INTERNATIONAL MONETARY FUND

Social Versus Individual Work Preferences: Implications for Optimal Income Taxation

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WP/22/62

2022
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 WP/22/62

IMF Working Paper
Fiscal Affairs Department

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Authorized for distribution by David Coady
March 2022

ABSTRACT: The benchmark optimal income taxation model of Mirrlees (1971) finds that the optimal marginal income tax rate (MIT) is always non-negative. A key model assumption is the coincidence between social and individual work preferences. This paper extends the model to allow for differences in social and individual work preferences. The theoretical and simulation analyses show that under this model, when the government places a higher social weight on work than individuals, the optimal MIT schedule is shifted downwards, introducing the possibility for optimal wage subsidies at the bottom of the income distribution. This implies lower revenues, demogrants, and overall progressivity.

RECOMMENDED CITATION: An, Zhiyong, and David Coady, "Social versus Individual Work Preferences: Implications for Optimal Income Taxation," IMF Working Papers 2022/062 (Washington: International Monetary Fund).

JEL Classification Numbers:	D3, H2
Keywords:	Preference Differences; Optimal Income Taxation; Wage Subsidies; Progressivity
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WORKING PAPERS

Social versus Individual Work Preferences: Implications for Optimal Income Taxation

Prepared by Zhiyong An and David Coady[1]

[1] The author(s) would like to thank Alan J. Auerbach, Alejandro Badel, Lahcen Bounader, Ruud A. de Mooij, Vitor Gaspar, Bas Jacobs, Carolina Osorio-Buitron, Marina M. Tavares, Jean-Francois Wen, and participants at the IMF Fiscal Affairs Department Seminar for very helpful comments. We are also extremely grateful to Mengfei Gu for outstanding research assistance and Daine Hale for superb editorial work.

Contents

I. Introduction

Wage subsidies have grown in popularity in advanced economies in recent decades. An early review by Immervoll and Pearson (2009) found that, as of 2009, 16 of the 30 OECD countries had operated wage subsidy programs, and in some countries these programs have been expanded to become a core component of social protection systems. For example, since its inception in 1975 as a modest program aimed at offsetting the social security payroll tax for low-income families with children, the Earned Income Tax Credit (EITC) in the US has grown to become one of its largest anti-poverty programs. The UK has had a wage subsidy program to support low-income working families since 1971, which has undergone numerous design and name changes since then. Germany introduced wage subsidies as part of its broader labor market reforms in the early 2000s, while Denmark and Sweden implemented wage subsidy programs from 2004 and 2007, respectively. In response to the COVID-19 pandemic, many countries also greatly expanded the use of wage subsidies to prevent a surge in unemployment and help maintain firm-employee links. These countries face the imminent challenge of how to adjust these schemes as restrictions to economic activities are gradually being withdrawn (OECD, 2020).

The increasing popularity of wage subsidy programs partly reflects growing concerns about the work disincentives inherent in means-tested anti-poverty programs and the need to support the working poor. Many advanced economies have long relied on means testing of anti-poverty transfers as a way of reducing the fiscal cost of such programs and thus avoiding higher income and consumption taxes on other households which can also create work disincentives (Friedman, 1962; Tobin, 1966; Brewer et al., 2009; Coady et al., 2021). However, the withdrawal of benefits under means testing reduces incentives to work and stay attached to the labor market. While lowering out-of-work benefits can help strengthen work incentives, this can undermine poverty alleviation objectives. Wage subsidies for lower-income workers are often seen as an attractive approach to addressing these dual concerns, i.e., strengthening work incentives and supporting the incomes of the working poor (Moffitt, 2003).

Yet the standard optimal income taxation model pioneered by Mirrlees (1971), which focuses on individual labor supply decisions on the intensive margin (i.e., hours worked), did not support any role for wage subsidies. Numerous papers have since extended the model in different directions, such as labor supply behavior on the extensive margin (i.e., whether or not to work), multi-dimensional informational asymmetry between the government and individuals, differential preferences held by the government and individuals, or individual failures, all of which allow for a potential role for wage subsidies in the optimal income tax schedule.

In this paper, we further extend the standard model to allow for the possibility of differences in social (government) and individual preferences over labor supply and leisure. More specifically, we focus on the context where the government places a higher social value on work than individuals. This perspective is often seen as a driving motivation for wage subsidies in practice and, more generally, for conditioning benefit eligibility on labor market participation or participation in active labor market programs such as training and job search (Moffitt, 2003, 2006). For instance, all individuals (including both net taxpayers and net transfer recipients) may want the government, when formulating public policy, to place a higher value on increasing incomes of the poor through promoting increased work and earnings rather than through public transfers.[1]

We start by providing a brief overview of the Mirrlees model and the various model extensions. We then describe the model of Diamond (1998) which we use as our benchmark model and present an extended version that allows for differences in social and individual work preferences, allowing for the possibility of social preference differences that are either homogeneous or heterogeneous across individuals. We also present the results from model simulations to demonstrate the implications of these model extensions.

The theoretical and simulation analyses show that under this more general framework, when the government places a higher weight on labor supply than individuals, the optimal marginal income tax rate (MIT) schedule is shifted downwards with lower MITs across the earnings distribution reflecting the higher social welfare loss from income taxation compared to the benchmark model. This introduces the possibility of wage subsidies being optimal at the bottom of the income distribution under certain parameter constellations. In addition, lower MITs across the redistribution imply lower revenues and demogrants, resulting in a decline in the progressivity of the overall tax and transfer system compared to the benchmark model.

II. Brief Literature Overview

The Mirrlees (1971) model examined the design of individual income taxation to achieve distributional objectives where individuals differ only in terms of skills (and thus wage rates) but where the government can only observe an individual's total income and is thus unable to infer exogenous skills. This informational asymmetry gives rise to an equity-efficiency trade-off captured by all optimal income taxation models. The government chooses a non-linear income tax schedule to maximize a utilitarian social welfare function subject to a revenue requirement, an overall budget constraint, and expectations about how individuals will adjust their labor supply decisions in response to income taxes. Individuals decide on their own labor supply to maximize their individual utilities, taking as given the income tax schedule chosen by the government. All individuals are assumed to be working and can adjust their hours worked (i.e., on the intensive margin) in response to income taxes. Based on this framework, Mirrlees (1971) showed that the optimal marginal income tax rate is always non-negative suggesting that wage subsidies have no role to play in the optimal income tax schedule.

[1] Note that a similar case for the government valuing work more than individuals could be made based on information failures (e.g., where individuals underestimate the productivity gains from being in work or working longer hours) or based on the social externalities associated with higher employment rates (e.g., lower crime or improved mental health). Of course, it is also possible that the government values leisure (or non-market work) more than (market) work for some groups, such as those involved in home care for the elderly or very young children. In such cases, the results discussed in the paper would work in the opposite direction.

Intuitively, suppose the government starts with a negative marginal income tax rate at a specific income level, then a small decrease in the subsidy would have three effects.[2] First, ignoring behavioral responses and keeping the rest of the marginal tax rate schedule constant, the subsidy reform would always raise more tax revenue (i.e., reduce subsidy spending) from everybody above that income level (i.e., the mechanical effect $dM > 0$). Second, this increase would be reinforced by a positive behavioral effect since the lower subsidy decreases labor supply and therefore also the total subsidy bill (i.e., the behavioral effect $dB > 0$). Finally, while the reform would create a social welfare cost for everybody at or above that income level (i.e., the welfare effect $dW < 0$), the fact that social welfare weights decrease with income means that returning dM to the whole population as a uniform lump-sum transfer would generate a welfare improvement, i.e., $dM + dW > 0$. Therefore, the total effect on social welfare will also be positive (i.e., $dSW = dM + dW + dB > 0$), so that wage subsidies cannot be part of an optimal income tax system in the Mirrlees model.

Four distinct extensions to the standard optimal income taxation model allow a potential role for wage subsidies. First, the model has been extended to allow individual labor supply to respond along both the intensive (hours of work) and extensive (labor force participation) margins (Diamond, 1980; Saez, 2002). Second, it has been extended to allow for two-dimensional informational asymmetry between the government and individuals (Choné and Laroque, 2010). Third, it has been extended to allow for non-welfarist (i.e., non-individualistic) social welfare functions (Kanbur et al., 1994). Finally, it has been extended to allow for individual information failures (Gerritsen, 2016; Farhi and Gabaix, 2020; Lockwood, 2020). We briefly discuss each of these extensions in turn:

(a) *Intensive versus Extensive Margin of Labor Supply Responses*. The standard optimal income taxation model à la Mirrlees focuses exclusively on individual labor supply responses along the intensive margin, i.e., through varying hours or intensity of work on the job. However, the empirical literature on labor supply (Heckman, 1993) has also emphasized the extensive margin where individuals decide whether to enter the labor force or not. In an early contribution, Diamond (1980) developed an optimal income taxation model that focuses exclusively on the extensive margin and showed that in this model the optimal income tax schedule may involve subsidization of the work of low earners. Intuitively, suppose the government starts from a transfer scheme with a positive marginal income tax rate for low-income workers (e.g., a negative income tax scheme), then introducing an additional small in-work benefit that increases net transfers to low-income workers would have three effects. First, it would have a mechanical fiscal cost (i.e., $dM < 0$). Second, it would generate a social welfare gain for low-income workers (i.e., $dW > 0$). Finally, since the reform would induce some low-skilled non-workers to enter the labor force and the marginal income tax rate is positive for low-income workers, there would be a tax revenue gain (i.e., $dB > 0$). If the government values redistribution to low-income workers so that social welfare weights for low-income workers are greater than 1 (the value of income to the government) then $dM + dW > 0$, so that $dSW = dM + dW +$

[2] See Piketty and Saez (2013) for a more detailed discussion of the intuition behind the standard results in the optimal income taxation literature.

