Estate Taxation with Warm-Glow Altruism*

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Abstract

In this paper we examine the properties of the optimal fiscal policy in an economy with warm-glow altruism (utility interdependence) and heterogeneous individuals. We explicitly consider an implicit constraint in the act of giving: donors cannot bequeath to donees more than their existing resources. Considering this constraint, we show that the market equilibrium is not socially efficient. However, the efficient level of bequests transfers can be implemented by the market with an estate and labor-income subsidies and a capital-income tax. In the absence of lump-sum taxation, the government faces a trade-off between minimizing distortions and eliminating external effects. The implied tax policy differs from Pigovian taxation since the government ability to correct the external effects is limited. Finally, we show that the efficiency-equity trade-off does not affect the qualitative features of the optimal distortionary fiscal policy.

Keywords: optimal taxation, altruism, dynamic general equilibrium.

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1. Introduction

The existence and consequences of estate taxes have been recently debated in public domains. The supporters of estate taxation note that only a very small percentage of citizens pays this tax, mainly those with large estates. The rationale for a highly progressive tax is to reduce the concentration of wealth and provide equal opportunity for the newborn generations. The opponents claim that estate taxes slow down economic growth, destroy small business, and generate large transaction costs and inefficiencies that households necessarily have to incur in order to avoid estate taxation. The debate has resulted in a wide variety of proposals, which range from the abolition of any source of estate or gift taxation and raise revenues through other taxes, to highly increase the marginal rate of estate taxation. Just as Cremer and Pestieau (2006) suggest, the optimal estate tax should be judged, just like any other tax, against two criteria: efficiency and equity. Efficiency implies to minimize the distortionary effects of taxation whereas equity relies in some normative social preference for inter or intra generational distribution.

At the aggregate level the importance of altruism is evident. The empirical studies of Kotlikoff and Summers (1981, 1986), McGarry and Schoeni (1995), and Davies and Shorrocks (2000) reveal that between 40% to 80% of wealth is transferred across generations. In particular, Gale and Scholz (1994) use direct measures of intergenerational links to attribute 63% of the current U.S. capital stock to bequests. Nonetheless, one of the most serious difficulties in studying this problem is that the empirical evidence is not conclusive on why individuals are altruistic. This fact can be summarized by the different class of models that have been used to rationalize this behavior: dynastic, warm-glow or joy-of-giving, accidental, or strategic (see Laitner [1997] for a detailed survey). Clearly, the implications of the estate taxation should depend on the bequest motive.

In this paper we consider a warm-glow altruism motive where parents derive utility directly from giving bequests to their offspring, as in Yaari (1965). A large scale version of this model, where generations live more than two periods,[1] is consistent with the observed wealth and income distribution in developed countries.[2] The introduction of this form of altruism has important

[1] In the analysis we use a two period economy for two reasons. The first one is to have comparable results with previous work in the literature. Second, models with more than two periods impose some constraints in the set of fiscal instruments if age-specific taxes are not allowed (see Escolano [1992], Garriga [2000] and Erosa and Gervais [2002]). These restrictions usually imply capital-income taxes different from zero. Therefore, given that we want to study the pure effects of altruism, the driving forces of the main results should not depend on exogenous restrictions on the set of instruments that the government can use.

[2] Quadrini and Ríos-Rull (1997) find that the standard models with dynastic altruism cannot account for the observed wealth and income distribution. Nevertheless, de Nardi (2004) shows that warm-glow linkages are important to explain the emergence of large estates that characterize the upper tail of the wealth distribution observed in the data

implications for the optimal fiscal policy in an otherwise standard life-cycle model. In the presence of warm-glow altruism the donor usually only considers the direct effect on her utility but she does not consider the indirect effect on the donee. This utility interdependence generates an external effect that confers a new role to estate and gift taxation.[3]

The paper has two important contributions. The first one is to analyze the concept of Pareto-efficiency in the presence of warm-glow altruism. Counting warm-glow in the social welfare function raises a number of issues. Since bequests are not part of the resource constraint of the economy, some authors have claimed that they should be infinite and, then, individuals derive a non-bounded utility from giving at no real resource cost. To avoid this problem, a common strategy has been to eliminate any warm-glow (or utility interdependence) in the notion of social optima.[4] Even though efficient allocations are well-defined in this reduced context, the social planner ignores individual preferences and it does not consider the indirect effect that the donor transfer has on the donee. We argue that both approaches ignore an implicit constraint in the act of giving: the donor cannot bequeath to the donee more than her existing available resources. The social planner should respect this constraint inherent to the act of giving, but it should also have some ability to redistribute resources to attain the socially efficient level of altruism. Therefore, efficiency should not only consider the presence of external effects and utilitarian social preferences, but also this implicit constraint in the act of giving. We show that the utility interdependence implied by the warm-glow altruism usually leads to a socially inefficient level of altruism giving. Moreover, socially efficient allocations are attainable in the market economy with negative estate and labor-income taxes, and positive capital-income taxation.

In the absence of lump-sum taxation, estate subsidies would requiere to use distortionary taxation to be funded. Our second contribution is to analyze the optimal estate tax in the context of distortionary taxation. In particular, we focus the analysis along two important dimensions. The first dimension is the trade-off between efficiency and eliminating the external effects. We show how the optimal fiscal policy equates these distortions at the margin and the implied estate tax differs from the first-best policy. The second dimension is the efficiency-equity trade-off in the presence of heterogeneity (associated to different endowments of efficiency units of labor or individual skills). We show that when the government can condition taxes by the skill type, the qualitative features

for U.S. and Sweden, while a model with accidental bequests does not generate the observed wealth concentration.

[3] When bequests are accidental, a confiscatory estate tax is optimal. However, in the presence of dynastic altruism Cremer and Pestieu (2006) show that wealth transfers should not be taxed in the long-run.

[4] Another alternative has been to use the standard infinite horizon model of Barro-Becker and avoid double counting by considering only the welfare of the first generation.

of the model without heterogeneity can be extended to the heterogeneity case.

Finally, we present a numerical simulation of the optimal fiscal policy under different tax constraints. The objective is to illustrate the theory and its implications, but not to develope a quantitative analysis. In the presence of homogenous consumers, we find that the model can generate relatively high capital-income taxes and estate and labor-income subsidies to implement the efficient level of bequests. In the second-best, the government has to balance the distortionary effects of the different tax instruments with the external effect of the bequests. This conflict is resolved with a higher positive capital-income tax and a lower estate subsidy. However, the labor-income tax becomes positive. In the presence of heterogeneity, we find that it is optimal for the government to implement a tax code with a large degree of progressivity across individual skills. However, the qualitative findings for the optimal tax rates are similar: a high estate subsidy, high capital-income tax, and a positive labor-income tax. When taxes cannot be conditioned by individual skills, the government faces a trade-off between efficiency (minimizing distortions) and equity (redistributing resources), since all households have to pay the same tax rates. One could interpret this solution as a pooling equilibrium where individual skills and effort are not observable. The lack of progressivity reduces the government effectiveness to minimize distortions, but the qualitative results are the same, too. Clearly, heterogeneity can imply important quantitative differences in terms of the optimal tax rates, but it does not affect the nature of the market inefficiencies associated to warm-glow altruism.

