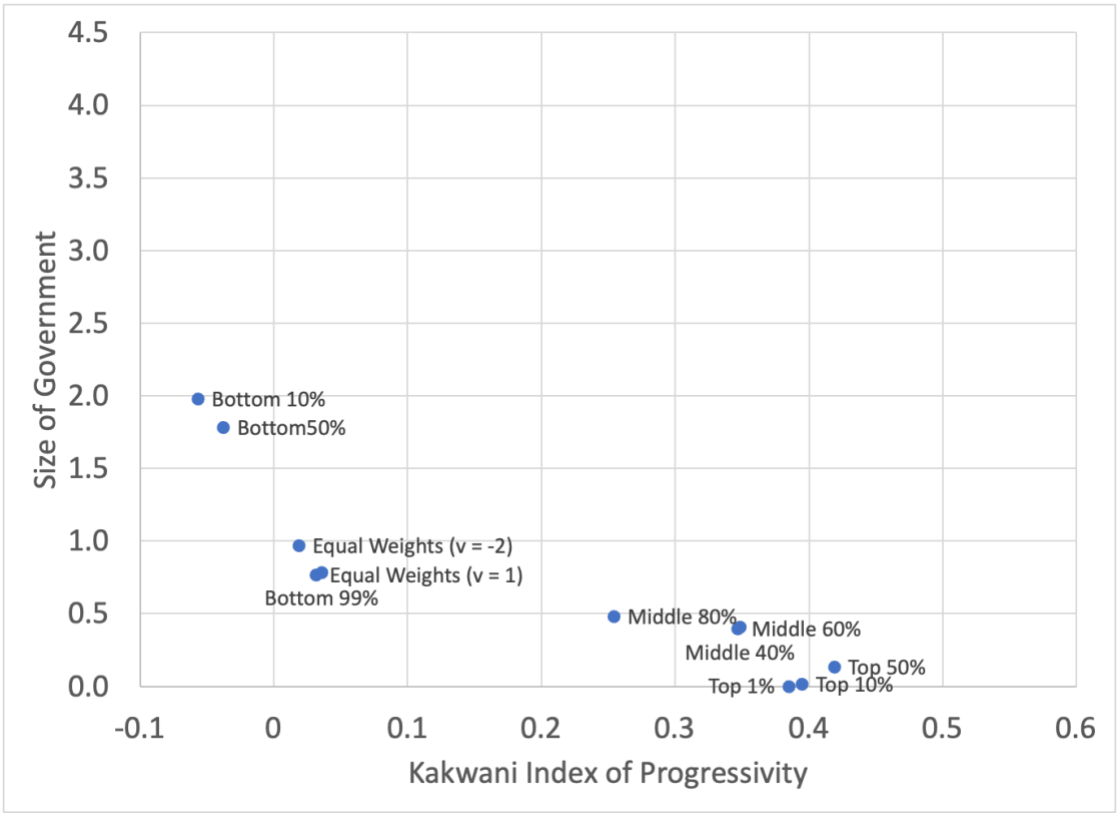


**Figure 7: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (four brackets, labor