$dB > 0$, suggesting that the positive marginal income tax rate for low-income workers is not optimal. Saez (2002) developed an optimal income taxation model with discrete income levels where labor supply responses are modeled along both the intensive and extensive margins.[3] He showed that the marginal income tax rate for low-income workers will be lower (and possibly negative under strong redistribution preferences) the higher the size of the participation elasticity relative to the intensive labor supply elasticity.

(b) *Two-Dimensional Informational Asymmetry Between the Government and Individuals.* The standard optimal income taxation model assumes one-dimensional informational asymmetry between the government and individuals, i.e., individuals are heterogeneous only along one dimension, namely skill (and thus wage rates), that cannot be observed by the government. Choné and Laroque (2010) considered that individuals are heterogeneous along two dimensions, namely skill and taste for leisure (i.e., opportunity cost of work), and that neither of the two characteristics can be observed by the government.[4] They show that negative marginal income tax rates can be optimal in the presence of such multi-dimensional informational asymmetry when the two characteristics are negatively correlated, i.e., lower-skilled individuals have a stronger taste for leisure. Intuitively, because lower-skilled individuals have a relatively stronger taste for leisure (and thus higher-skilled individuals have a relatively stronger taste for work), then the efficiency cost of redistribution can be reduced by switching taxes from low-skilled to high-skilled workers. Subsidies for low-income (low-skilled) workers may then be optimal if taste differences are large enough.

(c) *Non-Welfarist (i.e., Non-Individualistic) Social Welfare Functions.* The standard optimal income taxation model assumes a utilitarian social welfare function where social welfare is a function of individual utility functions capturing individual preferences over consumption and leisure (or work). In an early "non-welfarist (i.e., non-individualistic)" contribution, Kanbur et al. (1994) showed that if the government is concerned solely with poverty alleviation, e.g., with minimizing an income poverty index, then the optimal marginal income tax rates on the very poorest individuals could be negative since the government attaches a social value only to the consumption (i.e., income) of the poor and not to leisure.[5]

(d) *Individual Information Failures.* Building on the burgeoning literature on behavioral economics (DellaVigna, 2009), three recent studies (Gerritsen, 2016; Farhi and Gabaix, 2020; Lockwood, 2020) have examined the implications of individual information failures for optimal income taxation.[6] They showed that the existence

[3] See also Jacquet et al. (2013) for a similar model based on a continuum of earnings and skill levels.

[4] See also Sandmo (1993), Cuff (2000) and Boadway et al. (2002) for early models, and a more recent contribution by Lockwood and Weinzierl (2015).

[5] See also Blomquist and Micheletto (2006) for a model that extends Stiglitz (1982) to study optimal income and commodity taxation in the general case with a non-welfarist (i.e., non-individualistic) social welfare function.

[6] For example, individuals could fail to optimize their own utility because they might misperceive (i.e., have wrong information about) prices or taxes resulting in mistaken beliefs about their budget constraint (Chetty et al., 2009).

of such failures call for a corrective adjustment to optimal marginal income tax rates, which may then become negative (i.e., wage subsidies) at low incomes.

III. Benchmark Model with No Preference Difference

The utilitarian social welfare function employed in the standard optimal income taxation model implicitly assumes that the government respects individual preferences. However, in practice, there may be many reasons why government (i.e., social) and individual preferences might differ.[7] In this paper, we study how relaxing the assumption of coincident government and individual preferences affects the optimal income tax schedule, in particular in relation to the potential role for wage subsidies.[8] Our basic approach is to extend the more tractable optimal income taxation model developed by Diamond (1998) to allow for the possibility of preference differences between the government and individuals over labor supply and leisure choices where these differences can be both homogeneous and heterogeneous across individuals. Among the four distinct extensions discussed above, Kanbur et al. (1994) is most closely related to our paper and the preference differences modeled by us will nest their poverty alleviation model as a special case.

In the Mirrlees (1971) model the *government* chooses a non-linear income tax schedule to maximize a utilitarian social welfare function subject to an exogenous revenue requirement, an overall budget constraint, and expectations about how individuals will adjust their labor supply in response to income taxes to maximize their individual utilities, taking as given the income tax schedule chosen by the government. As our point of departure, we use a special case of this model developed by Diamond (1998) where the individual utility function is assumed to be quasi-linear in consumption so that there are no (negative) income effects on labor supply, which serves to greatly simplify the theoretical analysis but without losing the generality of the result since allowing for income effects would further reinforce the case for wage subsidies.[9]

Individuals are assumed to be heterogeneous only in one dimension, i.e., skill. An individual indexed by skill n has a marginal product equal to n. The distribution of skills is written as $F(n)$, with density $f(n)$. The density is assumed to be positive and continuous in the range of $[n_{min}, n_{max}]$. Individual n has a utility function $u^n\big(c(n), l(n)\big)$, where $c(n)$ denotes consumption, $l(n)$ denotes labor supply, $u_c^n \geq 0$ and $u_l^n \leq 0$, and pre-tax income is equal to labor income $nl(n)$. The total income tax revenue from labor income $nl(n)$ is $T\big(nl(n)\big)$ and

[7] Including, e.g., merit goods (Musgrave, 1959; Sandmo, 1983; Besley, 1988), specific egalitarianism (Tobin, 1970), paternalism (Thaler and Sunstein, 2003; O'Donoghue and Rabin, 2006), tax sheltering (Chetty, 2009), equal sacrifice (Weinzierl, 2014), and rent seeking (Piketty et al., 2014; Rothschild and Scheuer, 2016).

[8] In a related literature, it has been also shown that the use of the elasticity of taxable income as a sufficient statistic to calculate the deadweight loss depends on whether government and individual preferences differ or not (Feldstein, 1999; Chetty, 2009; An, 2015, 2017).

[9] The presence of income effects would simultaneously allow higher marginal income tax rates on high-income individuals without changing their labor supply and higher subsidies on low-income individuals without changing their labor supply.

consumption is equal to after-tax income, i.e., $c(n) = nl(n) - T\big(nl(n)\big)$. The *government* is assumed to have only one policy instrument, i.e., non-linear income taxation. In addition, the government is restricted to setting taxes as a function only of earnings reflecting the informational asymmetry between the government and individuals, i.e., the government can only observe individual's earnings, but not labor supply or skill. This informational asymmetry gives rise to an equity-efficiency trade-off captured by all optimal income taxation models.

As in Diamond (1998), we assume that individual utility function is quasi-linear in consumption, i.e., $u\big(c(n), l(n)\big) = c(n) + v\big(1 - l(n)\big) = nl(n) - T\big(nl(n)\big) + v\big(1 - l(n)\big)$, so that income effects are absent in the model. The total time endowment is normalized to unity. Denoting government expenditures as E, the government budget constraint can be written as:

$$\int_{n_{min}}^{n_{max}} \Big(u\big(c(n), l(n)\big) - v\big(1 - l(n)\big)\Big) f(n)dn \leq \int_{n_{min}}^{n_{max}} nl(n)f(n)dn - E \quad (1)$$

where the left-hand side (LHS) is aggregate consumption and the right-hand side (RHS) is aggregate earnings minus government expenditures, so that aggregate consumption is less than or equal to aggregate earnings minus government expenditures. Note that one advantage of assuming a quasi-linear individual utility function $u\big(c(n), l(n)\big) = c(n) + v\big(1 - l(n)\big)$ is that one can conveniently derive $c(n) = u\big(c(n), l(n)\big) - v\big(1 - l(n)\big) = nl(n) - T\big(nl(n)\big)$, suggesting that (1) equivalently says that government expenditures cannot exceed total government tax revenue, i.e., $E \leq \int_{n_{min}}^{n_{max}} T\big(nl(n)\big)f(n)dn$.