There are several theoretical papers that have studied the effects of the fiscal policy in economies with warm-glow altruistic agents. Michel and Pestieau (2004) show that, in the absence of cross elasticities, the capital-income tax might be higher than the estate tax if its own compensated elasticity is lower than that of bequests. When bequests are not part of the social utility function, clearly they have to be taxed at a relatively high rate. The purpose of our paper is to provide new insights on the optimal tax mix in the presence of warm-glow altruism by dealing directly with the presence of external effects. Hence, the inefficiency sources are highlighted. Finally, Blumkin and Sadka (2003) examine the optimal estate tax in an economy with altruistic and accidental bequests but with missing annuity markets and without capital. They find that the estate tax is highly sensitive to the relative importance of the two bequest motives. In particular, the estate tax serves to correct the incompleteness of the insurance market. We believe our results complement their findings and highlight different aspects of estate taxation. In particular, our model differs from their in several dimensions: we assume warm-glow altruism, there is capital accumulation, markets are complete, and households have a certain lifespan.

The paper is organized as follows. Section 2 describes the market economy. Section 3 discusses the command optimum problem and solves for the efficient allocation. Section 4 analyzes the optimal policy with distortionary taxation whereas section 5 illustrates the obtained results through a numerical example. Finally, section 6 concludes.

2. Market Economy

Consider an overlapping generations economy with production and constant population. Aggregate output is produced with a constant returns to scale technology $F(K_t, N_t)$, where K_t and N_t are capital and labor, respectively. The production function F is concave, C^2 and satisfies the Inada conditions. Capital depreciates at a constant rate $\delta \in [0,1]$. With competitive factor markets, each input receives its marginal product, so that $r_t = F_{K_t} - \delta$ and $w_t = F_{N_t}$, where r_t is the return of capital net of depreciation and w_t is the wage. The economy resource constraint is

$$C_t + K_{t+1} - (1-\delta)K_t + G_t = F(K_t, N_t), \quad \forall t, \tag{1}$$

where C_t denotes aggregate consumption at period t, G_t is a non-productive government expenditure and $K_{t+1} - (1-\delta)K_t$ is the gross investment.

There are n types of households. Each type is endowed with different publicly observable levels of efficiency units of labor given by $\theta^i \in \{\theta^1, ..., \theta^n\}$, where $\theta^1 < \theta^2 < ... < \theta^n$. Let μ^i denote the measure of agents of type θ^i. Individuals live for two periods: young and old. Individuals born in period t are endowed with one unit of time which they allocate between leisure $(1 - l_t^i)$, and labor market activities l_t^i, where $w_t\theta^i l_t^i$ is the gross labor-income. They also receive a physical bequest b_t^i from their parents. Then, they choose consumption c_{1t}^i, and asset holdings a_{t+1}^i. When individuals become old, they allocate the return from savings between consumption c_{2t+1}^i, and bequests to their offspring b_{t+1}^i. The warm-glow altruism implies that individuals derive utility from the bequest given to their offspring, but they do not derive it directly from their children happiness. We assume that parents value the after-tax bequest, otherwise estate taxation would be non-distortionary.[5] In this environment, an individual type θ^i of the generation born in period

[5] If the donee is taxed, then we should assume that the donor is interested on the net bequest received by the donee.

t chooses $x_t^i = \{c_{1t}^i, c_{2t+1}^i, a_{t+1}^i, l_t^i, b_{t+1}^i\}$ to solve

$$\max_{x_t^i} \; U(c_{1t}^i, l_t^i) + \rho V(c_{2t+1}^i, b_{t+1}^i), \tag{2}$$

$$s.to \qquad c_{1t}^i + a_{t+1}^i = (1 - \tau_t^{l^i}) w_t \theta^i l_t^i + b_t^i, \tag{3}$$

$$c_{2t+1}^i + (1 + \tau_{t+1}^{b^i}) b_{t+1}^i = a_{t+1}^i \left[1 + r_{t+1}(1 - \tau_{t+1}^{k^i}) \right], \tag{4}$$

where $l_t^i \in (0,1)$. The parameter $\rho > 0$ is the subjective time discount rate and $\tau_t^{b^i}, \tau_t^{k^i}$ and $\tau_t^{l^i}$ are estate, capital and labor-income proportional taxes at time t for the individual type θ^i, respectively. We purposely choose to define an equilibrium where tax rates can vary by skill type. In this set-up the government can always choose to tax all individuals at the same rate, i.e. $\tau_t^{l^i} = \tau_t^l$ for all i. Both period utility functions U and V are strictly concave, C^2 and satisfy the usual Inada conditions. At $t = 0$, there exists an initial generation who owns the initial stock of debt and capital and solves a similar problem.

Let $\pi = \{\{\tau_t^{b^i}, \tau_t^{k^i}, \tau_t^{l^i}, d_{t+1}^i\}_{i=1}^n\}_{t=0}^\infty$ be a fiscal policy and the period government budget be defined by

$$G_t + \sum_{i=1}^n \mu^i \left(R_t^i d_t^i - d_{t+1}^i \right) = \sum_{i=1}^n \mu^i \left(\tau_t^{k^i} r_t k_t^i + \tau_t^{l^i} w_t \theta^i l_t^i + \tau_t^{b^i} b_t^i \right), \quad \forall t, \tag{5}$$

where k_t^i and d_t^i is the capital and debt own by the individual type θ^i at period t, respectively, and R_t^i is the return on government bonds paid to the individual type θ^i.[6] The aggregates are computed adding up across different types. In particular, the aggregate consumption is $C_t = \sum_{i=1}^n \mu^i (c_{1t}^i + c_{2t}^i)$, the aggregate labor supply is $N_t = \sum_{i=1}^n \mu^i \theta^i l_t^i$, the aggregate capital is $K_t = \sum_{i=1}^n \mu^i k_t^i$, the aggregate bequest is $B_t = \sum_{i=1}^n \mu^i b_t^i$, and the government debt is $D_t = \sum_{i=1}^n \mu^i d_t^i$. The amount of government debt is bounded by a large positive constant to ensure that the government budget constraint is satisfied in present value. Finally, in the capital markets the aggregate level of asset holdings equals the stock of physical capital and government debt at $t + 1$,

$$\sum_{i=1}^n \mu^i a_{t+1}^i = K_{t+1} + D_{t+1}, \quad \forall t. \tag{6}$$

Definition 1 (Market Equilibrium): *Given a fiscal policy* π, *and a sequence of government expenditure* $\{G_t\}_{t=0}^\infty$, *a market equilibrium are individual allocations* $x = \{\{c_{1t}^i, c_{2t}^i, a_{t+1}^i, l_t^i, b_t^i\}_{i=1}^n\}_{t=0}^\infty$,

