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The optimal treatment of tax expenditures

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Abstract

This paper analyzes the optimal treatment of tax expenditures. It develops an optimal tax model where individuals derive utility from spending on a ‘‘contribution’’ good such as charitable giving. The contribution good has also a public good effect on all individuals in the economy. The government imposes linear taxes on earnings and on the contribution good so as to maximize welfare. The government may also finance directly the contribution good out of tax revenue. Optimal tax and subsidy rates on earnings and the contribution good are expressed in terms of empirically estimable parameters and the redistributive tastes of the government. The optimal subsidy on the contribution good is increasing in the size of the price elasticity of contributions, the size of the crowding out effect of public contributions on private contributions, and the size of the public good effect of the contribution good. Numerical simulations show that the optimal subsidy on contributions is fairly sensitive to the size of these parameters but that, in most cases, it should be lower than the earnings tax rate.

JEL classification: H21
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1. Introduction

The US government encourages a number of economic activities or consumption patterns through tax incentives. Individuals are allowed to deduct expenses such as charitable contributions or mortgage interest payments from their taxable income. In 1995, itemized deductions reported on excess of the standard deduction represented around 12% of taxable income and cost the federal government over $80 billion in tax revenues (which

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is around 15% of total individual federal income taxes collected in that year). Charitable giving represent about 15% of itemized deductions, and mortgage interest payments about 35%. Unsurprisingly, the use of these tax expenditures has been the subject of substantial controversy and the focus of debate among tax policy analysts.

Supporters of tax expenditures point out that it is efficient to encourage certain kinds of economic behaviors instead of using direct expenditures to achieve similar objectives. They argue that tax expenditures such as charitable giving or home ownership have positive external effects and are very responsive to tax incentives. Therefore, the government should promote these types of activities by providing a tax break.

Opponents emphasize that the external effect of such tax expenditures is too small to justify a complete tax exemption. Moreover, as tax expenditures are likely to be much more responsive to taxation than labor supply, they point out that allowing tax expenditures may both reduce the size of the tax base and increase significantly the elasticity of taxable income, thus increasing significantly the total deadweight burden from the income tax.[1]

The economic literature has devoted considerable attention to the empirical analysis of the behavioral responses to tax incentives. Many studies have analyzed the effect of tax subsidies on home ownership[2] and charitable giving.[3] The distribution effect of these tax expenditures, though less systematically investigated, has also attracted some attention.[4] However, in order to illuminate the policy debate on the desirability of tax expenditures, it is necessary to develop theoretical models that incorporate formally the pro and cons elements that are brought into the debate. Such models should allow to determine quantitatively how the different considerations intervene and should provide optimal tax or subsidy formulas expressed in terms of magnitudes empirically estimable. No study has provided precise policy recommendations using estimates from the empirical literature and few studies have investigated the normative side of the tax treatment of charitable contributions or other potential tax expenditures. Some studies have examined some of the aspects of this problem but without solving an explicit social welfare maximization problem.[5] Fewer studies have developed and analyzed the full optimal tax problem. Atkinson (1976) develops an altruistic model where high income individuals care about the needy. Using a simple log functional form specification for the utility function, he obtains fairly simple optimal tax credit formulas. Feldstein (1980) develops a representative individual tax model to compare the cost of increasing the level of a public good through government expenditure versus private giving. Roberts (1987) follows upon

[1] Hall and Rabushka (1985) who advocate a switch to a low rate flat tax with no tax expenditures allowed develop these points informally.

[2] See, e.g. Rosen (1985) for a survey.

[3] Clotfelter (1985) provides an extensive survey of empirical analyses on charitable giving. Steinberg (1990) updates this survey.

[4] See for example Clotfelter (1992) for an extensive analysis of the redistributive effects of the nonprofit sector.

[5] Hochman and Rogers (1969, 1977) develop a simple framework where gifts to individuals and charities produce external benefits that could be encouraged with Pigouvian subsidization. The recent studies by Kaplow (1995, 1998) analyze a number of models such as altruism, utility from giving per se, and exchange related motives which generate voluntary transfers. Kaplow provides important but informal discussions in each of these models of the pros and cons of tax subsidies for gifts.

Feldstein (1980) and analyzes under what conditions it is preferable to finance a public good through tax revenue rather than subsidies to voluntary contributions. Roberts analyzes in detail the role of crowding out of private contribution by public provision. The present paper builds upon these previous contributions and proposes a general model, which encompasses most of the situations previously analyzed.

This paper considers a model with three goods: private consumption, earnings, and a "contribution" good to which individuals may choose to contribute voluntarily and which also has a positive external effect. This contribution good can be for example charitable contributions, or home ownership. The government has redistributive goals and may also finance the contribution good out of general tax revenues. The paper derives optimal tax rates on labor income and the contribution good. A number of simplifying assumptions on behavioral responses to taxes are made to obtain simple optimal tax and subsidy formulas directly expressed in terms of observable magnitudes. Three important elements enter optimal tax and subsidy formulas.

First and obviously, the size of the subsidy is closely related to the size of the external effect. If the government can also finance directly the public good with tax revenue, then it can choose the total level of public good so as to equate the external effect to the marginal value of public funds. When the contribution good is socially overprovided by the private sector, the government cannot undo this overprovision.[6] Second, the optimal subsidy is positively related to the price elasticity of the contribution good. Inelastic contribution goods should be heavily taxed even if they generate a large external effect. Third, when the government can freely contribute to the public good, the more private contributions are crowded out by public contributions, the higher should be the subsidy on voluntary contributions.

It is interesting to note the relation between the optimal subsidy rate and the optimal tax rate on earnings. There is no theoretical reason to link the subsidy rate on the contribution good to the income tax rate as is currently done in the US income tax code. In the model developed here, the optimal tax rate on earnings is fairly independent from the price elasticity of the contribution good and can be high if earnings are not very responsive to taxation and redistributive tastes are strong. However, tying the subsidy rate to the income tax rate, as is done in the US income tax system, may increase substantially the elasticity of taxable income and reduce substantially the redistributive power of the income tax.

It is important to note that the framework presented here is conceptually close to the analysis of optimal taxation in the presence of public goods or externalities. The seminal study on optimal taxation and externalities by Sandmo (1975) showed that optimal tax rates can be decomposed into a Ramsey component and a Pigouvian corrective component.[7] The central difference between those models and the one presented here is that, in the current model, the government can supply the contribution good and this government supply in turn can crowd-out private contributions. The current paper is also close to

[6] For a number of goods, such as religious services, the government is constrained by law not to contribute and there may be either over or under provision even when taxes are set optimally.

[7] Several papers have extended Sandmo (1975) along several dimensions such as the environment (Bovenberg and Goulder, 1996; Cremer and Gahvari, 2001) or non-linear income taxes (Cremer et al., 1998).

studies analyzing optimal taxation in the presence of public goods (Atkinson and Stern, 1974; Boadway and Keen, 1993; Kaplow, 1996). The main difference is that, here, individuals are allowed to contribute to the public good as well.[8]

Finally, it should be noted that the warm glow model raises difficult conceptual issues for normative welfare evaluation. Diamond (2002) contrasts models of optimal taxation and charitable giving with and without warm glow preferences and points out some of the conceptual difficulties introduced by the warm glow model. In the present paper, because we restrict ourselves to a simple second best setting with distortionary taxation, such difficulties will not be apparent but they would happen in alternative settings.[9]

The present paper is organized as follows. Section 2 presents the model and derives the optimal tax and subsidy conditions of the government. Section 3 introduces additional assumptions to simplify the optimal tax formulas and discusses in detail the different effects that come into play. Section 4 proposes a calibration exercise to assess the size of optimal subsidies using a range of empirical estimates on responses to taxation and distributional effects of tax expenditures. Finally, Section 5 offers a brief conclusion.

2. The Model

2.1. The individual program

I consider a model with three goods, private consumption c, earnings z and a "contribution" good g. The contribution good will stand for either charitable contributions or general tax expenditures such as mortgage interest payment or health expenditures. The utility of each individual is increasing in consumption c and decreasing in earnings z (labor supply is costly). Individuals may also derive utility from personal contributions g. Therefore, individual utility functions depend directly on the individual "consumption" choices of the three goods (c, z, g). As a potential public good, contributions may also provide indirect utility to the individuals in the economy. For example, contributions to a particular religious organization improve the service provided to members of this organization. To model the public good nature of contributions, I assume that the level of contributions *per capita*, which I denote by G, is an additional argument in the utility functions of individuals. Therefore, each individual has a utility function $u = u(c, z, g, G)$ which is non-decreasing in c, g and G, and decreasing in z.

Note that contributions are modeled both as a private good, through the argument g in $u(\cdot)$, and as a public good, through the argument G in $u(\cdot)$. This warm glow model of giving, developed by Andreoni (1990), captures accurately the real situation because it is

[8] Bloomquist and Christiansen (1998) also consider a public good model where individual can also voluntary contribute to the public good but with no warm glow. Such a theoretical model predicts a 100% crowding out of contributions (Bergstrom et al., 1986) and cannot account satisfactorily for the empirical large level of voluntary giving.