Individuals decide on their individual labor supply to maximize individual utility, taking $T\big(nl(n)\big)$ as given. The first-order condition (FOC) for individual labor supply choice can be written as:

$$v'\big(1 - l(n)\big) = n\Big(1 - T'\big(nl(n)\big)\Big) \quad (2)$$

where T' denotes the marginal income tax rate. Using (2), the derivative of consumption with respect to skill satisfies:

$$c'(n) = \big(l(n) + nl'(n)\big)(1 - T') = \frac{\big(l(n)+nl'(n)\big)v'\big(1-l(n)\big)}{n} \quad (3)$$

With the quasi-linear utility function, one can calculate the derivative of u with respect to n as:

$$u'\big(c(n), l(n)\big) = c'(n) - v'\big(1 - l(n)\big)l'(n) = \frac{l(n)v'\big(1-l(n)\big)}{n} \quad (4)$$

For later use when deriving the optimal income tax schedule, it is convenient to note that, for the quasi-linear utility function, the elasticity of labor supply evaluated at the chosen labor supply of an individual with skill n, $e(n)$, is:

$$e(n) = \frac{-v'\big(1-l(n)\big)}{l(n)v''\big(1-l(n)\big)} \quad (5)$$

Since the wage rate equals the skill level, this is also the elasticity with respect to the wage rate, evaluated at the labor supply level that is chosen by someone with skill n.

The social welfare function is modelled as:

$$W = \int_{n_{min}}^{n_{max}} G\left(U^n\big(c(n), l(n)\big)\right) f(n)dn \qquad (6)$$

where $U^n\big(c(n), l(n)\big)$ is the utility attained by individual n reflecting the individual's own preferences over consumption and leisure (or work), and G is an increasing and strictly concave transformation of utility, with G independent of n.

Taken together, the optimal tax problem of the government can be written as:

$$\max \int_{n_{min}}^{n_{max}} G\left(u\big(c(n), l(n)\big)\right) f(n)dn$$

subject to:

$$\int_{n_{min}}^{n_{max}} \left(u\big(c(n), l(n)\big) - v\big(1 - l(n)\big)\right) f(n)dn \leq \int_{n_{min}}^{n_{max}} nl(n)f(n)dn - E \qquad (7)$$

$$u'\big(c(n), l(n)\big) = \frac{l(n)v'\big(1 - l(n)\big)}{n}$$

Treating $u\big(c(n), l(n)\big)$ as a state variable and $l(n)$ as a control variable, (7) is a standard optimal control problem. Therefore, one can basically follow routine procedures to solve and derive the FOC for the optimal tax as:

$$\frac{T\prime}{1-T\prime} = \frac{\left(1+\frac{1}{e(n)}\right)\int_n^{n_{max}}\left(\lambda - G'(n)\right)dF(n)}{\lambda n f(n)} \qquad (8)$$

where λ is the multiplier with respect to the government budget constraint.[10] This is the formula for optimal taxes derived by Diamond (1998). Note that as the RHS is non-negative everywhere, T' should always lie in the range of $[0, 1]$ leaving no role in the optimal income tax schedule for wage subsidies.[11]

IV. Extended Model with Homogeneous Preference Differences

In the above benchmark model, the government respects individual preferences over consumption and leisure (or work) in the sense that the social welfare function, W, is a function of $U^n\big(c(n), l(n)\big)$, viz., the utility attained by individual n reflecting the individual's own preferences over consumption and leisure. We first extend the model to allow government and individual preferences over consumption and leisure to differ homogeneously across individuals. As for notation, let $\overline{u^n}\big(c(n), l(n)\big)$ denote the government's preference over the consumption

[10] Note that a general feature of optimal income tax models is that it is not possible to obtain an explicit formula for the optimal demogrant, $-T(0)$, as the demogrant is determined in general equilibrium. Even in the optimal linear tax model, the demogrant is deduced from the optimal tax rate using the government budget constraint. Note also that as the exogenous revenue requirement increases the optimal level of redistribution (and demogrant) can be expected to decline since the efficiency cost of redistribution will increase with the overall income tax level.

[11] Note that a key policy choice within the optimal income tax framework is the choice of the level of the uniform grant to individuals, which is chosen optimally and is the primary channel for affecting the overall progressivity of the tax and transfer system. If the level of the grant is constrained, say by the political and social context, then this will obviously significantly impact the shape of the optimal MIT schedule and the desirability of wage subsidies (i.e., negative MITs at lower income groups). For example, if the grant is constrained at zero then the only way of achieving redistribution is through negative MITs at lower income groups.

and labor supply choices made by individual n. In general, $\overline{u^n}(c(n), l(n)) \neq u^n(c(n), l(n))$ in the presence of preference difference between the government and individuals.

For analytical convenience, we assume a simple preference difference:

$$\overline{u}(c(n), l(n)) = c(n) + (1 + \overline{\delta})v(1 - l(n)) = u(c(n), l(n)) + \overline{\delta}v(1 - l(n)) \qquad (9)$$

where $\overline{\delta}$ measures the preference difference between the government and individuals. In addition, we assume that $\overline{\delta}$ does not vary with n, which means that preference differences are homogeneous across individuals, viz., the government has a particular social valuation of leisure (or equivalently labor) that applies to every individual regardless of skill and income levels. In general, $\overline{\delta} \neq 0$ in the presence of preference difference and Diamond (1998) can be interpreted a special case where $\overline{\delta} = 0$, viz., government and individual preferences are identical. For convenience, we focus in the paper on the case where $\overline{\delta} < 0$, which means that the government attaches a lower value to leisure than do individuals. This perspective is often seen as a driving motivation for wage subsidies in practice and, more generally, for conditioning benefit eligibility on labor market participation (Moffitt, 2003, 2006). However, in principle, $\overline{\delta}$ could be positive, e.g., when the government values non-market activities, such as care of the very young or elderly in the home, conducted by individuals.

In the presence of preference difference, the government's preferences for individuals are used to evaluate social welfare. The social welfare function can thus be stated as:

$$W = \int_{n_{min}}^{n_{max}} G\left(\overline{U^n}(c(n), l(n))\right) f(n)dn = \int_{n_{min}}^{n_{max}} G\left(U^n(c(n), l(n)) + \left(\overline{U^n}(c(n), l(n)) - U^n(c(n), l(n))\right)\right) f(n)dn \qquad (10)$$

where $\overline{U^n}(c(n), l(n))$ is contribution of individual n's consumption and leisure choices to social welfare.[12] Then (10) would be exactly reduced to (6) in the absence of preference difference, viz., $\overline{\delta} = 0$. Correspondingly, the optimal tax problem of the government can thus be written as:

$$\max \int_{n_{min}}^{n_{max}} G\left(\overline{u}(c(n), l(n))\right) f(n)dn = \int_{n_{min}}^{n_{max}} G\left(u(c(n), l(n)) + \overline{\delta}v(1 - l(n))\right) f(n)dn$$

subject to:

$$\int_{n_{min}}^{n_{max}} \left(u(c(n), l(n)) - v(1 - l(n))\right) f(n)dn \leq \int_{n_{min}}^{n_{max}} nl(n)f(n)dn - E \qquad (11)$$

$$u'(c(n), l(n)) = \frac{l(n)v'(1 - l(n))}{n}$$

Again, when $\overline{\delta} = 0$, (11) would be exactly reduced to the optimal tax problem solved by Diamond (1998) for the special case of no preference difference as reflected in (7) so that this model is a special case of our extended model that allows for the possibility of preference differences that are homogeneous across individuals.

[12] While the social welfare function in our extended model is clearly non-welfarist (i.e., non-individualistic), it still obeys the Pareto principle. In a recent paper, An (2021) shows that social welfare functions that only rely on individual utility (or individual preference orderings) may still reflect non-welfarist (i.e., non-individualistic) methods of policy assessment and also still obey the Pareto principle. Therefore, non-welfarist (i.e., non-individualistic) methods of policy assessment may also still obey the Pareto principle.

As with (7), (11) is also a standard optimal control problem. Hence, one can essentially follow the same routine procedures to solve and derive the FOC for the optimal tax as:

$$\frac{T\prime}{1-T\prime} = \frac{\overline{\delta} G'(n)}{\lambda} + \frac{\left(1+\frac{1}{e(n)}\right)\int_{n}^{n max}\left(\lambda - G'(n)\right)dF(n)}{\lambda n f(n)} \qquad (12)$$

This equation shows the implications of allowing for homogeneous preference differences over labor-leisure between the government and individuals. In particular:

(a) *The difference from the benchmark is additive.*[13] The generalized formula for optimal taxes depends on the preference difference between the government and individuals, viz., $\overline{\delta}$. When $\overline{\delta} = 0$, this formula would exactly collapse to that for the benchmark model with no preference difference. When $\overline{\delta} > 0$ the government has a relatively higher preference for leisure, while when $\overline{\delta} < 0$ it has a relatively higher preference for labor. Also, the additive shift differs with the ratio of the social marginal utility of income of individual n to the marginal cost of public funds, viz., $\frac{G'(n)}{\lambda}$.[14]

(b) *The optimal marginal income tax rate T' is increasing in $\overline{\delta}$.* Intuitively, when $\overline{\delta}$ increases (decreases), this means that the government places a larger (smaller) weight on leisure and hence a higher marginal income tax rate should be set to discourage (encourage) labor supply.