supply elasticity = 0.5)**



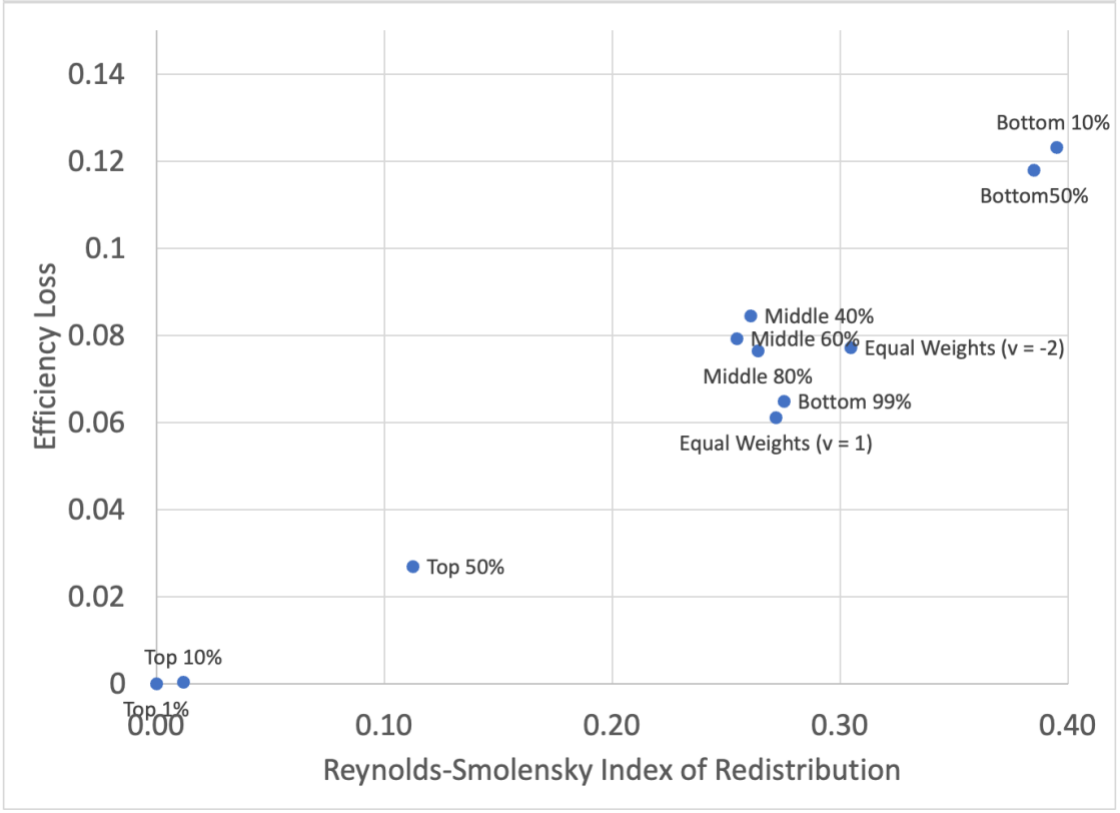
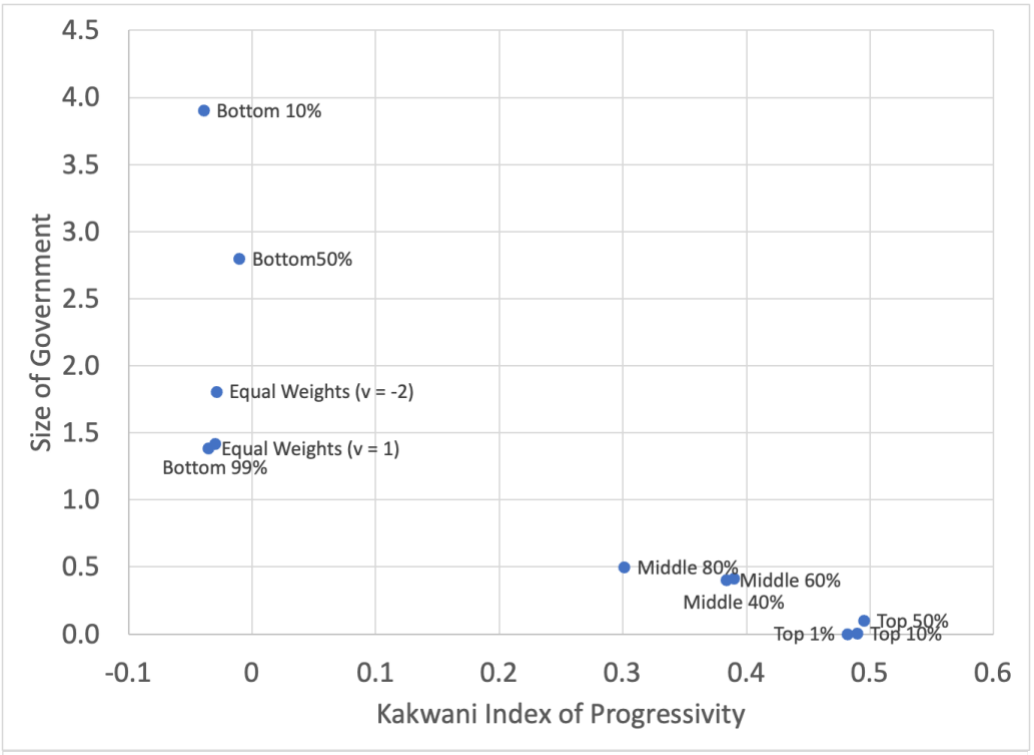