[6] Since the government may condition the taxes to the individual type θ^i, then it may condition the net return on government debt to the type, too.

production plans $\{K_t, N_t\}_{t=0}^{\infty}$*, and prices* $p = \{\{R_t^i\}_{i=1}^n, r_t, w_t\}_{t=0}^{\infty}$*, such that* 1) x *solves the households problem,* 2) *the production plans solve the firms problem,* 3) *markets clear, and* 4) *the government budget constraint holds.*

The first-order conditions of the optimization problem for a newborn generation of type θ^i yield

$$\frac{U_{c_{1t}^i}}{\rho V_{c_{2t+1}^i}} = \left[1 + r_{t+1}(1 - \tau_{t+1}^{k^i})\right], \quad \forall i, t, \tag{7}$$

$$-\frac{U_{l_t^i}}{U_{c_{1t}^i}} = (1 - \tau_t^{l^i}) w_t \theta^i, \quad \forall i, t, \tag{8}$$

$$\frac{V_{b_{t+1}^i}}{V_{c_{2t+1}^i}} = 1 + \tau_{t+1}^{b^i}, \quad \forall i, t, \tag{9}$$

together with an arbitrage condition between the net return on government bonds and capital, i.e. $R_{t+1}^i = 1 + r_{t+1}(1 - \tau_{t+1}^{k^i})$. Eq.(7) and Eq.(8) are the standard intertemporal and intratemporal first-order conditions.[7] Eq.(9) determines the optimal bequest, and shows that the donor only considers the direct effect of the bequest in her utility function, but she does not consider the indirect effect on the donee.

3. Command Optimum and First-Best Policy

3.1. Command Optimum

In the previous section we have shown that the donor first-order condition without proportional estate taxes is

$$V_{c_{2t+1}^i} = V_{b_{t+1}^i}, \quad \forall i, t. \tag{10}$$

In general, the market solution might fail to be efficient because the donor only considers the direct effect of the bequest in the utility function, but it fails to consider the indirect effect on the donee. One of the main problems to calculate the degree of market failure is that in the presence of warm-glow altruism there might be more than one way to characterize the socially efficient bequests. The problem is that individuals assign utility to the bequest, which is not properly a commodity and, consequently, it does not affect the aggregate resource constraint.[8] In the literature, there has

[7] As in Michel and Pestieau (2004), we exclude non-interior solutions for the leisure decision.

[8] This is not an important challenge for the definition of second-best allocations because they explicitly deal with the individual budget constraint. However, it can create some important problems to define first-best or Pareto

been two different strategies to characterize socially efficient outcomes. The main problem is that both imply different allocations and, consequently, different optimal policies addressed to correct the degree of market failure.

1) Utilitarian preferences: According to utilitarianism, social preferences should represent individual preferences. Thus, if bequests are part of the individual utility function, they should also appear in the social planner problem. An example is Cremer and Pestieau (2006), who solve a social planner problem of the form

$$\max_{y} \sum_{i=1}^{n} \beta^{-1} \mu^{i} \rho V(c_{20}^{i}, b_{0}^{i}) + \sum_{t=0}^{\infty} \sum_{i=1}^{n} \beta^{t} \mu^{i} \left[U(c_{1t}^{i}, l_{t}^{i}) + \rho V(c_{2t+1}^{i}, b_{t+1}^{i}) \right], \tag{11}$$

$$s.to \qquad \sum_{i=1}^{n} \mu^{i} \left(c_{1t}^{i} + c_{2t}^{i} \right) + K_{t+1} - (1-\delta) K_{t} + G_{t} = F(K_{t}, \sum_{i=1}^{n} \mu^{i} \theta^{i} l_{t}^{i}), \quad \forall t, \tag{12}$$

where the relative weight that the government places between present and future generations is captured[9] by $\beta \in (0,1)$, $l_t^i \in (0,1)$ for all i, and $y = \{\{c_{1t}^i, c_{2t}^i, l_t^i, b_t^i\}_{i=1}^n, K_{t+1}\}_{t=0}^{\infty}$. They conclude that the efficient allocation with respect to the bequest implies $V_{b_t^i} = 0$ for all i and t, where the level of b_t^i is very large or almost infinite. In this formulation the act of giving is not constrained by individual resources. If the social planner has no restriction on the bequests (i.e. $0 \leq b_t^i < \infty$), then the Dominium is not a compact set, since it is not bounded, and a maximum might not exist. In the market solution this is not a problem because the individual resource constraint imposes an upper bound on the act of giving that limits the size of bequests. The first-order conditions of the social planner and the market can only be simultaneously satisfied with an optimal estate tax of $\widehat{\tau}_t^{b^i} = -1$ for all i and t, that is, a 100% subsidy on bequest, so that its implied market price is zero.[10]

2) Laundering individual preferences: Several authors, as Hammond (1988) and Harsanyi (1995), have advocated to exclude all the external effects from the social utility function. In this case, the social planner utility would not represent the individual preferences. The efficient allocations would solve

$$\max_{z} \sum_{t=0}^{\infty} \sum_{i=1}^{n} \beta^{t} \mu^{i} \left[U(c_{1t}^{i}, l_{t}^{i}) + \rho \beta^{-1} v(c_{2t}^{i}) \right], \tag{13}$$

efficient allocations.

[9] Note that this specification of the social welfare function imposes some restrictions, since it rules out steady-state "golden-rule" equilibria.

[10] And a lump-sum tax of infinite.

$$s.to \qquad \sum_{i=1}^{n} \mu^i \left(c_{1t}^i + c_{2t}^i\right) + K_{t+1} - (1-\delta)K_t + G_t = F(K_t, \sum_{i=1}^{n} \mu^i \theta^i l_t^i), \quad \forall t,$$

where the period utility function v is strictly concave, C^2 and satisfy the usual Inada conditions, $l_t^i \in (0,1)$ for all i, and $z = \{\{c_{1t}^i, c_{2t}^i, l_t^i\}_{i=1}^n, K_{t+1}\}_{t=0}^{\infty}$. The first-order conditions include $U_{c_{1t}^i} = \rho\beta^{-1} v_{c_{2t}^i}$ for all i and t. Under this formulation, the social planner determines the socially efficient allocation of commodities, but it does not directly determine the size of the bequest. This is indirectly determined by the market equilibrium conditions.[11] Formally, $V_{c_{2t}^i} = V_{b_t^i}$ for all i and t. Under this notion of efficiency the market outcome is fully efficient since Eq.(5) and Eq.(6) are the same for the social planner[12], and the prescribed estate tax is zero, $\widehat{\tau}_t^{b^i} = 0$ for all i and t. Even though the first-best is well-defined, this approach ignores that the donor is not interested by the impact of her gift.[13]

Both models make different predictions on the optimal estate tax. With utilitarian preferences it is socially efficient to give a 100% subsidy on bequests, whereas when we ignore the utility interdependence in social preferences the implied optimal estate tax is zero.