(c) *If $\overline{\delta} < 0$, optimal income taxes may involve wage subsidies towards the bottom of the income distribution.* As the optimal marginal income tax rate T' is increasing in $\overline{\delta}$, then for a given negative $\overline{\delta}$, the optimal marginal income tax rates will shift downward for all income levels relative to the benchmark model with $\overline{\delta} = 0$, with the magnitude of the downward shift being inverted U-shaped (i.e., the decreases in T' are higher for middle than bottom and top) (Annex I). Therefore, if $\overline{\delta} < 0$, the optimal marginal income tax rates may be negative towards the bottom of the income distribution.

(d) *The optimal demogrant, $-T(0)$, is increasing in $\overline{\delta}$.* As the optimal marginal income tax rate T' is increasing everywhere in $\overline{\delta}$, the government budget constraint means that for fixed government expenditures E, the optimal demogrant $-T(0)$ must be increasing in $\overline{\delta}$.

(e) *The progressivity of the optimal income tax schedule tends to be increasing in $\overline{\delta}$.* When $\overline{\delta}$ increases, the optimal marginal income tax rate T' and the optimal demogrant $-T(0)$ are simultaneously

[13] As shown by Kanbur et al. (1994), the additive structure still holds in the more general model of Mirrlees (1971).

[14] Note that as we follow Diamond (1998) to assume that G is an increasing and strictly concave transformation of utility, the term multiplied by $\overline{\delta}$ (i.e., $\frac{G'(n)}{\lambda}$) is weighted more for individuals with higher social welfare weights. But if we, for example, assume G to be an identity function (i.e., social marginal utilities of income coincide with private marginal utilities of income), then $\frac{G'(n)}{\lambda} \equiv \frac{1}{\lambda}$. See Tuomala and Weinzierl (2020) for a detailed discussion of different specifications of G.

increasing in $\bar{\delta}$. As the increase in $-T(0)$ tends to dominate the increase in T' for low-income individuals, the average tax rate for low-income individuals tends to be decreasing in $\bar{\delta}$. In sharp contrast, as the increase in T' tends to dominate the increase in $-T(0)$ for high-income individuals, the average tax rate for high-income individuals tends to be increasing in $\bar{\delta}$. Therefore, the progressivity of optimal income tax schedule tends to be increasing in $\bar{\delta}$.

(f) *If $\bar{\delta} < 0$, the optimal income tax schedule tends to be less progressive compared to the benchmark model with $\bar{\delta} = 0$.* As the progressivity of the optimal income tax schedule tends to be increasing in $\bar{\delta}$, the optimal income tax schedule with $\bar{\delta} < 0$ tends to be less progressive compared to the benchmark model with $\bar{\delta} = 0$ (Annex I).

(g) *The model of Kanbur et al. (1994) can be interpreted as a special case of our model where $\bar{\delta} = -1$.* If $\bar{\delta} = -1$, then $\bar{u}\big(c(n), l(n)\big) = c(n)$ from (9), which means that the government is only concerned with consumption (i.e., income or poverty and not labor supply) when setting marginal income tax rates. In this case, (12) shows that it is possible that the optimal marginal income tax rates are negative towards the bottom of the income distribution. In this sense, our model nests Kanbur et al. (1994) as a special case as the poverty index employed by them is essentially a monotonic transformation of consumption (i.e., income).

V. Extended Model with Heterogeneous Preference Differences

We extend the above model further to allow for the possibility of heterogeneous preference differences across individuals by assuming that the preference difference between the government and individuals over leisure, $\delta(n)$, varies with n. Specifically, we assume $\delta(n) = \bar{\delta} + \varphi(n)$, where $\varphi(n)$ is a monotonically increasing function of n, capturing the view that the government may give relatively lower weight to the leisure of low-income individuals where, for example, lower income reflects shorter hours worked.[15] As above, we focus for convenience on the case where both $\bar{\delta} < 0$ and $\delta(n) < 0$, which means that the government attaches a lower value to leisure than individuals (Moffitt, 2003, 2006). Corresponding to (9) and (11), we have:

$$\bar{u}\big(c(n), l(n)\big) = u\big(c(n), l(n)\big) + \Big(\bar{\delta} + \varphi(n)\Big)\, v\big(1 - l(n)\big) \tag{13}$$

and

$$\max \int_{n_{min}}^{n_{max}} G\left(\bar{u}\big(c(n), l(n)\big)\right) f(n)dn = \int_{n_{min}}^{n_{max}} G\left(u\big(c(n), l(n)\big) + \Big(\bar{\delta} + \varphi(n)\Big) v\big(1 - l(n)\big)\right) f(n)dn$$

subject to:

[15] Our modeling of heterogeneous preference differences (i.e., $\varphi(n)$ is a monotonically increasing function of n) captures the spirit of the assumption made by Kanbur et al. (1994) that the government gives weight only to the consumption (i.e., income) of the poor.

$$\int_{n_{min}}^{n_{max}} \Big(u\big(c(n), l(n)\big) - v\big(1 - l(n)\big)\Big) f(n)dn \leq \int_{n_{min}}^{n_{max}} nl(n)f(n)dn - E \qquad (14)$$

$$u'\big(c(n), l(n)\big) = \frac{l(n)v'\big(1 - l(n)\big)}{n}$$

When $\varphi(n) \equiv 0$, (13) and (14) would collapse to (9) and (11), respectively. As for the case with homogeneous preference differences, (14) is still a standard optimal control problem whose FOC for the optimal tax can be derived as:

$$\frac{T\prime}{1-T\prime} = \frac{\big(\overline{\delta}+\varphi(n)\big)G'(n)}{\lambda} + \frac{\Big(1+\frac{1}{e(n)}\Big)\int_{n}^{n_{max}}\big(\lambda-G'(n)\big)dF(n)}{\lambda n f(n)} \qquad (15)$$

This equation shows the implications of allowing for heterogeneous preference differences over leisure between the government and individuals. In particular:

(a) *The difference from the benchmark is still additive.* The generalized formula for optimal taxes depends on the preference difference between the government and individuals, viz., $\overline{\delta} + \varphi(n)$. When $\varphi(n) \equiv 0$, (15) would collapse to (12). When both $\varphi(n) \equiv 0$ and $\overline{\delta} = 0$, (15) would collapse to (8).

(b) *The optimal marginal income tax rate T' is increasing in $\overline{\delta} + \varphi(n)$.* Intuitively, when $\overline{\delta} + \varphi(n)$ increases (decreases), this means that the government places a larger (smaller) weight on leisure and hence a higher marginal income tax rate should be set to discourage (encourage) labor supply.

(c) *If $\overline{\delta} < 0$, then heterogeneous preference differences will further decrease the optimal marginal income tax rates (relative to homogeneous preference differences), enhancing the potential role for wage subsidies.* This is because $\varphi(n)$ is a negative and monotonically increasing function of n, capturing the view that the government may give relatively lower weight to the leisure of low-income individuals where, for example, lower income reflects shorter hours worked.

(d) *The optimal demogrant, $-T(0)$, is increasing in $\overline{\delta} + \varphi(n)$*. As the optimal marginal income tax rate T' is increasing in $\overline{\delta} + \varphi(n)$, the government budget constraint suggests that for fixed government expenditures E, the optimal demogrant $-T(0)$ must be increasing in $\overline{\delta} + \varphi(n)$.

(e) *If $\overline{\delta} < 0$, then heterogeneous preference differences will further decrease the optimal demogrant, $-T(0)$.* If $\overline{\delta} < 0$, then heterogeneous preference differences will further decrease the optimal marginal income tax rate for all income levels (relative to homogeneous preference differences), so that the government budget constraint means that the optimal demogrant $-T(0)$ should be further decreased to finance the fixed government expenditures E.

(f) *If $\overline{\delta} < 0$, then heterogeneous preference differences will tend to further decrease the progressivity of the optimal income tax schedule.* If $\overline{\delta} < 0$, then heterogeneous preference differences will further decrease the optimal marginal income tax rate for all income levels and decrease the optimal demogrant $-T(0)$ simultaneously. As the decrease in $-T(0)$ tends to dominate the decrease in T' for low-income individuals, heterogeneous preference differences will tend to further increase the average tax rate for low-income individuals. In sharp contrast, as the decrease in T' tends to dominate the decrease in $-T(0)$ for high-income individuals, heterogeneous preference differences will tend to further decrease the average tax rate for high-income individuals. Therefore, if $\overline{\delta} < 0$, then heterogeneous preference differences will tend to further decrease the progressivity of the optimal income tax schedule.