**Figure 8: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (four brackets, labor supply elasticity = 0.25)**



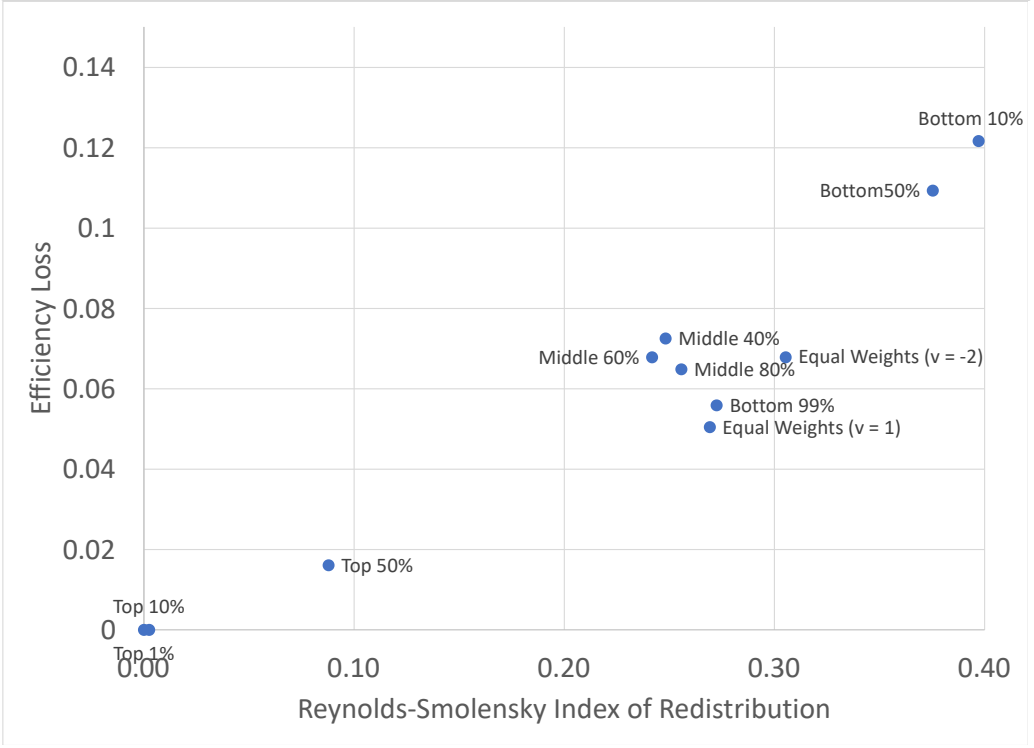



**Table 1: Optimal Tax Rates Under Alternative Social Welfare Objectives (two brackets)**

| Social Welfare Objective | $t_1$ | $t_2$ | g / Per Capita GDP | Percent in Bottom Bracket |
|---|---|---|---|---|
| *Labor Supply Elasticity = 0.5* | | | | |
| Equal Weights (v = 1) | 46.5% | 0.3% | 0.46 | 99.9% |
| Equal Weights (v = -2) | 51.0% | 0.3% | 0.50 | 99.9% |
| Bottom 99% | 47.2% | 0.0% | 0.47 | 99.9% |
| Bottom50% | 61.1% | 0.0% | 0.60 | 99.9% |
| Bottom 10% | 90.1% | 58.4% | 0.67 | 34.8% |
| Top 1% | 0.0% | 0.0% | 0.00 | 0.0% |
| Top 10% | 0.0% | 19.1% | 0.01 | 99.7% |
| Top 50% | 0.0% | 45.3% | 0.11 | 90.7% |
| Middle 80% | 0.0% | 51.7% | 0.30 | 34.8% |
| Middle 60% | 0.0% | 55.7% | 0.28 | 63.6% |
| Middle 40% | 0.0% | 57.0% | 0.28 | 50.7% |
| *Labor Supply Elasticity = 0.25* | | | | |
| Equal Weights (v = 1) | 48.7% | 61.6% | 0.51 | 88.3% |
| Equal Weights (v = -2) | 61.1% | 0.0% | 0.61 | 99.9% |
| Bottom 99% | 49.1% | 63.9% | 0.52 | 90.7% |
| Bottom50% | 72.9% | 0.1% | 0.73 | 99.9% |
| Bottom 10% | 93.8% | 70.2% | 0.79 | 34.8% |
| Top 1% | 0.0% | 0.0% | 0.00 | 0.0% |
| Top 10% | 0.0% | 8.1% | 0.00 | 99.8% |
| Top 50% | 0.0% | 52.6% | 0.09 | 91.9% |
| Middle 80% | 0.0% | 62.9% | 0.30 | 34.8% |
| Middle 60% | 0.0% | 67.8% | 0.27 | 63.6% |
| Middle 40% | 0.0% | 69.3% | 0.27 | 50.7% |