3.2. Efficiency

In welfare economics the concept of Pareto-efficiency is often silent about the income distribution. Consequently, to determine the socially efficient allocations the only constraint that matters is the aggregate resource constraint. However, when there exists a choice variable that does not appear in the resource constraint, we might need additional information to determine its value. In the presence of altruism, the act of giving (choice variable) is bounded by the amount of individual resources (the individual budget constraint). Consequently, an individual cannot promise and transfer more resources to another individual than her income\wealth. The social planner should respect this

[11] The main problem with laundering is to be able to discern what exactly the social preferences are. Let us illustrate this idea with one example. Consider that there is only one individual type and that individual preferences are $\left(\left[c_{1t}\left(1-l_t\right)^{\lambda}\right]^{1-\sigma} + \rho\left(c_{2t+1} b_{t+1}^{\varphi}\right)^{1-\sigma}\right) / (1-\sigma)$. In this case, if the social planner preferences are $\left(\left[c_{1t}\left(1-l_t\right)^{\lambda}\right]^{1-\sigma} + \rho\left(c_{2t+1}\right)^{1-\sigma}\right) / (1-\sigma)$ then the first-best would have too much consumption when old (with respect to the consumption the individual would prefer). Indeed, if the social planner preferences are $\left(\left[c_{1t}\left(1-l_t\right)^{\lambda}\right]^{1-\sigma} + \rho\left(a c_{2t+1}\right)^{1-\sigma}\right) / (1-\sigma)$, where a is an arbitrary constant, we may have too much, too less or the same consumption when old. This arbitrariness in choosing the social preferences is translated to the notion of efficiency. In particular, the market solution can imply over or under consumption and too much or too little physical capital.

[12] Note that the market allocation can be efficient but it can exhibit over or under consumption, since in general $V_{c_{2t}^i}$ does not coincide with $v_{c_{2t}^i}$.

[13] Alternatively, one could think that the donor is interested by the impact of her gift, but she cannot take into account this impact because she cannot observe it.

constraint inherent to the act of giving, but it should also have some ability to redistribute resources (i.e. make the donor relatively wealthier) and attain the socially efficient level of altruism. Hence, the bounds on the act of giving and the implied income distribution are determined by the social planner.

One way to think about the determination of each individual share on income is to view the social planner as the agent that assigns resources to the production process. In our particular case, young individuals provide labor units to produce, whereas old individuals provide capital units. Therefore, the production process has some implications in the income and consumption distributions, since individuals that provide labor units are entitled to receive labor earnings, and individuals that provide capital are entitled to receive capital earnings. Consequently, the determinants of the socially efficient income distribution are the same as in the market economy. Thus, a social planner whose social preferences represent individual preferences should take into account not only the external effects, but also that it is likely to affect the income distribution.

A social planner problem consists in maximizing a social welfare function subject to the sequencial individual constraints, the firms optimal conditions, the market clearing conditions, and the government budget constraint. Adding up these constraints gives the resource constraint of the economy. When markets are competitive and there is no market failures in the economy, it is easy to prove that the solution to the original problem coincides with the solution of the maximization of the social welfare function subject to the resource constraint. However, this is not necessaryly the case if there exists some type of market failure. As it is also our case, we use the original problem.

Definition 2 (Social Planner Problem): *The Pareto efficient allocation m solves*

$$\max_{m} \sum_{t=0}^{\infty} \sum_{i=1}^{n} \beta^t \mu^i \left[U(c_{1t}^i, l_t^i) + \rho\beta^{-1} V(c_{2t}^i, b_t^i) \right],$$

$$s.to \quad c_{1t}^i + a_{t+1}^i = F_{N_t}(K_t, N_t)\, \theta^i l_t^i + b_t^i - T_t^i, \quad \forall i, t, \tag{14}$$

$$c_{2t}^i + b_t^i = a_t^i (1 - \delta + F_{K_t}(K_t, N_t)), \quad \forall i, t, \tag{15}$$

$$\sum_{i=1}^{n} \mu^i a_{t+1}^i = K_{t+1}, \quad \forall t, \tag{16}$$

$$\sum_{i=1}^{n} \mu^i \theta^i l_t^i = N_t, \quad \forall t, \tag{17}$$

$$\sum_{i=1}^{n} \mu^i T_t^i = G_t, \quad \forall t, \tag{18}$$

where $l_t^i \in (0,1)$ *for all* i.

The initial distribution of entitlements at $t=0$ is exogenously given $\{a_0^i\}_{i=1}^n$, T_t^i is a lump-sum tax paid by the young individuals, and $m = \{\{c_{1t}^i, c_{2t}^i, a_{t+1}^i, l_t^i, b_t^i, T_t^i\}_{i=1}^n\}_{t=0}^\infty$. For simplicity, we assume $\mu^i = \mu = 1$. Separating the income source for each individual constraints the act of giving. Note that a_{t+1}^i should be interpreted as entitlements for the utilization of the capital stock next period. Also note that adding up Eq.(14) and Eq.(15) for all i and using Eqs (16)-(18), we have the resource constraint. Therefore, intergenerational transfers are possible. The social planner understands that next period aggregate capital stock requires a consumption sacrifice of the young generations. More importantly, the planner uses the distribution of entitlements to determine next period efficient allocation between consumption and bequests that is likely to be different than the implied by the market. The efficient distribution of entitlements (savings) can be decentralized as a market solution with the appropriate tax/subsidy policy.

In this problem, the social planner not only takes into account the external effects, but it also takes into account the impact of the labor supply and the entitlements on its respective marginal productivities. Individuals in the market are price takers, and they will not take this effect into account. Formally, the social planner solves

$$\max_m \sum_{t=0}^{\infty} \sum_{i=1}^{n} \beta^t \left[U(F_{N_t}\left(\sum_{j=1}^n a_t^j, \sum_{j=1}^n \theta^j l_t^j\right) \theta^i l_t^i + b_t^i - T_t^i - a_{t+1}^i, l_t^i) + \right.$$

$$\left. \rho\beta^{-1} V(a_t^i \left[1 - \delta + F_{K_t}\left(\sum_{j=1}^n a_t^j, \sum_{j=1}^n \theta^j l_t^j\right)\right] - b_t^i, b_t^i) \right], \tag{19}$$

$$s.to \quad \sum_{i=1}^{n} T_t^i = G_t, \quad \forall t. \tag{20}$$

The first-order conditions with respect to b_t^i, a_{t+1}^i, l_t^i and T_t^i are, respectively,

$$U_{c_{1t}^i} + \rho\beta^{-1}(-V_{c_{2t}^i} + V_{b_t^i}) = 0, \quad \forall i, t, \tag{21}$$

$$\beta \sum_{j=1}^{n} U_{c_{1t+1}^j} \theta^j l_{t+1}^j F_{N_{t+1}K_{t+1}} + \rho V_{c_{2t+1}^i}(1 - \delta + F_{K_{t+1}}) + \sum_{j=1}^{n} \rho V_{c_{2t+1}^j} a_{t+1}^j F_{K_{t+1}K_{t+1}} - U_{c_{1t}^i} = 0, \quad \forall i, t, \tag{22}$$

$$U_{c_{1t}^i} F_{N_t} + \sum_{j=1}^{n} U_{c_{1t}^j} \theta^j l_t^j F_{N_t N_t} + \frac{U_{l_t^i}}{\theta^i} + \sum_{j=1}^{n} \rho \beta^{-1} V_{c_{2t}^j} a_t^j F_{K_t N_t} = 0, \quad \forall i, t, \tag{23}$$

$$U_{c_{1t}^i} = U_{c_{1t}^j}, \quad \forall i \neq j, \quad \forall t. \tag{24}$$