VI. Numerical Simulations

To facilitate numerical simulations, we follow the approach of Saez (2001) to express (8), (12) and (15) in terms of the observable income distribution as follows:

$$\frac{T\prime}{1-T\prime} = \frac{\int_z^{z max}(\lambda-g(s))h(s)ds}{\varepsilon(z)\lambda z h(z)} \quad (16)$$

$$\frac{T\prime}{1-T\prime} = \frac{\overline{\delta} g(z)}{\lambda} + \frac{\int_z^{z max}(\lambda-g(s))h(s)ds}{\varepsilon(z)\lambda z h(z)} \quad (17)$$

$$\frac{T\prime}{1-T\prime} = \frac{\left(\overline{\delta}+\varphi(z)\right)g(z)}{\lambda} + \frac{\int_z^{z max}(\lambda-g(s))h(s)ds}{\varepsilon(z)\lambda z h(z)} \quad (18)$$

where z denotes pre-tax income, $\varepsilon(z)$ denotes the elasticity of taxable income, $h(z)$ denotes the income density that is related with the skill density $f(n)$ through the equation $h(z)\dot{z} = f(n)$, and $g(z)$ denotes the marginal social welfare of income, viz., $g(z) \equiv G'(z)$.

A. Calibration of the Benchmark Model

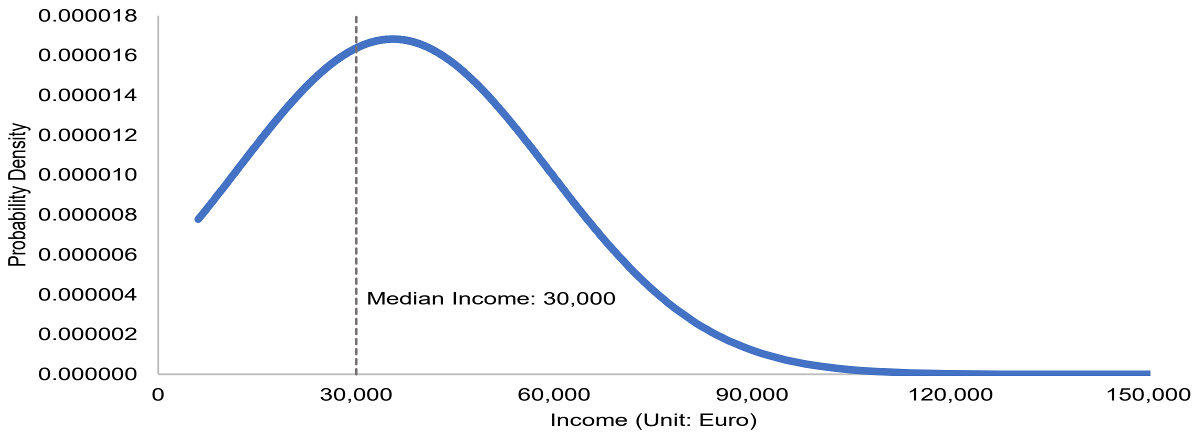
We follow the approach of Hummel and Jacobs (2016) to implement simulations for the benchmark model, and then extend their approach to conduct simulations for the two extended models with preference differences.[16] To calculate the optimal income tax schedule from (16) for the benchmark model, we need to specify: (1) the income density, $h(z)$; (2) the elasticity of taxable income, $\varepsilon(z)$; (3) the marginal social welfare of income, $g(z)$; (4) the marginal cost of public funds, λ; and (5) the government expenditures E.

First, our specification of the income density $h(z)$ largely follows a recent series of studies on the Dutch income taxation by Bas Jacobs and his coauthors (e.g., Jacobs et al., 2017; Zoutman et al., 2014). As the mean and median of income in the Netherlands are about €35,000 and €30,000, respectively, the simulations assume that the pre-tax income z follows a log-normal distribution with mean $\mu = ln(30000) = 10.31$ and standard deviation $\sigma = sqrt\left(2 * \left(ln(35000) - ln(30000)\right)\right) = 0.56$. As there are relatively few observations in the top tail of the income distribution, the simulations replace the top of the income distribution by a Pareto distribution with

[16] We are extremely grateful to Bas Jacobs for sharing his Excel template with us which we have heavily drawn upon in the simulations presented in this paper.

the Pareto parameter $\alpha = 3$ and the starting point of the Pareto distribution being at €75,649, viz., the 95th percentile of the log-normal distribution. Figure 1 presents the probability density function of z.

Figure 1. Income Distribution



Source: Authors' calculations.

Note: Our specification of the income density $h(z)$ largely follows a recent series of studies on the Dutch income taxation by Bas Jacobs and his coauthors (e.g., Jacobs et al., 2017; Zoutman et al., 2014). As the mean and median of income in the Netherlands are about €35,000 and €30,000, respectively, the simulations assume that the pre-tax income z follows a log-normal distribution with mean $\mu = ln(30000) = 10.31$ and standard deviation $\sigma = sqrt\left(2 * \left(ln(35000) - ln(30000)\right)\right) = 0.56$. As there are relatively few observations in the top tail of the income distribution, the simulations replace the top of the income distribution by a Pareto distribution with the Pareto parameter $\alpha = 3$ and the starting point of the Pareto distribution being at €75,649, viz., the 95th percentile of the log-normal distribution.

Second, Saez et al. (2012) surveyed the large literature estimating the elasticity of taxable income with respect to marginal tax rates using tax return data and found that the mid-range of the estimates from the literature is about 0.25. Therefore, the simulations take that $\varepsilon(z) \equiv 0.25$ as the benchmark.

Third, the simulations follow Saez (2002) to summarize the redistributive tastes of the government using a simple parametric form for the curvature of the marginal social welfare of income $g(z) = \frac{1}{\left(\frac{z}{1000}\right)^{\beta}}$, where β is a scalar parameter. The higher is β, the stronger are the redistributive tastes of the government, with $\beta = +\infty$ corresponding to the Rawlsian criterion. Note that this functional form is consistent with the use of a constant elasticity social welfare function as in Atkinson (1970). The range of values for β used in the empirical literature varies around 1.0 (Atkinson and Brandolini, 2010, p10). Chetty (2006) shows that a value of unity is consistent with empirical labor supply behavior and hence a reasonable benchmark. Therefore, the simulations take $\beta = 1$ as the benchmark.

Fourth, Diamond (1998) has shown that with quasi-linear preferences, the marginal cost of public funds λ is equal to the average of $g(z)$, viz., $\lambda = \int_{z_{min}}^{z_{max}} g(z)h(z)dz$. With quasi-linear preferences, a uniform transfer from the government to all workers (i.e., a demogrant) has no effect on labor supply, and so has no extra impact on the government budget. The welfare impact of such a transfer is the average of the marginal social welfare of income over the entire population since each individual receives the same share of total spending. Thus, since the demogrant is optimally chosen, the marginal cost of public funds λ is also equal to the average of $g(z)$, viz., $\lambda = \int_{z_{min}}^{z_{max}} g(z)h(z)dz$.

Finally, the simulations follow Tuomala (1984) by assuming that the government must collect 10 percent of total labor income to finance the government expenditures E. This is of the same order of the magnitude as Jacobs et al. (2017) and Zoutman et al. (2014) who assume that the government consumes 9.5 percent of total output.

B. Simulation Results for the Benchmark Model

The optimal income tax schedule calculated from (16) for the benchmark model is reported in Figure 2 for the case of $\overline{\delta} = 0$. Five key observations can be made. First, Figure 2(a) shows that the optimal marginal income tax rates are non-negative everywhere, confirming the theoretical result of Mirrlees (1971). Second, Figure 2(a) also shows a U-shaped pattern of optimal marginal income tax rates, verifying the simulation results of Diamond (1998). Third, Figure 2(a) shows that the optimal demogrant $-T(0)$ is positive, viz., a lump-sum grant. Specifically, the ratio of the optimal demogrant to the median income (€30,000) is 66 percent. Fourth, Figure 2(b) shows that the optimal average income tax rates for low-income people are negative, owing to the lump-sum grant. Finally, Figure 2(b) shows that the optimal average income tax rates increase in z, so that the optimal income tax schedule is progressive.[17]