Notes: Authors' calculation of optimal tax rates, and associated measures of progressivity and redistribution, under alternative social welfare objectives. Planners with equal weights have inequality aversion parameter of v=1 or v=-2 as indicated. All other planners have v=1. Calculations utilize the wage distribution from Mankiw et al. (2009).
$t_1$ = bottom bracket rate, $t_2$ = top bracket rate, g = lump sum transfer

**Table 2: Optimal Tax Rates Under Alternative Social Welfare Objectives (four brackets)**

| Social Welfare Objective | $t_1$ | $t_2$ | $t_3$ | $t_4$ | g / Per Capita GDP | Percent in Bottom Bracket | Percent in Top Bracket |
|---|---|---|---|---|---|---|---|
| *Labor Supply Elasticity = 0.5* | | | | | | | |
| Equal Weights (v = 1) | 39.8% | 53.1% | 87.5% | 0.0% | 0.43 | 90.7% | 0.1% |
| Equal Weights (v = -2) | 46.8% | 56.3% | 87.5% | 0.0% | 0.49 | 90.7% | 0.1% |
| Bottom 99% | 39.8% | 55.5% | 87.5% | 0.0% | 0.44 | 90.7% | 0.1% |
| Bottom50% | 75.0% | 46.9% | 59.4% | 0.0% | 0.64 | 50.7% | 0.1% |
| Bottom 10% | 96.9% | 87.5% | 59.4% | 0.0% | 0.66 | 7.0% | 0.1% |
| Top 1% | 0.0% | 0.0% | 99.0% | 0.0% | 0.00 | 99.0% | 1.0% |
| Top 10% | 0.0% | 15.8% | 87.5% | 0.0% | 0.01 | 99.7% | 0.1% |
| Top 50% | 0.0% | 46.9% | 87.5% | 0.0% | 0.11 | 90.7% | 0.1% |
| Middle 80% | 0.0% | 39.1% | 59.4% | 0.0% | 0.32 | 18.3% | 0.1% |
| Middle 60% | 0.0% | 56.3% | 87.5% | 0.0% | 0.28 | 50.7% | 0.1% |
| Middle 40% | 0.0% | 57.8% | 87.5% | 0.0% | 0.29 | 50.7% | 0.1% |
| *Labor Supply Elasticity = 0.25* | | | | | | | |
| Equal Weights (v = 1) | 87.5% | 46.9% | 62.5% | 9.4% | 0.58 | 7.0% | 0.1% |
| Equal Weights (v = -2) | 87.5% | 56.3% | 67.2% | 0.0% | 0.64 | 7.0% | 0.1% |
| Bottom 99% | 87.5% | 46.9% | 68.4% | 0.0% | 0.59 | 7.0% | 0.1% |
| Bottom50% | 75.0% | 87.5% | 71.1% | 12.5% | 0.74 | 34.8% | 0.1% |
| Bottom 10% | 93.8% | 87.5% | 71.9% | 0.0% | 0.80 | 18.3% | 0.1% |
| Top 1% | 0.0% | 99.0% | 99.0% | 0.0% | 0.00 | 99.1% | 0.9% |
| Top 10% | 0.0% | 87.5% | 12.5% | 0.0% | 0.00 | 99.9% | 0.1% |
| Top 50% | 0.0% | 53.1% | 87.5% | 0.0% | 0.09 | 91.9% | 0.1% |
| Middle 80% | 0.0% | 46.9% | 68.7% | 0.0% | 0.33 | 18.3% | 0.1% |
| Middle 60% | 0.0% | 50.0% | 68.8% | 0.0% | 0.29 | 34.8% | 0.1% |
| Middle 40% | 0.0% | 50.0% | 68.8% | 0.0% | 0.29 | 34.8% | 0.1% |

Notes: Authors' calculation of optimal tax rates, and associated measures of progressivity and redistribution, under alternative social welfare objectives. Planners with equal weights have inequality aversion parameter of v=1 or v=-2 as indicated. All other planners have v=1. Calculations utilize the wage distribution from Mankiw et al. (2009).