[9] For example, in a first best setting with warm glow, a very large subsidy to giving associated with large offsetting lumpsum taxes in order to induce complete private provision of public goods is preferable to government provision because of warm glow of giving. See Diamond (2002) for other examples.

impossible to account for actual levels of contributions without assuming that most contributors derive direct utility from giving.

We assume that the government sets a flat tax rate τ on earnings, a tax rate t on contributions, and provides a lumpsum payment R to all individuals in the economy. It is important to note that we exclude non-linear taxation from the analysis and we discuss later on how introducing non-linear taxation may affect the analysis. The government may also finance directly an amount G^0 of the contribution good per capita. Thus the total per capita amount of the contribution good is $G=G^0+G^P$ where G^P denotes average individual voluntary contribution. Consumption c is the untaxed good. It is useful to adopt this normalization as we want to investigate how contributions should be taxed relative to earnings.[10] For example, the case $t=-\tau$ corresponds to fully deductible charitable contributions. Individuals are indexed by $h\in H$ where H is an index set. I normalize the total population to one and I denote by $\mathrm{d}\nu(h)$ the density of individuals over H. The integration sign denotes summation over all individuals in H. Individual h maximizes $u^h(c, z, g, G)$ subject to the budget constraint, $c+g(1+t)\leq z(1-\tau)+R$. Note that utility functions may differ from individual to individual.

I assume that the number of individuals is large enough so that all individuals take G as fixed when choosing their optimal contribution level g. I denote by $v^h(1-\tau)$, $1+t$, R, G) the indirect utility of individual h, $z^h=z^h(1-\tau,\ 1+t,\ R,\ G)$ his earnings level, and $g^h=g^h(1-\tau,\ 1+t,\ R,\ G)$ his contribution level given the tax parameters. The individual welfare effects of changes in t and τ can be obtained using the Roy's identity conditions, $v^h_{1-\tau}=z^h v^h_R$ and $v^h_{1+t}=-g^h v^h_R$, where subscripts denote, from now on, derivatives.

2.2. Crowding out

I denote by $Z=Z(1-\tau,\ 1+t,\ R,\ G)=\int z^h \mathrm{d}\nu(h)$ and $G^P=G^P(1-\tau,\ 1+t,\ R,\ G)=\int g^h \mathrm{d}\nu(h)$ the average earnings and private contributions. Note that the argument G in $Z(\cdot)$ and $G^P(\cdot)$ is equal to G^0+G^P and is, therefore, endogenous. Consequently, it is conceptually useful to introduce $\bar{Z}=\bar{Z}(1-\tau,\ 1+t,\ R,\ G^0)$ and $\bar{G}=\bar{G}(1-\tau,\ 1+t,\ R,\ G^0)$ which denote the average earnings and voluntary private contribution for given tax parameters and a given level of government contribution G^0. Note that $\bar{G}_{G^0}=\partial\bar{G}/\partial G^0$ is the total crowding out resulting from a one dollar increase in public contribution. This parameter has been extensively studied in the empirical literature.[11] Presumably, $\bar{G}_{G^0}\leq 0$, and $\bar{G}_{G^0}=-1$ when there is complete crowding out.

2.3. The government program

As in standard optimal income tax models, the government sets the tax rates τ and t, the lumpsum level R, and possibly G^0 so as to maximize a social welfare function,

$$W=\int \mu^h v^h(1-\tau, 1+t, R, \bar{G}+G^0)\mathrm{d}\nu(h),$$

[10] As usual in optimal tax models, the normalization choice has no real effect on the optimal outcome.

[11] This is discussed in detail in Section 4.

where μ^h is the weight associated to individual h, subject to the aggregate budget constraint,

$$\tau\bar{Z} + t\bar{G} \geq R + G^0 + E, \tag{1}$$

where E denotes government consumption per capita and is taken as exogenous. The government budget constraint states that total taxes collected must finance the lumpsum amount R, government contributions G^0, and government consumption E. This model is an extension of the optimal tax model of Diamond and Mirrlees (1971). This model is formally close to the environmental externality model of Sandmo (1975) who considers a Diamond–Mirrlees model with a good producing an externality such as the contribution good g of this model.[12] The present model is also related to the model of Atkinson and Stern (1974) where the government finances a public good through linear commodity taxation but where individuals do not voluntary contribute.

2.4. General optimal tax formulas

I denote by λ the multiplier of the government budget constraint (1). The multiplier is equal to the marginal value of public funds. The first order conditions with respect to τ, t, and R, for the optimal tax structure can be written as,

$$-\int \mu^h [v^h_{1-\tau} + v^h_G \bar{G}_{1-\tau}] \mathrm{d}v(h) + \lambda[\bar{Z} - \tau\bar{Z}_{1-\tau} - t\bar{G}_{1-\tau}] = 0, \tag{2}$$

$$\int \mu^h [v^h_{1+t} + v^h_G \bar{G}_{1+t}] \mathrm{d}v(h) + \lambda[\bar{G} + \tau\bar{Z}_{1+t} + t\bar{G}_{1+t}] = 0, \tag{3}$$

$$\int \mu^h [v^h_R + v^h_G \bar{G}_R] \mathrm{d}v(h) + \lambda[-1 + \tau\bar{Z}_R + t\bar{G}_R] = 0. \tag{4}$$

Finally, in the case where the government can choose to contribute to the public good, the first order condition for G^0 is,

$$\int \mu^h [v^h_G + v^h_G \bar{G}_{G^0}] \mathrm{d}v(h) + \lambda[-1 + \tau\bar{Z}_{G^0} + t\bar{G}_{G^0}] = 0. \tag{5}$$

As the government cannot possibly contribute *negative* amounts to the public good, there is an additional constraint $G^0 \geq 0$. This constraint binds when the left-hand-side of (5) is negative at $G^0 = 0$. In that case, the public good is socially over-provided by the private sector and the government cannot undo directly this overprovision.

[12] In contrast to the present paper, in the Sandmo model, the government cannot directly affect the quantity of the good producing the externality.

In some cases, the government may not be able to contribute to the public good. For example, in the US, religious organizations cannot receive government funding and can only be financed by private contributions. In that case, $G^0 = 0$ and the amount of contributions may be either above or below the social optimal level and the first order condition (5) does not hold in general.

I denote by $\beta^h = \mu^h v_R^h / \lambda$ the social marginal value of consumption by individual h in terms of public funds. These social weights summarize the redistributive tastes of the government. For example, if the government values redistribution, then β^h is high for poor individuals and low for well-off individuals. If the government does not value redistribution at all, then the weights β^h are equal across individuals. I note, $\beta(R) = \int \beta^h \mathrm{d}\nu(h)$, the average social value (in terms of public funds) of giving one additional dollar to all individuals (i.e. increasing the lumpsum R by one dollar). Similarly, I denote by, $\beta(Z) = \int z^h \beta^h \mathrm{d}\nu(h)/\bar{Z}$, the average social weight weighted by earnings and $\beta(G) = \int g^h \beta^h \mathrm{d}\nu(h)/\bar{G}$, the average social weight weighted by contribution levels. If the government has no redistributive tastes, then obviously, $\beta(R) = \beta(Z) = \beta(G)$. If the government values redistribution, then β^h is negatively correlated to income z^h and thus $\beta(Z) < \beta(R)$. If private contributions g^h are even more concentrated toward the high end of the income distribution than earnings, as it is the case with charitable contributions in the US, then $\beta(G) < \beta(Z)$.[13]

Finally, I define by,

$$e = \int \frac{v \mu^h v_G^h \mathrm{d}\nu(h)}{\lambda} = \int \beta^h \frac{v_G^h}{v_R^h} \mathrm{d}\nu(h), \tag{6}$$

the social marginal value of the contribution good in terms of public funds. The parameter e, which measures the external effect of a marginal increase in the level of the contribution good, is a key element to determine the optimal tax rate on contributions. Using (6), the Roy's identities and the definitions of $\beta(R)$, $\beta(Z)$ and $\beta(G)$, Eqs. (2)–(5) can be rewritten as,

$$[1 - \beta(Z)]\bar{Z} = \tau \bar{Z}_{1-\tau} + (t + e)\bar{G}_{1-\tau}, \tag{7}$$

$$[1 - \beta(G)]\bar{G} = -\tau \bar{Z}_{1+t} - (t + e)\bar{G}_{1+t}, \tag{8}$$

$$1 - \beta(R) = \tau \bar{Z}_R + (t + e)\bar{G}_R, \tag{9}$$

$$e = 1 - \tau \bar{Z}_{G^0} - (t + e)\bar{G}_{G^0}. \tag{10}$$

[13] The calibration of the β's is discussed in Section 4.