Rearranging terms, we can rewrite the efficient bequest decision as

$$V_{c_{2t}^i} = V_{b_t^i} + \underbrace{\frac{\beta}{\rho} U_{c_{1t}^i}}_{\text{External Effect}}, \qquad \forall i, t.$$

The social planner equates the marginal cost from giving an additional unit of consumption from the donor perspective, to the social marginal benefit of giving a bequest. That includes the direct effect on the donor's utility function as well as the indirect effect on the donee budget set. The socially efficient allocation reduces the marginal utility of giving a bequest $V_{b_t^i}$ by considering its direct and indirect cost $V_{c_{2t}^i} - \frac{\beta}{\rho} U_{c_{1t}^i}$. In general, the market outcome is socially inefficient unless we consider efficient solutions where the social planner sets $\beta = 0$, i.e. it is only worried about the actual old generation.

The implied tax policy can be obtained by combining the first-order conditions of the social planner problem with the market conditions.

Proposition 1: *The efficient fiscal policy from $t > 0$ requires*

$$\tau_t^{b^i} = -\frac{\beta}{\rho} \frac{U_{c_{1t}^i}}{V_{c_{2t}^i}} < 0, \quad \forall i, t. \tag{25}$$

$$\tau_t^{k^i} = \frac{F_{N_t K_t} \sum_{j=1}^{n} V_{b_t^j} \theta^j l_t^j - \sum_{j=1}^{n} V_{c_{2t}^j} \left(F_{N_t K_t} \theta^j l_t^j + F_{K_t K_t} a_t^j \right)}{V_{c_{2t}^i} (F_{K_t} - \delta)}, \quad \forall i, t, \tag{26}$$

$$\tau_t^{l^i} = -\frac{\rho \beta^{-1} F_{K_t N_t} \sum_{j=1}^{n} V_{b_t^j} a_t^j + \sum_{j=1}^{n} U_{c_{1t}^j} \left(F_{N_t N_t} \theta^j l_t^j + F_{K_t N_t} a_t^j \right)}{U_{c_{1t}^i} F_{N_t}}, \quad \forall i, t. \tag{27}$$

The implied estate tax is always negative, even in steady-state, and it depends on the size of the bequest, the endogenous income distribution, and the ratio of discount rates (individual and planning weights). The objective of the estate subsidy is to reduce the relative price of the bequest and induce a higher level of transfers in the market. The capital and labor-income taxes are set to induce the efficient level of savings and labor supply. Individual lump-sum taxes are calculated given the individual collected taxes, the social planner allocation, Eq.(20) and Eq.(24).[14]

When individuals are homogeneous, we have that $n = 1$. Then, using the property of homogeneity of degree zero of the derivatives of the production function and suppressing the individual type superscript, we have that $a_t = K_t$, $\theta l_t = N_t$ and then the optimal capital-income tax is $\tau_t^k = \frac{V_{b_t}}{V_{c_{2t}}} \frac{N_t F_{N_t K_t}}{(F_{K_t} - \delta)} > 0$, whereas the optimal labor-income tax is $\tau_t^l = -\frac{\rho}{\beta} \frac{V_{b_t}}{U_{c_{1t}}} \frac{K_t F_{K_t N_t}}{F_{N_t}} < 0$. It is important to mention that if the social planner does not consider the impact of capital and labor supply decisions on each individual compensations, then the implied tax rates are zero. Also note that if there was no external effect, i.e. $V_{b_t} = 0$, then we would recover the typical first-best result where $\tau_t^k = \tau_t^l = 0$ for all t, and then we could have added up all the constraints into the resource constraint.

Corollary 1: *If individuals are homogeneous, then the efficient fiscal policy from* $t > 0$ *requires positive capital-income taxes and negative estate and labor-income taxes.*

One of the main problems with the analysis of the previous cases is that it relies on the existence of lump-sum taxation. When governments are far from having access to this class of instruments, they must rely on distortionary taxes. As a result, governments have to prioritize the distortions when choosing the optimal fiscal policy.

4. Government problem and Second-Best Policy

In this section we state and solve the government problem. We consider a government that chooses a fiscal policy π to maximize the welfare of all present and future generations.[15] In order to solve the government problem we use the primal approach of optimal taxation proposed by Atkinson and Stiglitz (1980).[16] This problem is characterized by having a larger constraint set than the social

[14] Note that Eq.(24) crucially depends on the weights the social planner assigns to each individual type.

[15] Throughout the paper we assume that the government can commit to the optimal policy, so that time-consistency issues are ignored.

[16] This approach is based on characterizing the set of allocations that the government can implement for a given fiscal policy π. The set of implementable allocations are described by a sequence of resource and implementability constraints. The implementability constraints are the households' present value budget constraint, after substituting in the first-order conditions of the consumers' and the firms' problems. These constraints capture that changes in the fiscal policy have a direct effect on agents' decisions and an indirect effect on prices. Thus, the government problem amounts to maximize a social welfare function over the set of implementable allocations. From the optimal

planner problem characterized in the previous section. Therefore, the solution of the second-best cannot yield higher utility than the command optimum.

Definition 3 (Government Problem): *Given an initial tax rates* $\{\tau_0^{k^i}\}_{i=1}^n$, *and wealth distribution* $\{a_0^i\}_{i=1}^n$, *the allocation* y *associated to the optimal fiscal policy* $\widehat{\pi}$ *is derived by solving*

$$\max_y \sum_{t=0}^{\infty} \sum_{i=1}^{n} \beta^t \left[U(c_{1t}^i, l_t^i) + \rho \beta^{-1} V(c_{2t}^i, b_t^i) \right] \tag{28}$$

$$s.to \quad c_{1t}^i U_{c_{1t}^i} + l_t^i U_{l_t^i} + \rho \left(c_{2t+1}^i V_{c_{2t+1}^i} + b_{t+1}^i V_{b_{t+1}^i} \right) = b_t^i U_{c_{1t}^i}, \quad \forall i, t, \tag{29}$$

$$c_{20}^i V_{c_{20}^i} + b_0^i V_{b_0^i} = V_{c_{20}^i} \left[1 + (1 - \tau_0^{k^i})(F_{K_0} - \delta) \right] a_0^i, \quad \forall i, \tag{30}$$

$$\sum_{i=1}^{n} (c_{1t}^i + c_{2t}^i) + K_{t+1} - (1-\delta) K_t + G_t = F(K_t, \sum_{i=1}^{n} \theta^i l_t^i), \quad \forall t, \tag{31}$$

where $l_t^i \in (0,1)$ *for all* i, $a_0^i = \left(k_0^i + d_0^i \right)$, *and* $K_0 = \sum_{i=1}^{n} k_0^i$.