$t_1$ - $t_4$ = bracket rates ranging from lowest to highest, g = lump sum transfer

**Table 3: Percent Reporting Pessimism by Issue**

| | *Income Inequality* | *Political System* | *Availability of Well-Paying Jobs* | *Education System* |
|---|---|---|---|---|
| U.S. | 61% | 63% | 36% | 58% |
| France | 86% | 76% | 69% | 62% |
| Germany | 79% | 46% | 44% | 43% |
| Greece | 82% | 75% | 80% | 64% |
| Italy | 65% | 68% | 68% | 36% |
| Netherlands | 64% | 43% | 30% | 41% |
| Spain | 84% | 74% | 76% | 57% |
| Sweden | 55% | 42% | 28% | 39% |
| U.K. | 76% | 71% | 57% | 52% |
| Bulgaria | 74% | 69% | 59% | 58% |
| Czech Republic | 60% | 51% | 36% | 27% |
| Hungary | 70% | 51% | 55% | 49% |
| Lithuania | 61% | 44% | 52% | 34% |
| Poland | 41% | 31% | 35% | 32% |
| Slovakia | 65% | 55% | 53% | 32% |

Source: Devlin and Moncus (2020), https://www.pewresearch.org/fact-tank/2020/08/06/many-around-the-world-were-pessimistic-about-inequality-even-before-pandemic/

**Appendix**

**Figure A1: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (Slemrod et al. 1994 parameterization, elasticity of substitution = 0.2)**

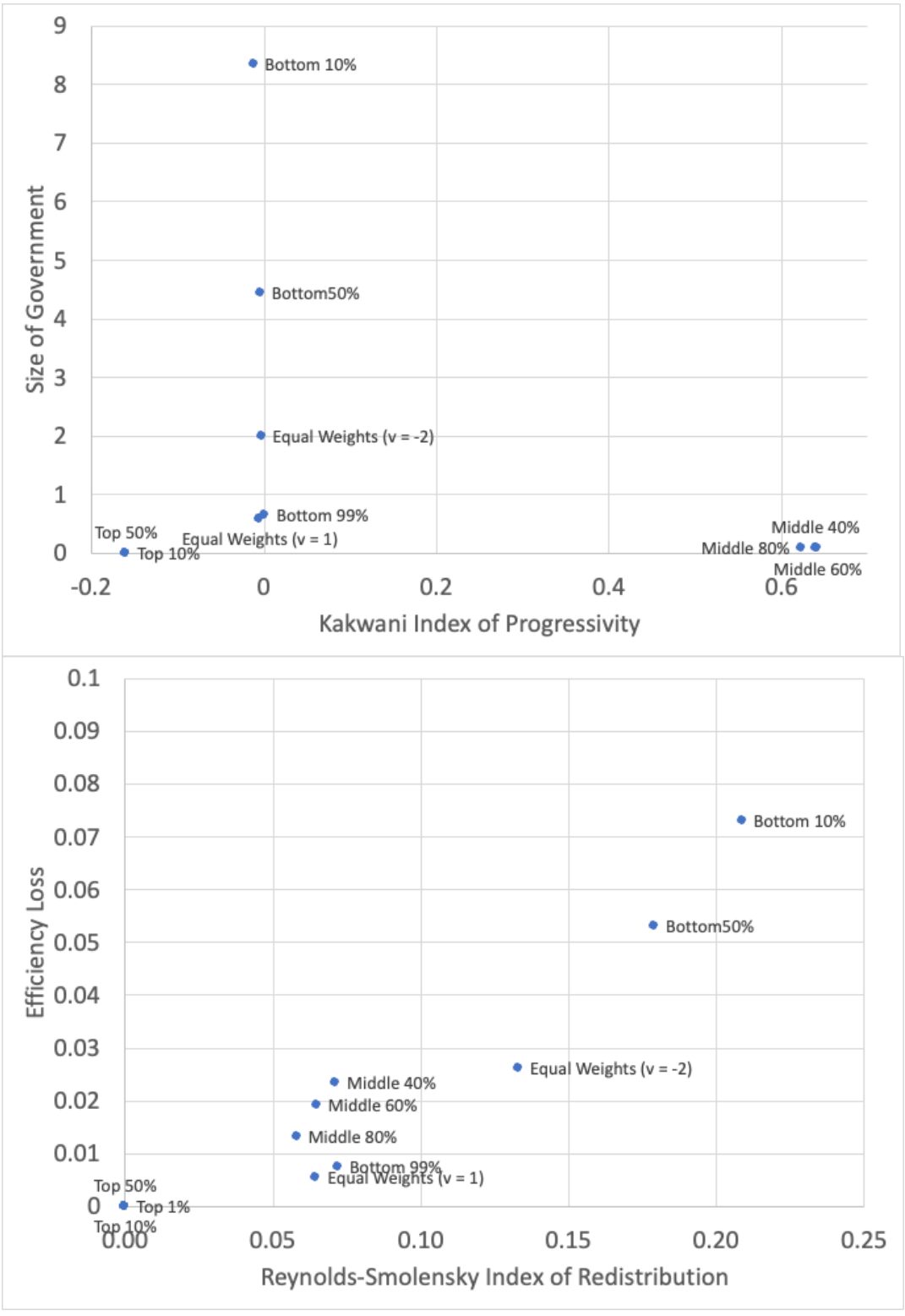


**Figure A2: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (Slemrod et al. 1994 parameterization, elasticity of substitution = 0.4)**