Eqs. (7)–(9) are close to the standard optimal tax formulas of Diamond and Mirrlees (1971). There are two important points to note relative to the standard case. The first difference is the external e term. The tax rate t on the right-hand-size of Eqs. (7)–(10) is replaced by $t' = t + e$ which I call the *shadow tax rate* on contributions. Therefore, the optimal tax rates can be computed in two steps. First, as in the standard case, the tax rates (τ, t') can be derived ignoring the external effect. Second, the real rate t on contributions is obtained by subtracting from the shadow tax rate t' the social external effect e. The tax subsidy e due to the external effect is conceptually equivalent to the classical Pigouvian tax or subsidy.[14] This additivity property has been noted by Sandmo (1975). Second, when the government can set G^0 freely, it sets the total level of public good such that the size of the external effect e is given by the first order condition (10). In the case where earnings are not affected by G (i.e. $\bar{Z}_{G^0} = 0$) and with no crowding out (i.e. $\bar{G}_{G^0} = 0$), Eq. (10) shows that the external effect e is equal to one at the optimum.

3. Specializing the model

Eqs. (7)–(10) are too general to allow the derivation of quantitative tax policy recommendations. Therefore, in this section, I specialize the supply side response of the model to the case where simple optimal tax formulas can be obtained and discussed in the light of empirical estimates on behavioral responses to taxation.

3.1. Simplifying assumptions

In this subsection, I introduce three simplifying assumptions. I assume first that there are no income effects on earnings at the individual level. That is, increasing the lumpsum R has no effect on labor supply. Most empirical studies have found that income effects are small relative to substitution effects (see e.g. the surveys by Blundell and MaCurdy, 1999; Pencavel, 1986). Therefore, this assumption is justified as a first approximation to the actual situation.

Assumption 1. There are no income effects on earnings at the individual level, $z_R^h = 0$ for all h.

The large empirical literature on charitable giving in the US (see e.g. Clotfelter, 1985 for a comprehensive survey) has focused on the effect of the tax price subsidy and the income level on the level of charitable contributions. Those studies make in general two implicit important assumptions on the structure of behavioral responses to taxation.

They first assume implicitly that earnings are not affected by the tax rate t on contributions. It is very likely that individuals decide about the level of their charitable givings once their earnings are realized and that their labor supply decisions are not much

[14] It is straightforward to extend this model to the case with many goods. Each tax rate should be equal to the standard Diamond–Mirrlees tax rate minus the social external effect produced by that particular good.

affected by their prospective charitable contributions levels and hence by the tax rate t on charitable givings. Therefore, in order to simplify the model of the previous section, it seems natural to assume the level of the contribution good G and tax rate t do not affect earnings and thus that $\bar{Z}_{G^0}=0$ and $\bar{Z}_{1+t}=0$.

This assumption might be violated in the case of charities providing income support for the poor. Such organizations, similarly to public welfare programs, might reduce labor supply of beneficiaries. At the other end of the income distribution, better art museums funded by contributions might increase average time spent in the museums and thus reduce labor supply accordingly. Very little is known about these effects. Therefore, assuming zero effects seems to be a reasonable starting point.

Assumption 2. Aggregate earnings are not affected by the level of the contribution good G and by the tax rate on contributions, $\bar{Z}_{G^0}=0$ and $\bar{Z}_{1+t}=0$.

Second, most empirical studies assume that a change in tax rate τ on earnings affects contributions only to the extent that it affects disposable earnings $z^h(1-\tau)+R$. Therefore, it is reasonable to assume that a *compensated* change in τ has no effect on the level of contributions. In other words, $\partial g^h/\partial(1-\tau)|_u=0$ where the subscript u means that the derivative is taken keeping the utility level constant.

Assumption 3. For all individuals, the compensated supply of contributions does not depend on the tax rate on earnings, $\partial g^h/\partial(1-\tau)\,|_u=0$.

Using the Slutsky equation, Assumption 3 implies,

$$\frac{\partial g^h}{\partial(1-\tau)}=\frac{\partial g^h}{\partial(1-\tau)}\,|_u+z^h\frac{\partial g^h}{\partial R}=z^h\frac{\partial g^h}{\partial R}. \tag{11}$$

Summing Eq. (11) over all individuals, we obtain,

$$\bar{G}_{1-\tau}=\bar{Z}\hat{G}_R, \tag{12}$$

where $\hat{G}_R$ is the average response weighted by earnings of contributions to a uniform one dollar increase of the lumpsum R.[15]

Assumption 1–3 allow to rewrite the optimal tax Eqs. (7) and (8) in a much simpler form. I define the elasticity of aggregate earnings with respect to (one minus) the tax rate by, $\epsilon_Z=(1-\tau)\bar{Z}_{1-\tau}/\bar{Z}$. Under Assumption 1, there are no income effects, and thus, uncompensated and compensated elasticities are identical. Hence, there is no need to distinguish the two concepts. Note that ϵ_Z is an average of the individual earnings elasticities ϵ_z^h weighted by earnings levels, $\epsilon_Z=\int\epsilon_z^h z^h \mathrm{d}v(h)/\int z^h \mathrm{d}v(h)$. I introduce the parameter $\rho=-\bar{G}_{1+t}/\bar{G}$ to measure the size of the price response of aggregate private contributions. As we expect a decrease in contributions when the price $1+t$ increase, we assume from now on that $\rho>0$. Note that $(1+t)\rho$ is the (uncompensated) elasticity of total contributions with respect to the price $1+t$. I discuss below in detail why using ρ is preferable to using the elasticity concept. We can state the following proposition.

[15] $\hat{G}_R$ and $\bar{G}_R$ are not identical in general because $\hat{G}_R$ is weighted by earnings while $\bar{G}_R$ is unweighted.

Proposition 1. *Under* Assumption 1–3, *the optimal tax rates formulas can be expressed as*,

$$t = -e + \frac{1}{\rho}[1 - \beta(G)], \tag{13}$$

$$\frac{\tau}{1-\tau} = \frac{1}{\epsilon_Z}[1 - \beta(Z) - (t+e)\hat{G}_R], \tag{14}$$

$$\beta(R) = 1 - (t+e)\bar{G}_R. \tag{15}$$

Finally, if the government can freely choose G^0 and that $G^0>0$ at the optimum,

$$e = 1 - (t+e)\bar{G}_{G^0} = \frac{1 - t\bar{G}_{G^0}}{1 + \bar{G}_{G^0}}, \tag{16}$$

and the optimal tax rate t is then given by,

$$t = -1 + \frac{1}{\rho}(1 + \bar{G}_{G^0})[1 - \beta(G)]. \tag{17}$$

Proof. The proof follows from a direct manipulation of (7)–(10) using the assumptions. It is perhaps useful to give a direct proof of Eq. (17) using a methodology closer to Roberts (1987). Suppose that the government increases the tax rate on the contribution good by dt and modifies the level of government provided public good G^0 so that the total level of public good $\bar{G}+G^0$ stays constant. Therefore, $\mathrm{d}\bar{G}+\mathrm{d}G^0=0$.

This tax rate increase has a mechanical effect on tax revenue equal to $\bar{G}\mathrm{d}t$. Increasing the tax rate has also a negative welfare effect on each individual equal to $\mathrm{d}u^h = v^h_{1+t}\mathrm{d}t = -g^h v^h_R \mathrm{d}t$. So using the definition of $\beta(G)$, the aggregated welfare effect, expressed in terms of tax revenue, is equal to $-\beta(G)\bar{G}\mathrm{d}t$.

Increasing the tax rate by dt reduces private contributions by $\mathrm{d}\bar{G} = \bar{G}_{1+t}\mathrm{d}t + \bar{G}_{G^0}\mathrm{d}G^0$ through the price effect and the crowding out effect. Using the fact that $\mathrm{d}G^0 = -\mathrm{d}\bar{G}$, we have, $\mathrm{d}\bar{G} = \bar{G}_{1+t}\mathrm{d}t/(1+\bar{G}_{G^0})$. The tax loss due to behavioral responses is equal to $t\mathrm{d}\bar{G}$ and the cost for the government of adjusting G^0 is equal to $-\mathrm{d}G^0 = \mathrm{d}\bar{G}$.

At the optimum, the sum of these four effects must be zero, therefore, we have, $\bar{G} - \beta(G)\bar{G} + (t+1)\bar{G}_{1+t}/(1+\bar{G}_{G^0}) = 0$ which is equivalent to Eq. (17). □

3.1.1. Interpretation

Formula (13) shows that the optimal rate t is equal to a subsidy equal to the external effect e plus a standard commodity tax component.[16] The standard component is

[16] Because the individual labor supply decisions z^h are independent of the level of the contribution good and the tax rate on contributions t, the optimal rate on contributions t does not depend explicitly on labor supply behavioral responses.

decreasing in $\beta(G)$. A low $\beta(G)$ means that the well-off contribute disproportionately. In that case, taxing contributions is valuable from a redistributive view point. Note that, in the model, contributions are voluntary and thus are equivalent to a consumption good for the donors. This is exactly the opposite of the common sense view that considers contributions as a sacrifice. Assuming that $\beta(G) < 1$, the standard component is inversely proportional to the size of the price response of contributions $\rho = -\bar{G}_{1+t}/\bar{G}$. This is the standard inverse elasticity rule of optimal taxation: elastic goods should be taxed less than inelastic goods. In the case where contributions are infinitely elastic, the optimal rate t is negative and the subsidy rate is exactly equal to the external effect e. However, when the price response of contributions is small, the tax rate t can be large even in the presence of substantial external effects.