Note that in this case we can add all the restrictions up in the resource constraint since the implementability constraint, Eq.(29), contains how individual decisions and income distribution are affected by the government. In particular, the external effects are taken into account in the right-hand side of the implementability constraint for newborn cohorts. Using the primal approach, it is direct to prove that the allocations in a market equilibrium satisfy the set of implementable allocations defined by Eqs (29)-(31). Moreover, if an allocation y is implementable, then we can construct a fiscal policy π and market prices p, such that the allocation together with the prices p and the tax policy π constitute an equilibrium as defined in the second section.[17]

In the absence of lump-sum taxation, the government faces a trade-off between distortions and external effects. We assume that $n = 1$ and thus we suppress the individual type superscript. We will show that all the findings can be generalized as long as the government can observe either the labor supply and\or the skill type and therefore the optimal tax rates can be conditioned on observables $\pi(\theta^i)$. When taxes cannot be conditioned on skills, the government faces a trade-off

allocations we can decentralize the economy finding the prices and the optimal fiscal policy. The implementability constraint can be easily derived combining the first-order conditions of the consumer problem with the intertemporal budget constraint (see Chari and Kehoe [1999] for a detailed derivation).

[17] The presence of debt allows the government to redistribute resources across generations and attain the modified golden-rule. We assume that the initial capital-income tax, $\left\{\tau_0^{k^i}\right\}_{i=1}^n$, is inherited by the government. In economies where agents live a finite number of periods this assumption is not very important since taxes at $t = 0$ cannot be used to mimic lump-sum and obtain a first-best assignment.

between efficiency and redistribution. However, in the last section we use a numerical example to show that the qualitative properties of a pooling equilibrium where all the individual types pay the same tax rates are similar.

In order to derive a solution to the previous problem, we redefine the government objective function by introducing the implementability constraint of each generation in. For a newborn generation the government period utility becomes

$$W(e_t,\eta_t) = U(c_{1t},l_t) + \rho V(c_{2t+1},b_{t+1}) + \eta_t \underbrace{\left[(c_{1t}-b_t)U_{c_{1t}} + l_t U_{l_t} + \rho\left(c_{2t+1}V_{c_{2t+1}} + b_{t+1}V_{b_{t+1}}\right)\right]}_{\text{Effect distortionary taxation}}, \tag{32}$$

where $e_t = (c_{1t}, l_t, c_{2t+1}, b_{t+1})$, and η_t is the Lagrange multiplier associated to the implementability constraint of a generation born at period t. The additional term measures the effect of distortionary taxes on the utility function. The optimal conditions for $t > 0$ are characterized by[18]

$$-\frac{W_{l_t}}{W_{c_{1t}}} = F_{N_t}\theta, \tag{33}$$

$$\frac{W_{c_{1t}}}{\rho W_{c_{2t+1}}} = 1 - \delta + F_{K_{t+1}}, \tag{34}$$

$$W_{c_{1t}} = \frac{\rho}{\beta} W_{c_{2t}}, \tag{35}$$

$$W_{b_t} = \frac{\eta_t \beta}{\rho} U_{c_{1t}}, \tag{36}$$

where the term W_x denotes the derivative of the objective function with respect to x.[19] The Lagrange multiplier in Eq.(36) captures the external effect on the budget constraint of the younger generations. Clearly, the first-order conditions of the government problem and the social planner are different. In particular, if we combine Eq.(35) and Eq.(36) we can derive an expression similar

[18] It is important to note that, given the nature of this problem, the first-order conditions together with the transversality condition might not be sufficient to characterize a solution; that depends on the properties of the implementability constraint, which might fail to be convex. A detailed discussion of this problem can be found in Lucas and Stokey (1983).

[19] Formally,

$$\begin{aligned} W_{c_{1t}} &= U_{c_{1t}} + \eta_t\left[U_{c_{1t}} + (c_{1t}-b_t)\,U_{c_{1t}c_{1t}} + l_t U_{l_t c_{1t}}\right], \\ W_{l_t} &= U_{l_t} + \eta_t\left[U_{l_t} + l_t U_{l_t l_t} + (c_{1t}-b_t)\,U_{c_{1t}l_t}\right], \\ W_{c_{2t}} &= V_{c_{2t}} + \eta_{t-1}[V_{c_{2t}} + c_{2t}V_{c_{2t}c_{2t}} + b_t V_{b_t c_{2t}}], \\ W_{b_t} &= V_{b_t} + \eta_{t-1}[V_{b_t} + b_t V_{b_t b_t} + c_{2t}V_{c_{2t}b_t}]. \end{aligned}$$

The additional terms on the marginal utilities capture the efficient distortion, in terms of allocations, chosen by the government. At $t = 0$ these expressions include additional terms that take into account the initial income distribution.

to Eq.(21),

$$V_{c_{2t}} - \left[V_{b_t} + \frac{\beta}{\rho} V_{c_{1t}} \right] = H_t \equiv \frac{\beta}{\rho} \eta_t Z_{1t} + \eta_{t-1} Z_{2t}, \tag{37}$$

where the terms Z_{it} capture the distortionary effects of estate taxation for the individual of age i at time t.[20] The incentives to reduce the external effect need to be balanced with the negative impact of raising additional distortions in both existing generations. This is captured by the Lagrange multiplier of the implementability constraint η_t for all t, and the impact on the optimal decisions of each cohort Z_{it} for $i = 1, 2$. In the presence of lump-sum taxation, the Lagrange multiplier of the implementability constraint is zero, i.e. $\eta_t = 0$ for all t. However, in the absence of lump-sum taxation the multiplier of the implementability constraint is binding. In order to characterize the optimal fiscal policy we combine the optimal conditions of the government problem together with the consumer and the firms optimal conditions.

Proposition 2: *If the government can choose $\widehat{\pi}$, then the optimal fiscal policy from $t > 0$ requires*

$$\widehat{\tau}_t^l = 1 - \frac{W_{c_{1t}}}{W_{l_t}} \frac{U_{l_t}}{U_{c_{1t}}}, \tag{38}$$

$$\widehat{\tau}_t^b = -\frac{\beta}{\rho} \frac{U_{c_{1t}}}{V_{c_{2t}}} - \frac{H_t}{V_{c_{2t}}}, \tag{39}$$

$$\widehat{\tau}_t^k = 1 - \left(\frac{\frac{U_{c_{1t-1}}}{\rho V_{c_{2t}}} - 1}{\frac{W_{c_{1t-1}}}{\rho W_{c_{2t}}} - 1} \right). \tag{40}$$

The trade-off between efficiency and external effects is captured by the term $H_t \neq 0$, and the optimal estate tax differs from the efficient one obtained in the previous section. In general, the presence of warm-glow altruism implies estate and capital-income taxes different from zero. We state without proof the next corollary, which shows a sufficient condition for uniform taxation in this economy.