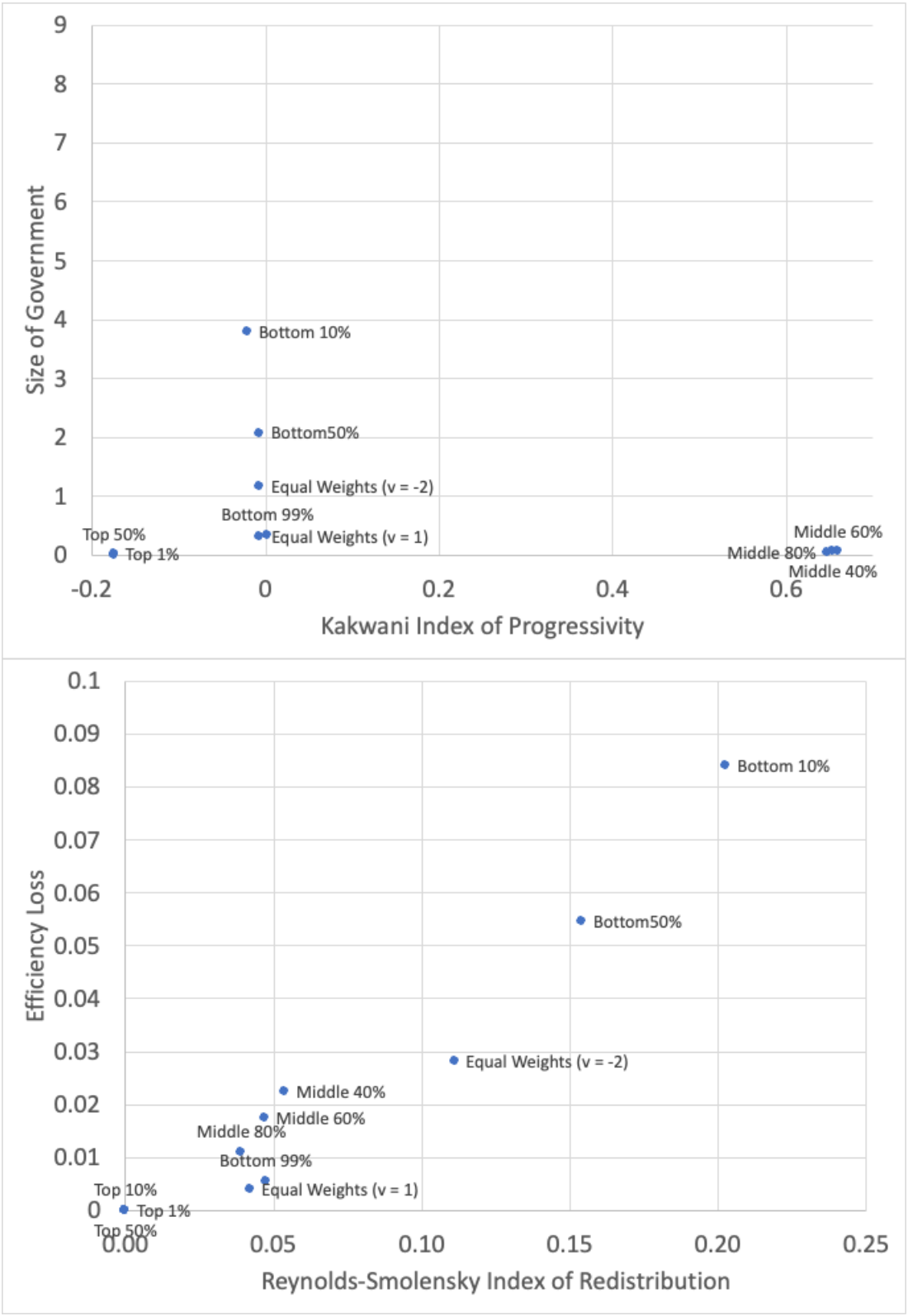