When the government can contribute directly to the public good, e is given by Eq. (16). Crowding out of private contributions by public contributions implies that $\bar{G}_{G^0} < 0$. As Eq. (13) implies that $t+e>0$, Eq. (16) shows that $e>1$. The intuition is the following: when crowding out is high, it requires more than one dollar of direct public contributions to increase the total level of the contribution good by one dollar, and therefore, the marginal value of the contribution good is higher.[17] In that case, the expression for e can be used to rewrite the optimal tax rate t as in Eq. (17). Eq. (17) shows that the optimal t is decreasing in $\beta(G)$, the size of the price response of contributions ρ, and in the absolute size of crowding out $\bar{G}_{G^0}$. The intuition for the latter result is the following. When crowding out is important, direct government funding of the public good is more expensive. As a result, it is better to rely more on private contributions, and the subsidy to private contributions should be increased accordingly. Note that in the extreme case of complete crowding out, $\bar{G}_{G^0} = -1$, the optimal rate should be $t = -1$, implying that contributions should be made free.[18]

As mentioned above, Eqs. (13) and (17) are not expressed in terms of the elasticity $\epsilon_G = -(1+t)\bar{G}_{1+t}/\bar{G}$. It is possible to rewrite Eq. (17) in terms of the elasticity ϵ_G as follows,

$$\epsilon_G = (1 + \bar{G}_{G^0})[1 - \beta(G)]. \tag{18}$$

The interpretation of Eq. (18) is the following. When the elasticity ϵ_G is larger than the right-hand-side expression, the subsidy rate should be increased up to the point where the elasticity is driven down to the value of the right-hand-side. Formula (18) is a generalization of the "efficiency" concept: when there is no crowding out ($\bar{G}_{G^0} = 0$) and the welfare of the contributors is not taken into account ($\beta(G) = 0$), Eq. (18) becomes $\epsilon_G = 1$ which states precisely that subsidies to contributions should be increased when the elasticity is above unity and should be reduced when the elasticity is below unity.[19]

[17] This equation is a generalization of the famous Samuelson rule for the optimal level of public good. Atkinson and Stern (1974) who consider an optimal tax model with a public good exclusively provided by the government obtain a formula close to Eq. (16).

[18] This particular case has been studied in detail by Roberts (1987).

[19] The more general case where $\bar{G}_{G^0} < 0$ and $\beta(G) = 0$ has been analyzed by Roberts (1987) along these lines.

However, Eq. (18) does not provide an explicit expression for the optimal subsidy rate and is better used to assess whether the current tax system provides too much or too little subsidies. Previous studies by Feldstein (1980); Roberts (1987) focused mostly on this type of issues because they used formulas of the type Eq. (18) specialized to particular cases. If the elasticity ϵ_G is treated as an immutable parameter, then formula (18) states that the tax rate t should be either infinite or equal to minus one. In practice, we expect the elasticity ϵ_G to be affected by large changes in t. As a result, to cast light on optimal subsidy rates, it seems much preferable to use the form Eq. (17) whose interpretation requires to assume implicitly that the parameter ρ is the immutable parameter.[20] The optimal tax simulations presented in Section 4 specify a model with constant parameter ρ calibrated using the actual elasticity and actual subsidy rate.[21]

The optimal tax rate τ on earnings is given by formula (14). This formula is similar to the usual optimal linear income tax formula (see e.g. Dixit and Sandmo, 1977). Unsurprisingly, τ is decreasing with the elasticity of earnings ϵ_Z and with the average social weight $\beta(Z)$. As $e+t$ is positive (Eq. (13)), the optimal rate τ is also decreasing with the size of income effects on contributions $\hat{G}_R$. The intuition is the following. If the tax rate τ increases, then not only are tax revenues reduced because of the supply side response of earnings but also because lower disposable income leads to lower contributions $\bar{G}$ and thus further reductions in social welfare as the shadow tax rate $t' = t+e$ on contributions is positive.

Two important lessons from the previous analysis should be finally noted. First, there is no a-priori reason to tie the subsidy $-t$ to the tax rate τ as this is currently done in the US income tax system. Second, in the case where the government cannot directly contribute optimally to the public good, it is critical to assess the value of the external effect e in order to implement the optimal tax rates.

3.2. Extensions

3.2.1. Allowing tax expenditures versus broader base taxation

As mentioned in the introduction, a very important provision of the US income tax law states that a number of expenditures can be fully deducted from taxable income. As a result, these expenditures are effectively subsidized at the income tax rate (that is, in the notation of the model $t = -\tau$). This tax expenditure allowance has generated heated controversy. The main criticism is that, because tax expenditures are far more elastic than earnings, the elasticity of taxable income, and hence the deadweight burden of the income tax, are substantially increased by this provision. In this subsection, I derive the optimal tax rate τ when the government is constrained to set $t = -\tau$.

[20] There is no general reason to consider the elasticity parameter ϵ_G rather than the parameter ρ as the "exogenous" parameter. Both parameters may potentially vary with the tax parameters.

[21] These simulations might be misleading if the parameter ρ is in fact very sensitive to the subsidy rate because in that case, the parameter ρ in the optimal tax formulas might be different from the current parameter ρ estimated with the actual tax system in place.

I denote by $y^h = z^h - g^h$ taxable income. The budget constraint of individual h is $c^h \leq (1-\tau)(z^h - g^h) + R$. The program of the government is the same as in Section 2.3, except that $t = -\tau$. The general first order condition for τ becomes,

$$[1-\beta(Z)]\bar{Z} - [1-\beta(G)]\bar{G} = \tau\bar{Z}_{1-\tau} + (-\tau + e)\bar{G}_{1-\tau} + \tau\bar{Z}_{1+t} + (-\tau + e)\bar{G}_{1+\tau}. \quad (19)$$

I denote by $\bar{Y}(1-\tau, R, G^0) = \bar{Z} - \bar{G}$ aggregate taxable income, $\epsilon_Y = (1-\tau)\bar{Y}_{1-\tau}/\bar{Y}$ the aggregate taxable income elasticity,[22] and $\beta(Y) = \int \beta^h y^h \mathrm{d}\nu(h) / \int y^h \mathrm{d}\nu(h)$ the average β^h weighted by taxable income. Routine computations show that $\beta(Y) = \beta(Z)(\bar{Z}/\bar{Y}) - \beta(G)(\bar{G}/\bar{Y})$ and $\epsilon_Y = \epsilon_Z(\bar{Z}/\bar{Y}) + \rho\bar{G}(1-\tau)/\bar{Y} - \hat{G}_R\bar{Z}(1-\tau)/\bar{Y}$.

Proposition 2. *Under* Assumption 1–3, *the optimal tax rate on taxable income τ is given by,*

$$\frac{\tau}{1-\tau} = \frac{1}{\epsilon_Y}\left[1 - \beta(Y) + e\left(\rho\frac{\bar{G}}{\bar{Y}} - \hat{G}_R\frac{\bar{Z}}{\bar{Y}}\right)\right]. \quad (20)$$

If the government can freely choose G^0 and that $G^0 > 0$ at the optimum,

$$e = \frac{1 + \tau\bar{G}_{G^0}}{1 + \bar{G}_{G^0}}. \quad (21)$$

Proof. The proof follows from a direct manipulation of Eq. (19) using the assumptions and the definitions of ϵ_Y and $\beta(Y)$. □

3.2.1.1. Interpretation. There are three important differences between the optimal tax rate on taxable income given by Eq. (20) and the optimal tax rate on earnings given by Eq. (14).

First, as $\beta(Y) = \beta(Z)(\bar{Z}/\bar{Y}) - \beta(G)(\bar{G}/\bar{Y})$, if we assume that contributions are disproportionately made by high income earners, then $\beta(G) < \beta(Z)$, and thus $\beta(Y) > \beta(Z)$. The intuition is the following. As contributions are more concentrated than earnings, taxable income y is more equally distributed than earnings. As a result, the correlation between β^h and y^h is weaker than the correlation between β^h and z^h.

Second, since contributions are much more responsive than earnings, we expect $\epsilon_Y > \epsilon_Z$. These first two differences tend to make the tax rate on taxable income given by Eq. (20) *lower* than the optimal tax rate on earnings given by (14).