[20] Formally,

$$Z_{1t} = (c_{1t} - b_t) U_{c_{1t} c_{1t}} + l_t U_{l_t c_{1t}},$$
$$Z_{2t} = V_{b_t} + b_t V_{b_t b_t} + (c_{2t} - b_t) V_{c_2 b_t} - V_{c_{2t}} - c_{2t} V_{c_{2t} c_{2t}}.$$

Corollary 2: *If the utility function satisfies the following condition:*

$$\frac{(c_{1t} - b_t) U_{c_{1t}c_{1t}} + l_t U_{l_t c_{1t}}}{U_{c_{1t}}} = \frac{c_{2t+1} V_{c_{2t+1}c_{2t+1}} + b_{t+1} V_{c_{2t+1}b_{t+1}}}{V_{c_{2t+1}}}, \tag{41}$$

then the optimal policy implies setting $\widehat{\tau}_t^k = 0$ *from* $t > 1$.

In general, standard preferences used in macro and public finance literature do not satisfy this condition. Consequently, we believe that the presence of this form of altruism can lead to new roles for capital-income and estate taxation. These results differ from the standard model with dynastic altruism. In particular, Cremer and Pestieau (2006) show that in the dynastic altruism model the government would set capital-income and estate taxation to zero in the long-run.

Since estate subsidies might be difficult to implement and could require high administrative costs of monitoring the actual transfer, we consider the case where the government faces a non-negativity constraint on estate taxation. Formally, this amounts to impose an additional constraint in the government problem. In particular, second-best allocations need to satisfy $\tau_t^b = V_{b_t}/V_{c_{2t}} - 1 \geq 0$. When this constraint binds the restricted fiscal policy becomes $\pi_R = \{\tau_t^k, \tau_t^l, d_{t+1}\}_{t=0}^{\infty}$, and the intergenerational distribution becomes a constraint that the government can only indirectly influence through capital-income taxation. The associated optimal conditions for $t > 0$ are

$$-\frac{W_{l_t}}{W_{c_{1t}}} = F_{N_t}\theta, \tag{42}$$

$$\frac{W_{c_{1t}}}{\left[\rho W_{c_{2t+1}} + Q_{t+1}\right]} = 1 - \delta + F_{K_{t+1}}, \tag{43}$$

where Q_{t+1} is an additional term that captures the impact of the tax restrictions on the marginal utility of consumers.[21] Next proposition characterizes the optimal fiscal policy in the absence of estate taxes.

Proposition 3: *If the government can choose* $\widehat{\pi}_R$*, then the optimal fiscal policy from* $t > 0$ *requires*

$$\widehat{\tau}_t^l = 1 - \frac{W_{c_{1t}}}{W_{l_t}} \frac{U_{l_t}}{U_{c_{1t}}}, \tag{44}$$

[21] Formally,

$$Q_{t+1} = \frac{V_{c_{2t+1}c_{2t+1}} - V_{c_{2t+1}b_{t+1}}}{V_{b_{t+1}b_{t+1}} - V_{c_{2t+1}b_{t+1}}} (\rho W_{b_{t+1}} - \beta \eta_{t+1} U_{c_{1t+1}}).$$

$$\widehat{\tau}_t^k = 1 - \left(\frac{\frac{U_{c_{1t-1}}}{\rho V_{c_{2t}}} - 1}{\frac{W_{c_{1t-1}}}{\rho W_{c_{2t}} + Q_t} - 1} \right). \tag{45}$$

In the presence of estate taxes the government has some degree of flexibility to separate the external effects and minimize distortions on the consumer decisions. When the estate taxes are not available, the implied optimal capital-income tax has to take this effect into account. The effect is captured by the Q_{t+1} term in the first-order conditions of the government problem and, as a result, the optimal fiscal policy differs from the previous case where estate taxes were available.

We can extend these results to the case of $n > 1$ as long as the government can condition taxes on individual skills. In this case, the government can implement the second-best allocations focusing on efficiency and ignoring any equity considerations. Nevertheless, when taxes cannot be conditioned on skills, that is $\pi(\theta^i) = \pi$ for all θ^i, the government faces a trade-off between efficiency and equity. This trade-off can imply tax rates that differ from the obtained in propositions 2-3.[22] We explore all these issues in the next section.

5. An Example

In general it is difficult to characterize the properties of the optimal fiscal policy beyond the functional form since the optimal tax mix depends on the relative magnitude of the compensated elasticities. In the absence of a closed form solution, we present a numerical simulation of the optimal tax policy under different tax constraints. The objective is to illustrate a case example and its implications, not to develop a quantitative analysis on normative estate taxation. We solve numerically a steady-state equilibrium of the government problem for a given choice of functional forms and parameters and compare the outcomes with the first-best allocations.[23] To complement the example, we also consider an extension that includes heterogeneous consumers to analyze the optimal fiscal policy when taxes can and cannot be conditioned on individual skills.

[22] One could interpret this solution as a pooling equilibrium where individual skills and effort are not observable. In a separating equilibrium the government would offer a menu of contracts that satisfies the incentive compatibility constraint of each type. We are not exploring this possibility in the paper since we want to avoid the effect of informational frictions and focus only on efficiency considerations.

[23] We assume that the sequence of government expenditure converges in the long-run to a constant level G. In an infinitely-lived consumer model, the initial level of debt affects the tightness of the implementability constraint and therefore the optimal fiscal policy. In this economy the steady-state is independent of the initial conditions, because the level of debt at $t = 0$ only appears in the implementability constraint of the initial old, but not in the newborn generations. Hence, we can study the optimal fiscal policy regardless of the initial conditions.

We consider a standard constant returns to scale production function, $F(K_t, N_t) = K_t^{\alpha} N_t^{1-\alpha}$, and preferences of the form

$$\frac{[c_{1t}^{\varepsilon}(1-l_t)^{1-\varepsilon}]^{1-\sigma}}{1-\sigma} + \rho\frac{[c_{2t+1}^{\gamma} b_{t+1}^{1-\gamma}]^{1-\sigma}}{1-\sigma},$$

where when $\sigma = 1$ the utility function becomes logarithmic. The parameter values used in the simulation are summarized in table 1.[24]

Table 1: Parameter values (yearly)

α	δ	β	ρ	σ	ε	γ	θ	G/Y
0.4	0.06	0.968	0.95	3.5	0.3	0.85	1	0.20

Table 2 displays the numerical solutions of the optimal tax rates for different sets of instruments.