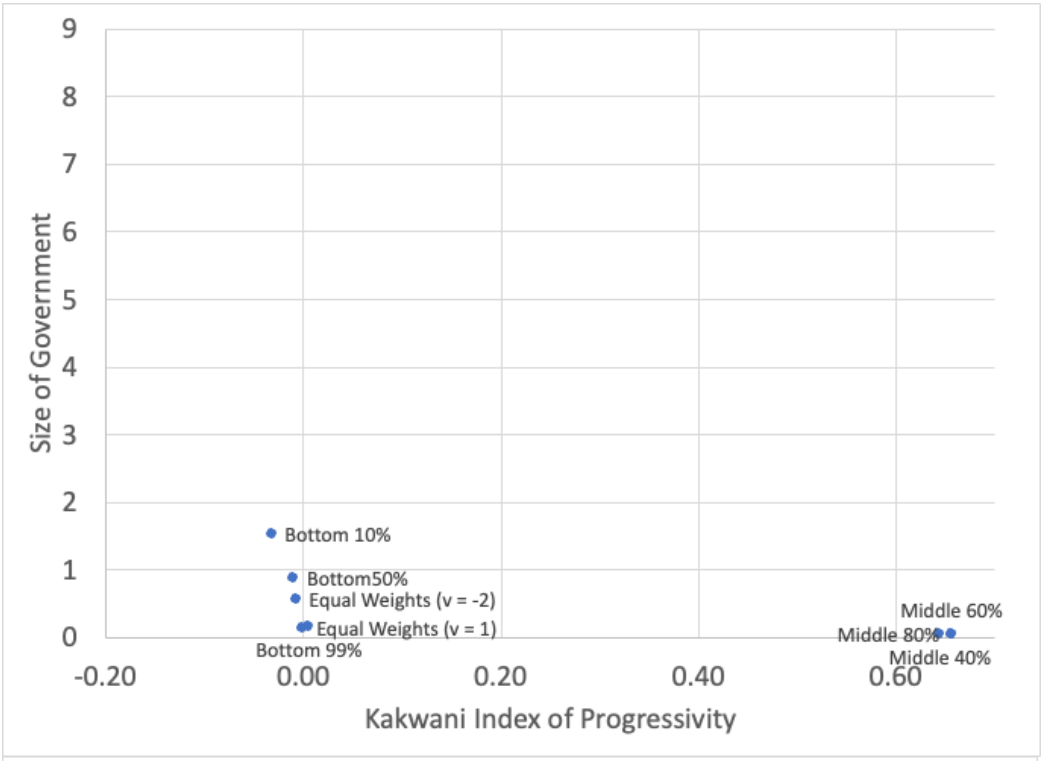