Third, lowering the tax rate on taxable income has a positive effect on contributions through the income effect on disposable income (which was also present in the earnings tax case) but also increases the price of giving and thus has a direct *negative* price effect on contributions. As displayed in Eq. (20), the net effect depends on the relative sizes of ρ and $\hat{G}_R$. In particular, the higher the price response of contributions, the higher the tax rates on taxable income. This new price effect relative to the situation of Proposition 1 tends to

[22] ϵ_Y is average of the individual taxable income elasticities weighted by taxable income.

make the tax rate on taxable income *higher* than the optimal tax rate on earnings. Note that in the case where the external effect e is zero, this effect disappears and the first two considerations suggest that the tax rate on taxable income should be lower than the tax on the broader earnings base.

It is necessary to turn to simulations to assess quantitatively the difference between these two tax rates and how changing parameters affects each of them. Some parameters inside formulas (14) and (20) are endogenous and, therefore, general equilibrium effects might be important and should be taken into account. Next section proposes an numerical calibration that casts light on all these effects.

When the optimal rates (τ, t) on earnings and contributions of Proposition 1 are such that t is very different from $-\tau$, tying the subsidy on contribution to the income tax rate as in Proposition 2 lowers welfare.[23] In particular, when there are little external effects and that, at the optimum $t>1$, then imposing $t=-\tau$ is suboptimal. Next section discusses this point in detail.

3.2.2. Leaky private contributions

In the model, we have assumed that contributions from individuals are exactly equivalent to government contributions. This is obviously a strong simplification assumption and there are many reasons why this might not be the case in practice.

First, private contributions maybe less efficient than direct government contributions because costly advertising campaigns are necessary to raise private contributions. This can be simply modeled, as in Feldstein (1980), by assuming that a dollar of private contribution translates into only $s<1$\$ of public good G and that $1-s$ are dissipated in advertisement costs.

Second and more generally, private and public contributions are not perfect substitutes. For example, private and public schools do not provide exactly the same services and are not attended by the same public. In principle, this should be modeled directly using a multi-good setting. However, assuming as above that a dollar of private contribution translates into only $s<1$\$ of government provided public good G is a parsimonious and perhaps reasonable way of modeling imperfect substituability.

In that case, the effective total level of contribution good is $G=s\bar{G}+G^0$ but the government budget constraint (1) is unchanged. The external effect e measures the effect of one additional dollar of government provided public good (or equivalently, $1/s$ dollars of privately provided public good). It is easy to see that, the only difference is that, in Eqs. (7)–(10), on the right-hand-side, $t+e$ is replaced by $t+s\cdot e$.

Proposition 1 should be modified such that in Eqs. (13)–(15), e is replaced by $s\cdot e$. Eq. (16) becomes, $e=1-(t+s\cdot e)\bar{G}_{G^0}=(1-t\bar{G}_{G^0})/(1+s\cdot\bar{G}_{G^0})$, and Eq. (17) becomes,

$$t=-s+\frac{1}{\rho}(1+s\cdot\bar{G}_{G^0})[1-\beta(G)]. \tag{22}$$

[23] Obviously, when the optimal rates of Proposition 1 are such that $t=-\tau$, then the optima of Propositions 1 and 2 are identical and there is no welfare loss of imposing the constraint $t=-\tau$.

Similarly, in Eq. (19), $-\tau + e$ should be replaced by $-\tau + s \cdot e$. In Proposition 2, in Eq. (20), e is replaced by $s \cdot e$ and Eq. (21) becomes $e = (1 + \tau \bar{G}_{G^0})/(1 + s \cdot \bar{G}_{G^0})$. When $s = 0$, private contributions are of no value for the government and the contribution good should be treated as a standard Ramsey consumption good. The simulations presented in Section 4 display the quantitative effect on tax and subsidy rates of changing s.

3.2.3. Utility from giving versus utility from sacrifice

The model proposed implicitly assumes that each individual cares about the amount g net of taxes and subsidies that is actually transferred to the charitable sector. If the individual cares in fact about his own financial sacrifice, perhaps because he cannot see through the tax and subsidy system,[24] then the utility function should be $u(z(1-\tau) + R - g(1+t), z, (1+t)g, G)$. In that situation, it is easy to see that a change in t has no (direct) effect on utility because the individual adjusts g so as to keep $(1+t)g$ constant. As a result, $\epsilon_G = 1$ and $\beta(G) = 0$. It is possible to develop optimal tax subsidies in that situation. Note that if $s = 1$ (public and private contributions are equivalent) and $\bar{G}_{G^0} < 0$ (there is some crowding out), then it is optimal to fully subsidize gifts ($t = -1$) so that all contributions go through the private sector.[25] This result is unrealistic and it is plausible to think that the pure sacrifice model would not be a good representation of actual behavior in the case of very large subsidy rates.

3.2.4. Non-linear taxation

As was pointed out in Section 2.1, the government uses only linear taxation on earnings and contributions. It is theoretically possible to consider the case of non-linear taxation of earnings and contributions. Diamond (2002) proposes such a general analysis in the case of a simple two-type model. Cremer et al. (1998) extend the seminal work of Sandmo (1975) on optimal linear taxation in the presence of externalities. They consider optimal both linear and non-linear taxation on earnings and commodities where some goods can generate externalities. They extend the Atkinson and Stiglitz (1976) result on the uselessness of commodity taxation in the presence of non-linear income taxation in the case with externalities. They show that a non-linear income tax plus strictly Pigouvian taxes on externality producing goods are sufficient when the assumptions of the Atkison–Stiglitz theorem hold: utilities are weakly separable in leisure and other consumption goods and all individuals have the same sub-utility function for consumption goods.

Assumption 2 described in Section 3.1 is not compatible with the Atkinson–Stiglitz theorem assumptions because, if utility is weakly separable in earnings z and consumptions goods (c, g), then the level of earnings z cannot be independent of the price of contributions $1+t$ and hence the condition $\bar{Z}_{1+t}$ cannot hold. Therefore, under our simplifying assumptions, the result of Cremer et al. (1998) cannot be applied. In our setting, allowing non-linear income taxation of income would not affect the optimal tax/subsidy rate formulas (13) or (17) because of Assumption 2 stating that earnings are

[24] For example, if the tax or subsidy is not administered through the individual income tax system but through matching grants or taxes directly at the level of the charitable organizations, it might be harder for the individuals to pierce the tax-subsidy veil. Kaplow (1998) discusses this type of model.

[25] If there is no crowding out (and $s = 1$), the optimal t is indeterminate.

independent of the price of contributions. Therefore, under the assumptions we have made, our results on optimal taxation of contributions are robust to the introduction of non-linear taxation on earnings.

Without the separability Assumption 2, however, introducing non-linear income taxes would substantially complicate the analysis of optimal subsidies on contributions. If we make the Atkinson–Stiglitz theorem assumption, then we can apply the result of Cremer et al. (1998) stating that the tax on the contribution good t should be purely Pigouvian and hence equal to $-e$, the external effect. However, when the government can contribute to the public good, and if we assume that the total level of the contribution good does not affect earnings ($\bar{Z}_{G^0}=0$), Eq. (10) implies $e=1$, and thus contributions should be made free for the individual ($t=-1$). Unsurprisingly, this result and the intuition are the same as in the first-best with pure Pigouvian taxation that we mentioned in introduction: if individuals enjoy giving, then it is more efficient to induce individuals to contribute rather than have government contributions. This extreme result becomes unrealistic because the warm-glow of giving might be destroyed if contributions are free and individuals perceive that their giving is obviously purposefully manipulated by the government. This shows that the warm-glow model raises some difficult modeling issues that should be tackled in future research to produce a fully convincing and general model of optimal tax expenditures (see Diamond (2002) for a more detailed discussion on some of these points). The linear model presented here does not run into those issues because linear taxation does not allow the government to manipulate to the full extent the warm-glow of giving, and hence does not "overstretch" the warm-glow model.

4. Numerical application

4.1. Empirical estimates

4.1.1. Behavioral responses to taxes

The empirical literature on responses of charitable giving to taxes has found in general elasticities with respect to price in excess of one (often around 1.3) and elasticities with respect to disposable income around 0.8. Clotfelter (1985) provides an extensive review of the empirical literature on charitable giving.[26] However, a recent study by Randolph (1995) using panel data and decomposing responses into short-term versus long-term responses has found smaller long-term price elasticities (around 0.5) and larger disposable income elasticities (around 1.3). There is, therefore, still substantial controversy about the size of these parameters. In general, the estimates from the literature are unweighted elasticities. We have seen that the relevant parameters are elasticities weighted by the level of contributions. There is evidence in the literature that both price and disposable income elasticities of contributions are increasing with income (see, e.g. Table 2.15 in Clotfelter, 1985). This suggests that the relevant elasticities are somewhat higher than the unweighted estimates reported in the literature.

[26] Steinberg (1990) updates this survey of empirical findings.