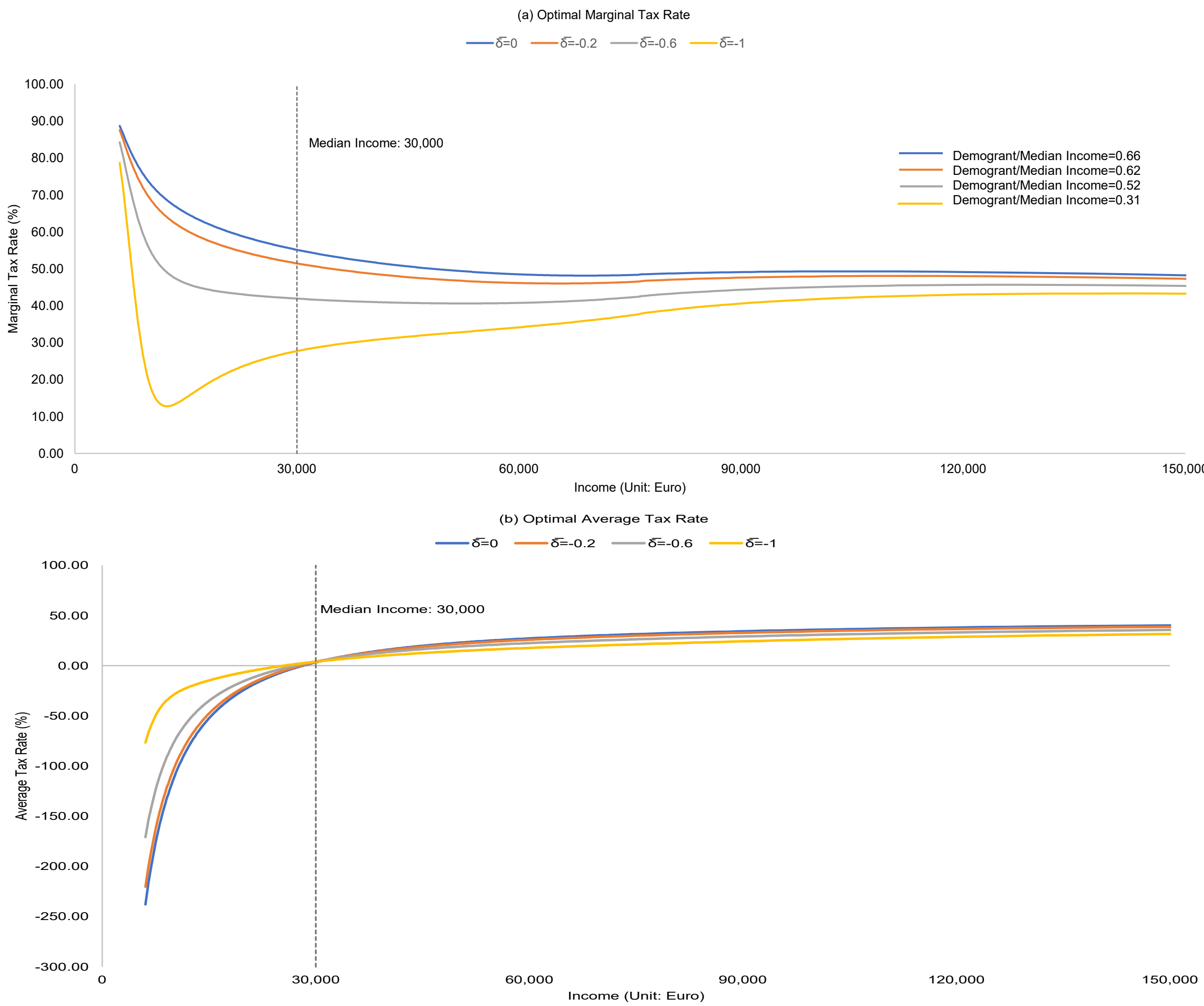
C. Simulation Results with Homogeneous Preference Differences

In addition to the benchmark model with $\overline{\delta} = 0$, we compute results for different $\overline{\delta}$ values of -0.2, -0.6, and -1 to show the effects of homogeneous preference differences on the optimal income tax schedule. The three corresponding optimal income tax schedules are also presented in Figure 2. Three additional key observations can be made from Figure 2. First, Figure 2(a) shows that since the optimal marginal income tax rates increase in $\overline{\delta}$, for a given negative $\overline{\delta}$ (e.g., $\overline{\delta} = -0.2$), the optimal marginal income tax rates have shifted down for all income levels relative to the benchmark model with $\overline{\delta} = 0$, with the magnitude of the downward shift first increasing and then decreasing in z. Second, Figure 2(a) shows that the optimal demogrant, $-T(0)$, decreases as $\overline{\delta}$ decreases, since the optimal marginal income tax rates also decrease. Specifically, the ratio of the optimal demogrant to the median income (€30,000) decreases from 66 percent when $\overline{\delta} = 0$ to 62 percent when $\overline{\delta} =$

[17] The optimum for the benchmark model therefore represents a (non-linear) negative income tax (NIT) scheme similar to the linear NIT scheme proposed by Friedman (1962) which soon found a number of academic champions, including Lampman (1965), Tobin (1966), Tobin et al. (1967), and many others.

-0.2, then to 52 percent when $\bar{\delta} = -0.6$, and finally to 31 percent when $\bar{\delta} = -1$.[18] Finally, Figure 2(b) shows that the optimal income tax schedule becomes less progressive as $\bar{\delta}$ decreases.

Figure 2. Homogeneous Preference Differences and Optimal Income Tax Schedule
$(\boldsymbol{\beta = 1, \varepsilon(z) \equiv 0.25, \gamma = 0})$



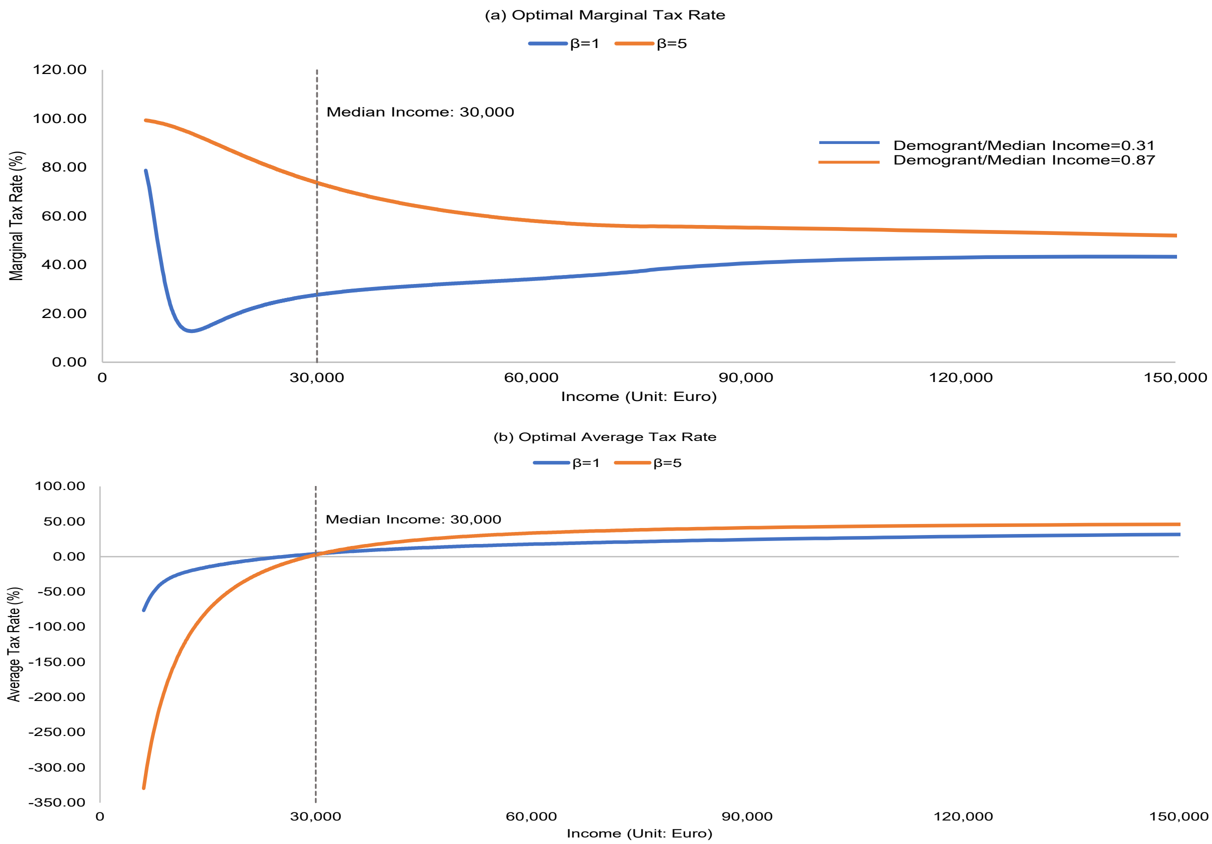
Source: Authors' calculations.

To analyze the implications of redistributive tastes of the government for the optimal tax scheme in the presence of homogeneous preference differences across individuals, we keep $\bar{\delta}$ fixed at -1 but increase the value of β from 1 to 5. The two corresponding optimal income tax schedules are reported in Figure 3. Two key observations can be made from Figure 3. First, Figures 3(a) shows that stronger redistributive tastes of the government result in higher marginal income tax rates T' for all income levels and an also higher demogrant

[18] Note that our extended model could thus be used to rationalize policies observed in many European countries in the context of their Guaranteed Minimum Income schemes whereby low demogrant generosity is combined with low marginal tax rates, especially for families and individuals without children (Coady et al., 2021).