**Figure A3: Optimal Progressivity and Redistribution Under Alternative Social Welfare Objectives (Slemrod et al. 1994 parameterization, elasticity of substitution = 1.0)**



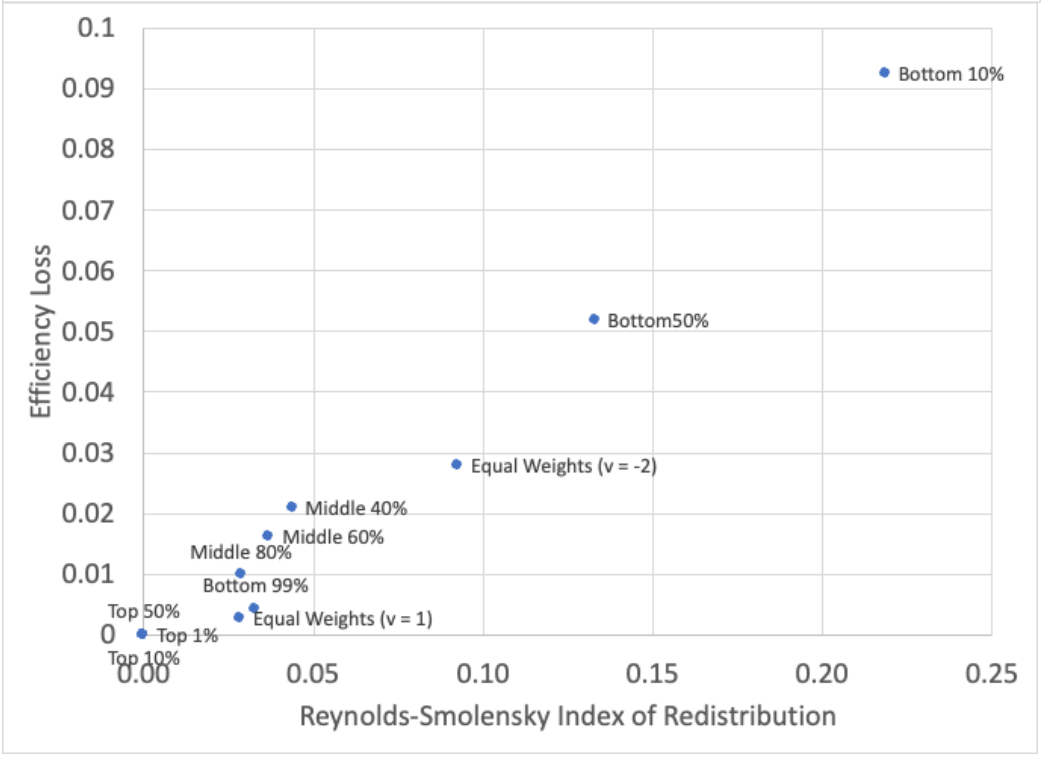



**Table A1: Optimal Tax Rates Under Alternative Social Welfare Objectives (Slemrod et al. 1994 parameterization)**

| Social Welfare Objective | $t_1$ | $t_2$ | g / Per Capita GDP | Percent in Bottom Bracket |
|---|---|---|---|---|
| | *ε = 0.2* | | | |
| Equal Weights (v = 1) | 37.2% | 32.3% | 0.37 | 78.8% |
| Equal Weights (v = -2) | 66.9% | 60.8% | 0.67 | 84.2% |
| Bottom 99% | 39.6% | 52.3% | 0.40 | 96.8% |
| Bottom50% | 82.1% | 73.7% | 0.82 | 83.8% |
| Bottom 10% | 91.8% | 81.5% | 0.89 | 43.9% |
| Top 1% | 0.0% | 0.0% | 0.00 | 0.0% |
| Top 10% | 0.2% | 0.0% | 0.00 | 0.0% |
| Top 50% | 1.8% | 0.0% | 0.01 | 0.0% |
| Middle 80% | 0.0% | 61.7% | 0.07 | 52.2% |
| Middle 60% | 0.0% | 70.7% | 0.08 | 52.5% |
| Middle 40% | 0.0% | 74.6% | 0.09 | 50.3% |
| | *ε = 0.4* | | | |
| Equal Weights (v = 1) | 23.5% | 20.3% | 0.23 | 74.6% |
| Equal Weights (v = -2) | 54.2% | 46.8% | 0.54 | 77.2% |
| Bottom 99% | 25.1% | 36.5% | 0.25 | 96.8% |
| Bottom50% | 68.2% | 56.7% | 0.67 | 83.6% |
| Bottom 10% | 83.6% | 67.8% | 0.79 | 43.1% |
| Top 1% | 51.8% | 0.0% | 0.01 | 0.0% |
| Top 10% | 0.0% | 0.0% | 0.00 | 0.0% |
| Top 50% | 6.9% | 0.0% | 0.00 | 0.0% |
| Middle 80% | 0.0% | 45.3% | 0.05 | 54.0% |
| Middle 60% | 0.0% | 54.5% | 0.06 | 53.2% |
| Middle 40% | 0.0% | 58.8% | 0.07 | 49.5% |
| | *ε = 1* | | | |
| Equal Weights (v = 1) | 12.5% | 0.8% | 0.12 | 1.00 |
| Equal Weights (v = -2) | 36.6% | 32.2% | 0.36 | 0.76 |
| Bottom 99% | 14.1% | 25.8% | 0.14 | 0.97 |
| Bottom50% | 47.6% | 38.3% | 0.47 | 0.84 |
| Bottom 10% | 70.1% | 49.4% | 0.61 | 0.37 |
| Top 1% | 0.1% | 0.0% | 0.00 | 0.00 |
| Top 10% | 12.2% | 0.0% | 0.01 | 0.00 |
| Top 50% | 1.8% | 0.0% | 0.00 | 0.00 |
| Middle 80% | 0.0% | 31.1% | 0.03 | 0.59 |
| Middle 60% | 0.0% | 37.5% | 0.04 | 0.55 |
| Middle 40% | 0.0% | 40.5% | 0.05 | 0.51 |

Notes: Authors' calculation of optimal tax rates, and associated measures of progressivity and redistribution, under alternative social welfare objectives. Calculations utilize the parameterization from Slemrod et al. (1994), which includes a lognormal wage distribution and CRRA utility function with elasticity of substitution ε and weight on consumption chosen such that no-tax labor supply = 0.67 for the median wage individual.
$t_1$ = bottom bracket rate, $t_2$ = top bracket rate, g = lump sum transfer