The price response parameter $\rho = -\bar{G}_{1+t}/\bar{G}$ that enters optimal tax formulas can be obtained from the empirical estimate of the price elasticity of contribution ϵ_G as, $\rho = \epsilon_G/(1+t)$, where $1+t$ is the average current price of contributions. I assume that $1+t=0.7$, that is, that the average marginal income tax rate of contributors is 30%. In the simulations, I consider three different values for the elasticity ϵ_G, namely 0.5, 1, and 1.5. The income effect on contributions $\hat{G}_R$ which enters formula (13) can be deduced from the disposable income elasticity of contributions reported in empirical studies, which I denote by ϵ_R, using the approximation formula, $\hat{G}_R = \epsilon_R G/((1-\tau)Z+R)$. The factor $G/((1-\tau)Z+R)$ is the average contribution level over average disposable income which is around 0.025 for charitable giving but higher and around 0.15 for all itemized deductions bundled together. I assume in the simulations that $\epsilon_R = 1$ or $\epsilon_R = 0.5$.

There is an extensive empirical literature on the behavioral responses of earnings to taxation. The labor supply literature that has mostly focused on hours of work has in general found small elasticities of hours with respect to (net-of-tax) wages (see, e.g. the surveys of Blundell and MaCurdy, 1999; Pencavel, 1986). Elasticities are in general smaller than 0.25 and often very close to zero. However, as pointed out by Feldstein (1995), the response of earnings may not be limited to changes in hours of work but may also include intensity of work, occupational changes or labor force participation. As a result, the full elasticity of earnings may be substantially higher. Feldstein (1995) estimates very large elasticities, in excess of one, of Taxable Income and Adjusted Gross Income (AGI) with respect to (one minus) the tax rates. A number of studies have followed upon Feldstein (1995) and have found much smaller elasticities ranging from 0 to 0.8. This literature is summarized in Gruber and Saez (2002) who find that taxable income, from which tax expenditures have been deducted, is much more responsive than gross income before deducting tax expenditures. They find a taxable income elasticity around 0.4 and a broad income elasticity around 0.15. It seems reasonable to assume that the earnings elasticity ϵ_Z is substantially lower than the price elasticity of contributions. In the simulations, I consider two possible values for this elasticity: 0.25 and 0.5.

4.1.2. External effects

As we saw in the previous sections, to derive optimal tax rates, it is crucial to assess whether the government can freely contribute directly to the public good. If this is the case, then the government sets the total level of public good optimally and the external effect is given by Eq. (16). In many instances, public goods are financed by both the government and private contributions. This is the case, for example, for Health Services, Education, and Social Services. However, it is often the case that private and public contributions are not perfect substitutes. As discussed in Section 2.3, this is modeled by assuming that a dollar of private contribution is worth only s dollars of government contributions. In most simulations, I assume that $s=0.75$ and do some sensitivity analysis with $s=0.5$ and $s=1$.

In other instances, the government cannot contribute to the public good or there is overprovision by the private sector. An example of the former is contribution to religious organizations. It is a matter of debate to assess whether some public goods are over-provided by the private sector. In those cases, the external effect is no longer given by Eq. (16) and should in principle be computed directly using Eq. (6). To compute e, it is necessary to assess, by income level, as to who benefits from the contribution good.

Relatively few studies have tried to assess the redistributive effects of the non-profit sector. A notable exception is Clotfelter (1992) which finds that the redistributive effect is in general modest but with variations by sectors. Non-profit health providers serve more low income patients than for-profit but less than public institutions suggesting that non-profit institutions are not a perfect substitute to public institutions and thus less valuable from a government perspective. Similarly non-profit education institutions serve on average more affluent families than public institutions, especially at the university level. In the US, religious organizations are fully privately funded. Sacramental activities constitute around 70% of congregational spending and redistribution to the needy less than 10%. Religious organizations have, therefore, little redistributive impact. Arts and Culture are disproportionately consumed by the affluent but are also to a large extent funded by public money. Social and Human services are clearly the most redistributive non-profit organizations. However, higher the federal funding, the higher the agencies orientation towards the poor, suggesting again that these agencies are not perfect substitutes to public money.[27]

4.1.3. Crowding out

It is well known (see Warr, 1983) that for a privately provided pure public good, there is a case for expecting in theory 100% crowding out. However, the pure public good case fails to capture many important aspects of the problem.[28] When there is warm glow of giving, as modeled in the present paper, crowding out is substantially reduced and might well be negligible for large populations. There is a very large empirical literature on crowding out for many public goods. Findings are very diverse, ranging from zero crowding out (see, e.g. Reece, 1979) up to complete crowding out (see e.g. Roberts, 1984). However, most studies find modest crowding out, less than 20% in general (see, e.g. Schiff, 1985). Therefore, in the simulations, the crowding out parameter takes two values: 0% and 25%.

4.2. Numerical results

4.2.1. Calibration

Simulations are presented using the model described in Section 3. Government consumption E per capita is taken equal to \$6000 which corresponds to the actual tax revenue raised by the federal plus state income tax. In order to simplify the computations, I do not fully specify all individual utility functions and I assume simple functional forms for the *aggregate* supply functions. The Appendix A presents the technical details of the simulations. I assume that the aggregate earnings elasticity ϵ_Z is constant. The aggregate contribution level $\bar{G}$ is specified so that the price response ρ, the income elasticity ϵ_R, and the crowding out effect $\bar{G}_{G^0}$ are approximately constant. I consider two scenarios for the

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[27] It is obviously impossible to assess precisely the redistributive effects of the non-profit sector. For example, many advances in medicine or in agriculture have been funded by private foundations and have had large positive impacts both in the US and in less developed countries.

[28] Even in an experimental set-up which reproduces as closely as possibly the pure public good case, Andreoni (1993) finds less than 70% crowding-out.

level of the contribution good. The first scenario models the contribution good as charitable giving only. In that case, using current tax parameters, the level $\bar{G}$ matches the current level of charitable giving, namely 2.0% of AGI. In the second scenario the contribution good represents a broader set of itemized deductions that are allowed in the individual income tax code. In that case, the level $\bar{G}$ matches approximately the current level of itemized deductions, namely 12.0% of AGI.[29]

The external effect of contributions on welfare is modeled such that it depends only of the total effective level of contribution good $s \cdot \bar{G} + G^0$ with decreasing returns. I consider again two scenarios. In the first scenario, the contribution has a strong external effect so that it is optimal for the government to supplement private contributions with public contributions ($G^0 > 0$). In the second scenario, the external effect is smaller and thus the contribution good is overprovided by the private sector and thus government contributions are zero. In this case, the external effect is calibrated to be around 0.5.

I assume that the marginal welfare weights β^h depend on disposable income only and thus are specified as, $\beta^h = 1/\lambda(z^h(1-\tau)+R)^v$, where λ is the multiplier of the government budget constraint and v is a (constant) parameter measuring the redistributive tastes of the government. $v=0$ corresponds to no redistributive tastes and $v=+\infty$ corresponds to the Rawlsian criterion. $v=1$ means that the government values twice as much a marginal increase in consumption of a taxpayer with disposable income $I/2$ relative to a marginal increase in consumption of a taxpayer with disposable income I. In the simulations, v takes three values, 0.25, 1, and 4.

Computing $\beta(R)$, $\beta(Z)$, and $\beta(G)$ requires to know the individual distribution of z^h and g^h. These distributions are calibrated using individual tax return data for year 1995 so that when using the actual tax parameters, the distributions of z^h and g^h match the actual distribution of AGI and Charitable Giving. Complete details are provided in Appendix A.

4.2.2. Results

The results are presented in Tables 1–3. In each table, I consider, in Panel A, the basic specification where $\epsilon_G = 1$ (price elasticity of contributions), $\epsilon_Z = 0.25$ (earnings elasticity), $v=1$ (redistributive tastes), $s=0.75$ (relative value of private contributions), $\bar{G}_{G^0}=0$ (crowding out parameter), and $\epsilon_R = 1$ (income elasticity of contributions). Panel B displays simulation results for alternative values of the elasticities ϵ_G and ϵ_Z (keeping the other parameters as in Panel A) and Panel C considers alternative values of the other parameters. For each specification, the first five columns display simulation results when the government can set differentiated tax rates on earnings and contributions as in Proposition 1. The optimal tax rate on earnings τ, the optimal tax rate t on the contribution good (a negative number is a subsidy), the guaranteed income level R, the level of private contributions over earnings $\bar{G}/\bar{Z}$, and the level of public contributions $G_0/\bar{Z}$ are reported. The last five columns display simulation results in the case where the government sets a unique tax rate on earnings minus contributions as in Proposition 2.

[29] More precisely, 12.0% is the projected level of itemized deductions (if there were no standard deduction) and excluding state income tax deductions.