$-T(0)$. Specifically, the ratio of the optimal demogrant to the median income (€30,000) increases from 31 percent when $\beta = 1$ to 87 percent when $\beta = 5$. Second, Figure 3(b) shows that stronger redistributive tastes of the government result in more progressive optimal income tax schedules.

Figure 3. Inequality Aversion and Optimal Income Tax Schedule
$(\bar{\delta} = -1, \varepsilon(z) \equiv 0.25, \gamma = 0)$

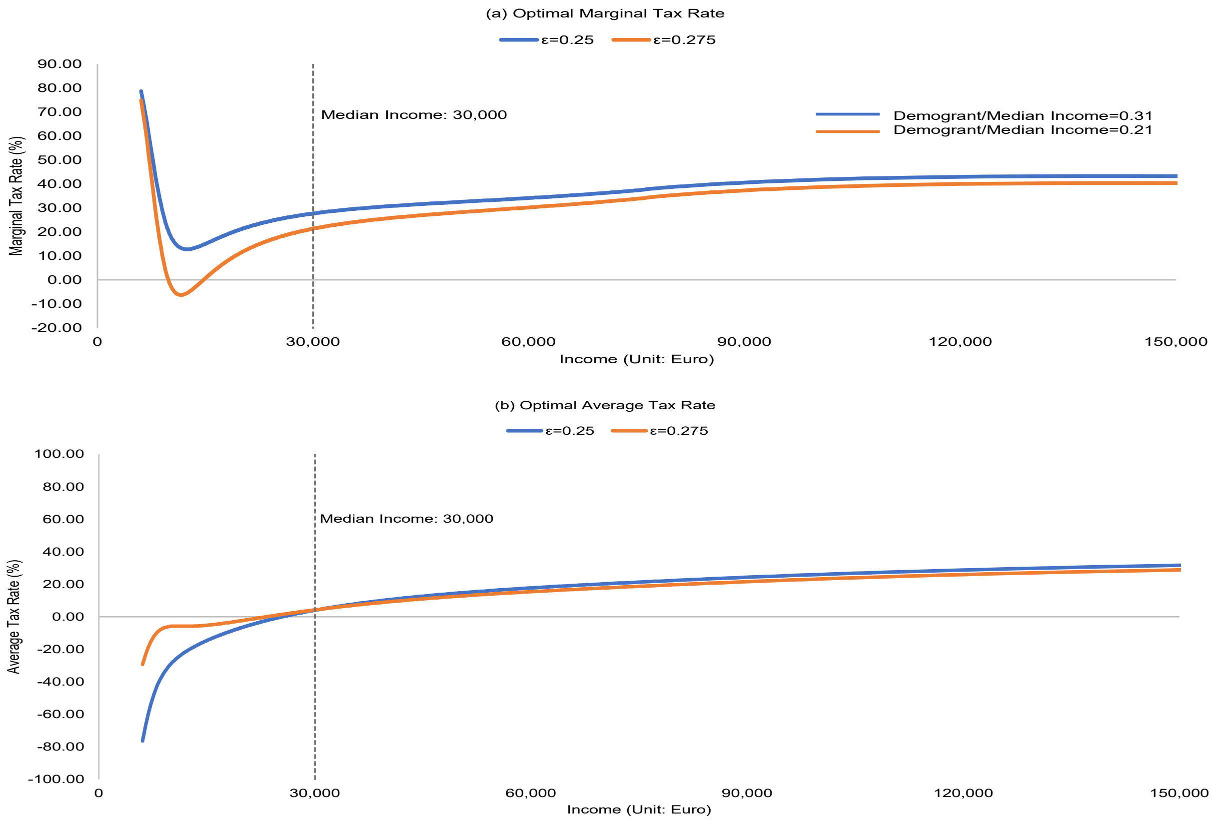


Source: Authors' calculations.

To analyze the implications of the elasticity of taxable income for the optimal tax scheme in the presence of homogeneous preference differences across individuals, we keep $\bar{\delta}$ fixed at -1 but increase the value of $\varepsilon(z)$ from $\varepsilon(z) \equiv 0.25$ to $\varepsilon(z) \equiv 0.275$, while keeping the value of β fixed at 1. The two corresponding optimal income tax schedules are reported in Figure 4. Four key observations can be made from Figure 4. First, Figure 4(a) shows that that since the optimal marginal income tax rates decrease in the elasticity of taxable income, the optimal marginal income tax rates have shifted down for all income levels relative to the benchmark with $\varepsilon(z) \equiv 0.25$. Second, Figure 4(a) shows that the optimal marginal income tax rates are negative at low-income levels, suggesting that with homogeneous preference differences, the optimal income tax schedule may involve wage subsidies at the bottom of the income distribution for certain parameter constellations. Third, Figure 4(a) shows that the optimal demogrant $-T(0)$ decreases as the elasticity of taxable income increases, consistent with the decrease in optimal marginal income tax rates across all income levels. Specifically, the ratio of the optimal demogrant to the median income (€30,000) decreases from 31 percent when $\varepsilon(z) \equiv 0.25$ to 21 percent when $\varepsilon(z) \equiv 0.275$. Finally, Figure 4(b) shows that more elastic taxable income results in less progressive optimal income tax schedules.

Figure 4. Elasticity of Taxable Income and Optimal Income Tax Schedule

$(\overline{\boldsymbol{\delta}} = -\mathbf{1},\ \boldsymbol{\beta} = \mathbf{1},\ \boldsymbol{\gamma} = \mathbf{0})$



Source: Authors' calculations.

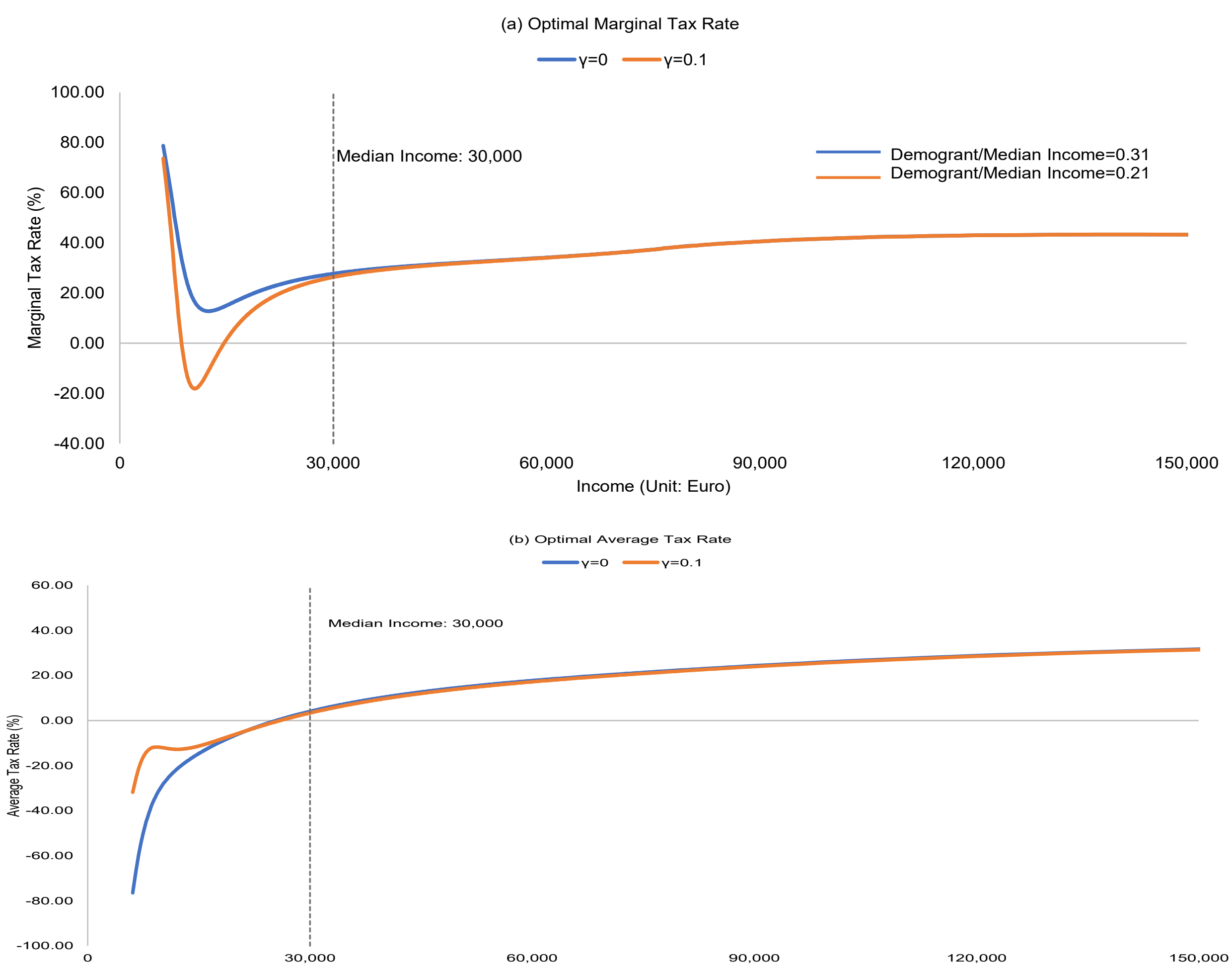
D. Simulation Results with Heterogeneous Preference Differences