Table 2: Optimal fiscal policy (n = 1)

	Social Planner	Second-Best	Second-Best ($\tau_b \geq 0$)
Capital-income tax	37.9%	54.8%	33.3%
Estate tax	−73.3%	−50.0%	0.0%
Labor-income tax	−46.4%	28.1%	28.39%
Consumption Equivalent Variation		1.17%	1.20%

The first column describes the command optimum first-best policy where the government has access to lump-sum taxes. The second and third columns show the numerical solution when the government only has access to distortionary linear taxes and when estate taxes are restricted to be non-negative, respectively. The last row measures the welfare cost of distortionary taxation using the equivalent variation in consumption.

A close inspection of the table shows that the market equilibrium is suboptimal and that the model can be consistent with large labor-income and estate subsidies, and capital-income taxes. The larger capital-income tax is consistent with preferences that violate Eq.(41) and is not related to dynamic inefficiencies since the economy satisfies the modified golden-rule.

When lump-sum taxes are not available the government has to balance the distortionary effects of taxation with the external effect associated to the bequests. This trade-off is resolved with a

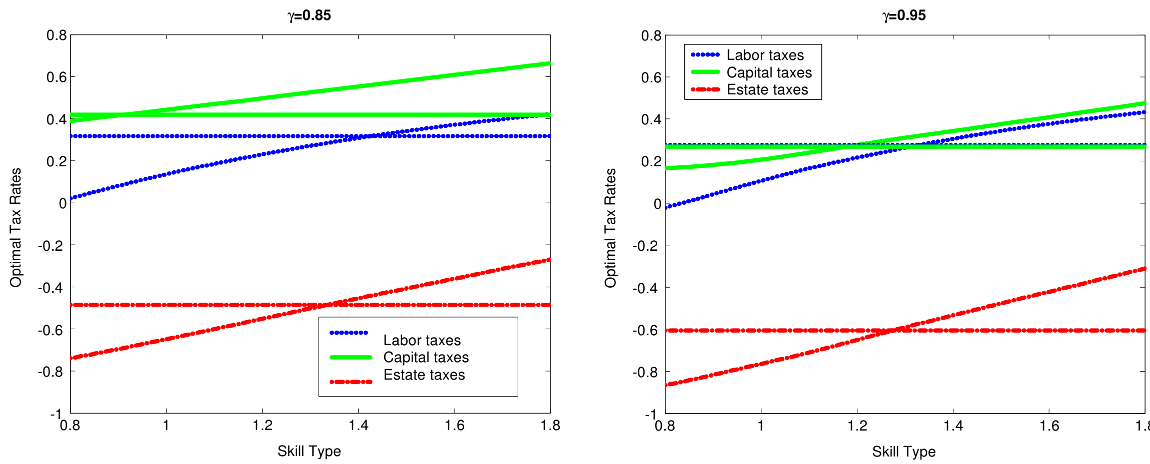
[24] In the numerical simulations, the parameters δ, β and ρ have been adjusted to consider that one period in the model consists of thirty years.

higher positive capital-income tax and a lower estate subsidy. The absence of lump-sum taxation requires a change in the sign and the magnitude of the labor-income tax. In the last case, the government policy is even more restricted. When the non-negativity constraint in estate taxation binds, the government resolves the trade-off between the external effects and efficiency with a lower capital-income tax and almost the same labor-income tax. Since estate transfers are not subsidized, there is no need for high capital-income taxation. This is the qualitative effect of the term Q_{t+1} in the Euler equation of the government problem Eq.(43). The trade-off between efficiency and external effects implies a utility loss for the newborn.

Finally, we want to illustrate the effects of introducing intragenerational heterogeneity.[25] Estate taxation is considered to be an important redistributive fiscal instrument given the documented significance of wealth transfers across generations and the skewness of the wealth distribution. We show that if the government can condition the tax rates on the individual types, then the qualitative results presented in the previous section remain unchanged. Nevertheless, the actual rates could substantially vary by skill type. The distributions of taxes across individual types (or productivity levels) when taxes can be conditioned on skills $\pi(\theta^i)$ or not $\pi(\theta^i) = \pi$ are displayed in Figure 1. Each graph is calculated using a different relative weight for bequests in the utility function. The optimal tax rates can vary substantially with a small change in parameter values, but the qualitative results discussed in the previous sections remain unchanged. As we can observe in both graphs, the implied tax policy across individual types is highly progressive and as a result households with a higher level of skills pay substantially higher taxes.

[25] We have approximated a continuous distribution of individual types $\theta^i \in [0.8, 1.8]$ using a discrete number of types and then interpolating on the decision rules.

Figure 1: Optimal fiscal policy with heterogeneous types: $\pi(\theta^i)$ and $\pi(\theta^i) = \pi$



When government cannot condition taxes on individual types all households have to pay the same tax rates regardless of the skill type, that is $\pi(\theta^i) = \pi$ for all θ^i. In this case, the government faces a trade-off between efficiency (minimizing distortions) and equity (redistributing resources), and the optimization problem requires additional restrictions to ensure that the marginal rates of substitution across households are equated to the same after tax prices. In this particular example, the trade-off implies deviations from the average tax rate for labor and capital-income taxes. However, estate taxes are roughly set to the average value. In essence, the qualitative features of the theoretical findings from the previous section remain unaltered, but the lack of progressivity reduces the government effectiveness to minimize distortions. Clearly, heterogeneity can imply important quantitative differences in terms of the optimal tax rates, but it does not affect the nature of the market inefficiencies associated to warm-glow altruism.

6. Conclusions

This paper analyzes the effect of warm-glow altruism on the optimal fiscal policy in an economy with heterogeneous consumers. We explicitly consider an implicit constraint in the act of giving: the donor cannot bequeath to the donee more than her existing available resources. We show that in the presence of bequests the socially efficient level of bequests might be different than the implemented by the market allocation. The external effect leads to an inefficient level of altruistic transfers that can be corrected with an estate and labor-income subsidies and a capital-income tax.

In analyzing the second-best tax policy, the government faces a trade-off between efficiency and external effects. Hence, the optimal tax policy equates these distortions at the margin. A quantitative example shows that the estate subsidy is lower and the capital-income tax is higher than in the first-best, whereas the labor-income tax changes the sign and becomes positive.

Finally, we show that the qualitative features of the model without heterogeneity can be extended to the heterogeneity case when the government can condition taxes by the individual type. However, the optimal policy can generate a large degree of tax progressivity across types. Nevertheless, when taxes cannot be conditioned by the individual type, the government faces a trade-off between efficiency (minimizing distortions) and equity (redistributing resources) since all households have to pay the same tax rates. The lack of progressivity reduces the government effectiveness to minimize distortions, but the qualitative results are the same. Clearly, heterogeneity can imply important quantitative differences in terms of the optimal tax rates, but it does not affect the nature of the market inefficiencies associated to warm-glow altruism.

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