Table 1
Numerical simulations with large external effects and positive government contributions

	Differential earnings and contribution tax rate					Unique taxable income tax rate				
	Earnings tax rate, τ	Contribution tax rate, t	Guaranteed income, R	Private contributions, G/Z	Public contributions G^0/Z	Taxable inc. tax rate, τ	Guaranteed income, R	Private contributions, G/Z	Public contributions, G^0/Z	Taxable inc. elasticity, ε_Y
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Basic Specification $\varepsilon_Z = 0.25$, $\varepsilon_G = 1$, $\nu = 1$, $s = 0.75$, $\varepsilon_R = 1$, and $G_{G0} = 0$										
	60	− 40	\$10,000	2.0%	3.3%	60	\$10,000	2.7%	2.6%	0.26
Panel B: Varying earnings elasticity ε_Z and contributions price elasticity ε_G										
$\varepsilon_Z = 0.25$, $\varepsilon_G = 1.5$	60	− 52	\$10,100	2.9%	2.6%	59	\$10,000	3.4%	2.0%	0.27
$\varepsilon_Z = 0.25$, $\varepsilon_G = 0.5$	60	− 5	\$10,100	1.5%	3.9%	60	\$10,100	2.2%	3.1%	0.25
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1$	48	− 31	\$5300	1.8%	4.1%	48	\$5300	2.3%	3.6%	0.51
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1.5$	48	− 45	\$5300	2.5%	3.4%	47	\$5300	2.6%	3.3%	0.52
$\varepsilon_Z = 0.5$, $\varepsilon_G = 0.5$	48	14	\$5300	1.3%	4.5%	48	\$5400	2.0%	3.7%	0.50
Panel C: Varying redistributive tastes ν, value of private contributions s, income elasticity of contributions ε_R, and crowding out G_{G0}										
$\nu = 4$	71	− 23	\$11,600	1.6%	4.2%	71	\$11,600	3.2%	2.5%	0.26
$\nu = 0.25$	41	− 56	\$5900	2.6%	2.4%	41	\$5900	2.1%	2.9%	0.26
$s = 1$	60	− 65	\$10,000	3.0%	2.4%	60	\$10,000	2.7%	2.6%	0.26
$s = 0.5$	60	− 15	\$10,000	1.5%	4.0%	60	\$10,000	2.7%	2.6%	0.26
$\varepsilon_R = 0.5$	60	− 39	\$10,200	3.0%	2.5%	59	\$10,000	4.0%	1.5%	0.27
$G_{G0} = -0.25$	60	− 54	\$10,400	4.1%	0.6%	60	\$10,300	4.5%	0.4%	0.26

Simulations are calibrated on current level and distribution of charitable contributions. Government consumption is E=\$6000.

Table 2
Numerical simulations with low external effects

	Differential earnings and contribution tax rate					Unique taxable income tax rate				
	Earnings tax rate, τ	Contribution tax rate, t	Guaranteed income, R	Private contributions, G/Z	External effect, e	Taxable inc. tax Rate, τ	Guaranteed income, R	Private contributions, G/Z	External effect, e	Taxable inc. elasticity, ε_Y
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Basic Specification $\varepsilon_Z = 0.25$, $\varepsilon_G = 1$, $v = 1$, $s = 0.75$, $\varepsilon_R = 1$, and $G_{G0} = 0$										
	59	−5	$11,100	1.3%	0.51	59	$10,700	2.8%	0.34	0.26
Panel B: Varying earnings elasticity ε_Z and contributions price elasticity ε_G										
$\varepsilon_Z = 0.25$, $\varepsilon_G = 1.5$	59	−15	$11,100	1.4%	0.50	60	$10,600	3.5%	0.31	0.27
$\varepsilon_Z = 0.25$, $\varepsilon_G = 0.5$	59	28	$11,200	1.3%	0.52	60	$10,800	2.3%	0.38	0.25
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1$	47	1	$6400	1.2%	0.55	47	$6100	2.4%	0.39	0.51
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1.5$	47	−12	$6300	1.3%	0.53	47	$6000	2.7%	0.37	0.52
$\varepsilon_Z = 0.5$, $\varepsilon_G = 0.5$	47	43	$6500	1.2%	0.56	47	$6200	2.2%	0.41	0.50
Panel C: Varying redistributive tastes v, value of private contributions s, income elasticity of contributions ε_R, and crowding out G_{G0}										
$\nu = 4$	71	8	$12,900	1.1%	0.57	71	$12,200	3.3%	0.33	0.26
$\nu = 0.25$	41	−16	$6800	1.5%	0.45	41	$6700	2.1%	0.38	0.26
$s = 1$	59	−14	$11,100	1.5%	0.47	59	$10,700	2.8%	0.34	0.26
$s = 0.5$	59	6	$11,200	1.2%	0.55	59	$10,700	2.8%	0.34	0.26
$\varepsilon_R = 0.5$	59	1	$11,200	1.2%	0.45	60	$10,500	4.0%	0.29	0.27
$G_{G0} = -0.25$	59	−6	$11,100	2.2%	0.39	60	$10,400	4.6%	0.27	0.26

Simulations are calibrated on current level and distribution of charitable contributions. Government consumption is E=$6000.

Table 3
Numerical simulations with low external effects and high contribution levels

	Differential earnings and contribution tax rate					Unique taxable income tax rate				
	Earnings tax rate, τ	Contribution tax rate, t	Guaranteed income, R	Private contributions, G/Z	External effect, e	Taxable inc. tax rate, τ	Guaranteed income, R	Private contributions, G/Z	External effect, e	Taxable inc. elasticity, ε_Y
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Basic Specification $\varepsilon_Z = 0.25$, $\varepsilon_G = 1$, $v = 1$, $s = 0.75$, $\varepsilon_R = 1$, and $G_{G0} = 0$										
	59	−6	$10,900	9.4%	0.55	59	$8,100	17.0%	0.37	0.28
Panel B: Varying earnings elasticity ε_Z and contributions price elasticity ε_G										
$\varepsilon_Z = 0.25$, $\varepsilon_G = 1.5$	59	−17	$10,600	9.9%	0.54	60	$7600	20.9%	0.35	0.36
$\varepsilon_Z = 0.25$, $\varepsilon_G = 0.5$	57	33	$11,600	8.9%	0.54	60	$8800	14.6%	0.37	0.23
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1$	46	1	$6200	8.7%	0.58	47	$4400	15.2%	0.41	0.54
$\varepsilon_Z = 0.5$, $\varepsilon_G = 1.5$	46	−13	$6000	9.3%	0.57	46	$4200	16.7%	0.40	0.62
$\varepsilon_Z = 0.5$, $\varepsilon_G = 0.5$	44	49	$7000	8.2%	0.56	49	$4900	13.8%	0.37	0.48
Panel C: Varying redistributive tastes v, value of contributions s, income elasticit of contributions ε_R, and crowding out G_{G0}										
$v = 4$	70	6	$12,900	8.1%	0.61	69	$9000	19.2%	0.34	0.29
$v = 0.25$	40	−18	$6300	10.6%	0.50	41	$5200	14.0%	0.43	0.28
$s = 1$	59	−15	$10,600	10.6%	0.51	59	$8100	17.4%	0.37	0.28
$s = 0.5$	59	5	$11,100	8.1%	0.59	59	$8100	17.3%	0.37	0.28
$\varepsilon_R = 0.5$	59	0	$11,000	12.3%	0.49	60	$6800	25.5%	0.32	0.41
$G_{G0} = -0.25$	58	−5	$10,800	15.3%	0.42	59	$6600	26.1%	0.28	0.28

Simulations are calibrated on current level and distribution of itemized deductions less state income tax deduction. Government consumption is E=$6000.

The optimal rate τ, the guaranteed income level R, the level of private contributions $\bar{G}/\bar{Z}$, the level of public contributions $G_0/\bar{Z}$, and the elasticity of taxable income ϵ_Y are reported.

Table 1 considers the scenario where the contribution good level matches the level of charitable contributions (around 2.0% of AGI using actual tax parameters) and where the external effect is high enough so that government contributions are positive at the optimum. As private contributions are a small share of earnings, the earnings tax rate (column (1)), the taxable income tax rate (column (6)), and the guaranteed income levels (columns (3) and (7)) are hardly affected by contribution parameters.[30] The optimal rate τ is 60% and R around \$10,000 when $\epsilon_Z = 0.25$ and $v = 1$. Unsurprisingly, increasing ϵ_Z to 0.5, decreases τ to 48% and R to \$5300. Changing the redistributive taste parameter v has also the expected effects on τ and R.

The optimal subsidy rate t (column (2)) is very sensitive to most parameters. In the basic specification, $t = -40\%$,[31] showing that contributions should be extensively subsidized. In Panel B, we see that if $\epsilon_G = 1.5$, the subsidy should be increased to 52% but if $\epsilon_G = 0.5$, the subsidy is reduced to a negligible 5%. Note also the increasing ϵ_Z also reduces the optimal subsidy rate through general equilibrium effects. In Panel C, we see that the subsidy rate is negatively related to the redistributive tastes of the government because contributions are more concentrated than earnings. The subsidy rate is very strongly positively related to the relative value of private contributions s. It increases to 65% with $s = 1$ and drops to 15% with $s = 0.5$. A crowding out rate of 25% increases to optimal subsidy to 54%. The income elasticity of contributions has a negligible impact on t. In all cases, the government contributes directly to the public good (see columns (5) and (9)). Note that government contributions are adjusted to the level of private contributions so that the total level of effective public good is optimal. This shows that the spending policy of the government is closely linked to its tax policy and subsidy policy.