To show the effects of heterogeneous preference differences for the optimal income tax schedule, we keep $\overline{\delta}$ fixed at -1 and assume that $\delta(z) = \overline{\delta} + \varphi(z) = -1 + \gamma * log\big(H(z)\big)$, where γ is a scalar parameter and $H(z)$ is the cumulative distribution function (CDF) of z. We keep the value of β fixed at 1 and $\varepsilon(z) \equiv 0.25$. This specification has three notable properties. First, if $\gamma = 0$, then $\delta(z) \equiv -1$, viz., heterogeneous preference differences reduce to homogeneous preference differences with $\overline{\delta} = -1$. Second, if $\gamma > 0$ (e.g., $\gamma = 0.1$), then $\varphi(z) = \gamma * log\big(H(z)\big)$ would be negative for any z and monotonically increasing in z capturing a lower social preference for labor supply at higher earnings that at lower earnings. Finally, $\lim_{z \to +\infty} \varphi(z) = \gamma * log(1) = 0$, viz., $\lim_{z \to +\infty} \varphi(z) = 0$ does not depend on the value of the scalar parameter γ.

With the above specification, viz., $\delta(z) = -1 + \gamma * log(H(z))$, we calculate the optimal income tax schedule for two cases: (1) $\gamma = 0$ (i.e., homogeneous preference differences with $\overline{\delta} = -1$); and (2) $\gamma = 0.1$. The two corresponding optimal income tax schedules are reported in Figure 5. Four key observations can be made from Figure 5. First, Figure 5(a) shows that since the optimal marginal income tax rates decrease in γ, for a given positive γ (e.g., $\gamma = 0.1$), the optimal marginal income tax rates have shifted down for all income levels relative to the benchmark case with $\gamma = 0$. Second, Figure 5(a) shows that the optimal marginal income tax rates are negative at low-income levels, suggesting that heterogeneous preference differences further enhance the potential role for wage subsidies. Third, Figure 5(a) shows that the optimal demogrant $-T(0)$ decreases as γ increases, consistent with optimal marginal income tax rates decreasing for all income levels as γ increases. Specifically, the ratio of the optimal demogrant to the median income (€30,000) decreases from 31 percent when $\gamma = 0$ to 21 percent when $\gamma = 0.1$. Finally, Figure 5(b) shows that the optimal income tax schedule becomes less progressive as γ increases.

Figure 5. Heterogeneous Preference Differences and Optimal Income Tax Schedule

$(\overline{\boldsymbol{\delta}} = -\mathbf{1},\ \boldsymbol{\beta} = \mathbf{1},\ \boldsymbol{\varepsilon}(\boldsymbol{z}) \equiv \mathbf{0.25})$



Source: Authors' calculations.

VII. Concluding Remarks

Wage subsidies have become more prevalent in advanced economies over recent decades. Yet the standard Mirrlees (1971) model, which focuses on the intensive margin (i.e., individual decisions on hours of work or effort), does not envision a role for wage subsidies in the optimal income tax system. In practice, the rationalization of wage subsidies often appeals to the social value attached to income from work relative to public transfer income. This paper shows that extending the standard model to incorporate differences in preferences between the government (or society) and individuals over labor supply and leisure does indeed introduce a potential role for wage subsidies under certain parameter constellations.

The theoretical and simulation analyses of this extended model demonstrate that introduction of such preference differences results in a reduction in optimal marginal income tax rates (MITs) across the earnings distribution relative to the standard model, with reductions being highest at the middle of the earnings distribution. This, in turn, results in lower revenues and thus a lower uniform demogrant to individuals, which tends to reduce the progressivity of the overall tax and transfer system. Under the "homogeneous" case, i.e., where differences in social and individual preferences over work and leisure apply uniformly across the earnings distribution, the case for wage subsidies increases with the magnitude of the elasticity of taxable income. When social preferences for work are relatively high for those with low earnings (i.e., "heterogeneous" preference differences), the potential role for wage subsidies at lower earnings is reinforced, resulting in a larger decrease in optimal MITs relative to the standard model, lower revenues, a lower uniform demogrant, and lower progressivity of the overall tax and transfer system.

The extended model also provides a framework for rationalizing the variation in benefit (grant) generosity and MITs often observed in practice (Coady et al., 2021). For example, the typically high labor supply elasticity for single adults combined with a social preference for work would call for a combination of relatively low benefit generosity and low MITs or even wage subsidies. For those whose employment prospects are limited by lack of labor demand (e.g., due to lack of basic skills or redundancy of skills due to structural and technological change), subsidies could be conditioned on participation in active labor market programs that address these skill mismatches. For single parents with young children, a social preference for "leisure" (i.e., non-market work in the form of childcare) combined with a low labor supply elasticity (e.g., say reflecting fixed employment costs such as private childcare services) and a strong concern for poverty would call for high benefit generosity with medium to high MITs. As children near formal school age, generosity and MITs could be gradually reduced to incentivize gradual return to work and possibly combined with, or preceded by, subsidies conditioned on participation in active labor market programs to enhance employment prospects. Similar reasoning could be applied to justify generous benefits for those caring for the elderly at home, especially if this also reduces public spending pressures from public social care provision.

Annex I. Proofs for Two Propositions

This annex provides a detailed analysis of the impact of differential social and individual preferences over work and leisure on the optimal income tax system. It examines the case where differential preferences are uniform across the earnings distribution, comparing this to the standard optimal income tax model that assumes common social and individual preferences.

Impact on the optimal marginal income tax schedule

Proposition 1. For a given negative $\overline{\delta}$, the optimal marginal income tax schedule will shift downward for all income levels relative to the benchmark model with $\overline{\delta} = 0$, with the magnitude of the downward shift being inverted U-shaped (i.e., the decreases in T' are higher for middle than bottom and top).

Proof. If we let $x(z) \equiv \frac{\int_z^{zmax}(\lambda - g(s))h(s)ds}{\varepsilon(z)\lambda z h(z)}$, then (16) suggests that $T' = \frac{x(z)}{1+x(z)}$ so that $\frac{dT'}{dx(z)} = \frac{1}{(1+x(z))^2}$. If we further let $\Delta x(z) \equiv \frac{\overline{\delta} g(z)}{\lambda}$, then by applying the Taylor expansion, (17) suggests that $\Delta T' \approx \frac{\Delta x(z)}{(1+x(z))^2} = \overline{\delta} * \frac{1}{(1+x(z))^2} * \frac{g(z)}{\lambda}$. Figure 2(a) for the case of $\overline{\delta} = 0$ shows that $x(z)$ is, roughly speaking, monotonically decreasing in z so that $\frac{1}{(1+x(z))^2}$ is monotonically increasing in z. Also, $\frac{g(z)}{\lambda}$ is monotonically decreasing in z. Therefore, we can conclude that for a given negative $\overline{\delta}$ (e.g., $\overline{\delta} = -0.2$), the optimal marginal income tax schedule will shift downward for all income levels relative to the benchmark model with $\overline{\delta} = 0$, with the magnitude of $\Delta T'$ (i.e., $|\Delta T'|$) first increasing and then decreasing in z. Q.E.D.

Impact on the progressivity of the optimal tax-transfer system

Proposition 2. If $\overline{\delta} < 0$, the optimal income tax schedule tends to be less progressive compared to the benchmark model with $\overline{\delta} = 0$.

Proof. When $\overline{\delta}$ decreases from 0 to a negative value (e.g., $\overline{\delta} = -0.2$), the optimal marginal income tax rates T' and the optimal demogrant $-T(0)$ both decrease. As the decrease in $-T(0)$ tends to dominate the decrease in T' for low-income individuals, the average tax rate for low-income individuals tends to increase. In sharp contrast, as the decrease in T' tends to dominate the decrease in $-T(0)$ for high-income individuals, the average tax rate for high-income individuals tends to decrease. Therefore, if $\overline{\delta} < 0$, the optimal income tax schedule tends to be less progressive compared to the benchmark model with $\overline{\delta} = 0$.

However, note that although the overall profile of the optimal income tax schedule with $\overline{\delta} < 0$ tends to be less progressive compared to the benchmark model with $\overline{\delta} = 0$, *Proposition 1* suggests that this might not be true locally as when $\overline{\delta}$ decreases from 0 to a negative value (e.g., $\overline{\delta} = -0.2$), the decreases in the optimal marginal income tax rates T' are higher for middle than bottom and top. Q.E.D.

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PUBLICATIONS

Social versus Individual Work Preferences: Implications for Optimal Income Taxation

Working Paper No. **WP/2022/062**