Table 2 repeats the same set of simulations but assumes that the contribution good is overprovided by the private sector. Government contributions are zero and columns (5) and (9) display the (sub-optimal) external effect instead of government contributions as in Table 1. Relative to Table 1, the optimal tax rate t on contribution is substantially higher and becomes positive in a number of cases. For example, in the basic specification, $t = -5\%$ instead of -40% in Table 1. Note that in the case where the subsidy rate is tied to the tax rate, the contribution level is much higher due to stronger incentives and the external effect becomes correspondingly smaller. However, the optimal tax rate and guaranteed income levels are almost identical to the case where t may differ from $-\tau$ because the level of contributions relative to earnings is just too small to affect the general income tax rate.

Table 3 repeats the situation of Table 2 but with a much higher equilibrium level of contribution calibrated to the total level of itemized deductions (excluding state income taxes paid) instead of charitable giving only. I assume, as in Table 2, that the

[30] Note in column (10) that the taxable income elasticity ϵ_Y is almost identical to ϵ_Z.

[31] As $\tau = 60\%$, this is equivalent to a deduction of two thirds of contributions from earnings.

contribution good is overprovided by the private sector so that $G^0 = 0$ and e is suboptimal. The tax and subsidy rates, and the guaranteed income levels are strikingly similar to those displayed in Table 2. In particular, even though the elasticity of taxable income ϵ_Y (column (10)) is sometimes substantially different from the earnings elasticity, the tax rate on taxable income (column (6)) is almost identical to the optimal tax rate on earnings (column (1)). These simulations, therefore suggest, somewhat strikingly, that even if itemized deductions are a large share of gross income and are substantially more elastic than gross income, the optimal tax rate on taxable income should be very close to the optimal rate on gross income. Note, however, that the level of private contributions is much higher (around 15–20% of earnings) in the full deduction case than in the differentiated tax case because contributions are much more subsidized in the former case and respond to price incentives. It is interesting to note, however, that the guaranteed income level in the differentiated tax rates case is noticeably higher than in the single tax rate because for a given income tax rate, the former raises much more revenue than the latter because the earnings base is substantially higher than the taxable income base.

5. Conclusion

This paper has analyzed the optimal tax treatment of tax expenditures. Optimal tax and subsidy rates formulas have been derived in terms of empirically estimable parameters and numerical simulations have been presented using a range of realistic parameters. There are a number of important lessons to take away from this exercise.

First, a fairly simple formula for the optimal subsidy rate, which generalizes previous findings, has been obtained. This optimal subsidy rate is expressed in terms of the price response of contributions, the size of crowding out of private contributions by public contributions, and the redistributive tastes of the government. Second, it is critical to note that this formula is correct only in the case where the contribution good is underprovided by the private sector and when the government can complement private contributions with direct funding. If these conditions are not satisfied, the optimal subsidy rate depends directly on size of the external effect of marginal private contributions, which can be measured by assessing who benefits from contributions. Third, numerical simulations show that the optimal tax rate on earnings is fairly independent from the contributions supply side parameters even when contributions are a large share of earnings. Fourth, tying the subsidy rate to the income tax rate as this is the case in the US, generates in most simulations more generous subsidies than optimal. However, simulations show that the tax rate on income is almost always identical in the full deduction case and in the case where the tax rate on earnings and the subsidy rate on contributions can be differentiated. This suggests that, even though the elasticity of income net of contributions is higher than the elasticity of broad income, it is not necessarily the case that the former should be taxed less than the latter.

There is still substantial uncertainty on many of the parameters entering tax formulas. Though the supply side parameters have been extensively studied in the empirical literature, the size of these central parameters is still controversial. It is also critical to assess the value of private contributions relative to direct government contributions (through the parameter s). This parameter is impossible to measure explicitly and depends critically on the views of the government. Finally, the clean theoretical distinction between cases where the government can and cannot contribute directly to the public good, and which is so important to assess optimal contribution rates, is blurred in practice because government and private contributions are rarely perfect substitutes. Investigating these issues in more depth is necessary to cast further light on the controversial policy issue of tax expenditures.

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Appendix A

This appendix describes the details of the numerical simulations.

• Aggregate functions.

I assume that the earnings elasticity ϵ_Z is constant and thus aggregate earnings are specified as,

$$\bar{Z} = \bar{Z}_0 \left(\frac{1-\tau}{1-\tau_0} \right)^{\epsilon_Z}, \tag{23}$$

where $\bar{Z}_0$ is baseline aggregate earnings and τ_0 is the current average marginal income tax rate taken as equal to 30%.

Aggregate contributions $\bar{G}$ are specified as follows,

$$\bar{G} = \bar{G}_0 \frac{e^{-\rho(1+t)}}{e^{-\rho(1+t_0)}} \left[\frac{\bar{Z}(1-\tau)+R}{\bar{Z}_0(1-\tau_0)+R_0} \right]^{\epsilon_R} - \alpha G^0, \tag{24}$$

where $\bar{G}_0$ is baseline aggregate private contributions, $\rho = -\bar{G}_{1+t}/\bar{G}$ is the (constant parameter) measuring the price response of contributions, ϵ_R is the (constant) income elasticity of contributions, and α is the (constant) crowding out parameter $-\bar{G}_{G^0}$. Note that because of the crowding out term, ρ and ϵ_R are not exactly equal to $-\bar{G}_{1+t}/\bar{G}$ and the income elasticity. However, as α is small in the simulations, this approximation is acceptable.[32] The baseline level $\bar{G}_0$ is calibrated from tax return data. There are two scenarios. In the first, $\bar{G}_0$ is calibrated on charitable contributions and in the second, $\bar{G}_0$ is calibrated on total itemized deductions (less state income tax deductions).

[32] This approximation is exact in most simulations where $\alpha = 0$.

Finally, the external effect of contributions on individual utilities is taken as homogeneous and such that,

$$\frac{v_G^h}{v_R^h} = B \cdot (s \cdot \bar{G} + G^0)^{-l}, \tag{25}$$

where B and l are constant parameters. Therefore, using Eq. (6), the external effect is given by $e = B \cdot (s \cdot \bar{G} + G^0)^{-1} \beta(R)$. In the simulations, $l = 0.5$ and B takes two values: a high value so that, at the optimum, the government contributes a positive amount G^0 and a low value where the public good is over-provided by the private sector and the government contributes zero.

• Individual functions.

I assume that individual earnings are equal to,

$$z^h = z_0^h \left(\frac{1 - \tau}{1 - \tau_0} \right)^{\epsilon_Z}$$

where z_0^h is the baseline earnings level for individual h, and τ^0 is the average marginal tax rate. Therefore, it is assumed that the elasticity is constant and equal across individuals. As only linear taxation is considered, this assumption is innocuous. The distribution z_0^h is computed using the actual distribution of AGI from tax returns data for year 1995 assuming that everybody faces a constant marginal tax rate equal to $\tau^0 = 0.3$. The distribution of incomes is summarized by 30 representative individuals whose income range from \$0–200,000. As only linear taxation is considered, the simulations are hardly sensitive to the number of representative individuals.

The marginal welfare weights β^h depend on disposable income only and thus are specified as, $\beta^h = 1/(z^h(1 - \tau) + R)^v$, where v is a (constant) parameter measuring the redistributive tastes of the government. Finally, the distribution of contributions is calibrated so that, with a flat tax of 30%, it is distributed as the current distribution of charitable contributions in the first scenario and as the current distribution of itemized deductions in the second scenario. Note again that the price and income elasticities of individual contributions are considered as constant and equal across individuals. It would have been strictly equivalent to assume that the probability of contributing varies by income level.

• Computations.

The exogenous government consumption level E is taken equal to \$6000 so that the simulated tax schedule raises as much revenue (net of government direct contributions and subsidies) than the actual federal plus state income tax system.

In the case of different rates on earnings and contributions, the non-linear system of Eqs. (1), (13)–(16) is solved in the unknowns τ, t, R, G^0, and λ. If $G^0 < 0$ then G^0 is set equal to zero and the system is solved discarding Eq. (16).

When $t = -\tau$, the system of Eqs. (1), (15), (20) and (21) is solved in the unknowns τ, R, G^0, and λ. Again, if $G^0 < 0$ then G^0 is set equal to zero and the system is solved discarding Eq. (21).

The values at the optimum of τ, R, $\bar{G}/\bar{Z}$, $G^0/\bar{Z}$, when $G^0 = 0$, and ϵ_Y are reported in Tables 1–3.

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