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Esteban García-Miralles

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(**) Contact: esteban.garcia.miralles@bde.es

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Abstract

This paper calibrates the full social optimal inheritance tax rate derived by Piketty and Saez (2013) and shows that different assumptions on the form of the social welfare function lead to very different optimal inheritance tax rates, ranging from negative (under a utilitarian criterion) to positive and large (even assuming joy of giving motives). The paper also calibrates the optimal tax rate by percentile of the distribution of bequest received, as Piketty and Saez do, but accounting for heterogeneity in wealth and labor income. The result is that the optimal tax rate from the perspective of the non-receivers varies significantly, contrary to the constant tax rate obtained by these authors.

Keywords: optimal taxation, inheritance, social welfare criteria.

JEL classification: H21, H23, H24.

Resumen

En este artículo se calibra el impuesto óptimo a las herencias derivado por Piketty y Saez (2013) mostrando que diferentes supuestos sobre la función de bienestar social dan lugar a tipos óptimos muy dispares, que varían desde tipos negativos (cuando el criterio de bienestar social es utilitarista) hasta tipos positivos y elevados (incluso suponiendo que la motivación del donante es de tipo *joy of giving).* También se calibra el tipo óptimo por percentiles de herencia recibida, como hacen Piketty y Saez, pero teniendo en cuenta la heterogeneidad en riqueza y rentas del trabajo. El resultado es que el tipo impositivo óptimo desde la perspectiva de quienes no reciben ninguna herencia varía significativamente, en contraste con el tipo impositivo constante que obtienen Piketty y Saez.

Palabras clave: imposición óptima, herencias, criterios de bienestar social.

Códigos JEL: H21, H23, H24.

1 Introduction

Taxation of wealth is currently at the center of many academic and political debates. For the case of inheritance taxation, in the U.S. the marginal tax rate has been changing almost every year since 2001 and after its removal in 2010 it is now operative at a marginal rate of 40% with an exemption of $5.4 million. This paper aims to provide a positive analysis of two of the main features that underlie the debate around inheritance taxation, namely the importance of the assumed preference for redistribution (the social welfare function —SWF—) and the large variation across individuals regarding their preferred optimal tax rate.

Most studies on inheritance taxation assume a utilitarian SWF. While this is a standard approach in the literature of optimal taxation, the effect of this assumption for the case of inheritances has special relevance due to the possibility of positive externalities arising from joy of giving bequest motives and amplified by the high concentration of bequests at the top of the distribution. The model derived by Piketty and Saez (2013) —henceforth PS13— allows for different SWFs, which can be used to calibrate the optimal tax rate under different social welfare criteria. However, they opt for calibrating the optimal tax rate from the perspective of each percentile of the distribution of bequest received rather than the full social optimum under standard social welfare criteria. While their approach is informative of the main drivers of the tax and exploits heterogeneity in bequest received, it does not result in a single tax rate applicable to the entire population.

This paper presents two contributions. First, I show that different assumptions on the SWF lead to very different full social optimal inheritance tax rates due to the high concentration of bequests in the top of the distribution and the existence of positive externalities. To do so, I revisit the model of PS13 and calibrate their optimal tax formula under three different standard social welfare criteria.[1] I obtain that under a utilitarian criterion the optimal tax rate is always negative, even with fully accidental bequests. Under the responsibility and compensation criterion, the optimal tax rate is positive and very sensitive to other parameters of the model, particularly to bequest elasticity. Under a Rawlsian criterion the optimal tax rate is positive and large, solely limited by the bequest elasticity.

Second, I show that the calibration by percentile of the distribution of bequest received presented by PS13 can be extended to include heterogeneity in wealth and in labor income. I perform this analysis and obtain that the optimal tax rate for those who do not receive any bequest (70% of the population) varies significantly, from an 83.3% tax rate for the worst-off individuals to negative tax rates for those who, despite not having received any bequest, have accumulated wealth through high labor incomes. This result differs from the one obtained by PS13, in which the tax rate remains fairly constant around 50% for all zero-bequest receivers.

[1] PS13 [p.S15] write: "It would be interesting to use our estimates to compute the full social optimum implied by various SWFs ..."

2 Review of the literature

The study of optimal inheritance taxation should account for two relevant characteristics of inheritance taxation. This section presents an overview of how they have been addressed in the literature. The first characteristic is the bequest motive, that is, the motivation for the donor to leave a bequest. With *altruistic* motives donors care about the lifetime utility of their heirs and therefore internalize the effects of bequests on the donees. Under *joy of giving* motives the donors' utility function depends on the after-tax bequest left, but not on the utility of the donees, which can lead to a positive externality because donors do not internalize the effect of their actions on the donees.[2] Finally, *accidental* motives lead to unplanned bequests and in this case the tax rate has no effect on the donors' utility.[3]

A second crucial dimension for the study of optimal inheritance taxation is the assumption imposed on how individual utilities are weighted in the SWF. Frequently a utilitarian criterion is assumed. This turns out to be particularly relevant due to the high concentration of bequests on the top of the distribution and the presence of externalities of giving that increase proportionally with the amount bequeathed. Hence, even small variations in the social weight of individuals at the top of the distribution can cause significant changes in the results.

These two characteristics are unremarked in the most prominent results of the literature. For example, the model of Atkinson and Stiglitz (1976) has been extrapolated to the study of inheritance taxation reinterpreting consumption of different commodities as consumption at different points in time, and taxation of future consumption as a tax on bequests, which should be zero. This two-generation version of the model indicates an implicit joy of giving bequest motive because it is the bequests left, and not the utility of the heirs, what enters in the utility function of the first generation. The social planner of this model maximizes a utilitarian SWF.

Chamley (1986) and Judd (1985) study capital taxation using an infinite-life model, measuring social welfare from the first generation. They assume altruistic bequest motives and since it is a representative agent model, the implicit SWF is utilitarian. They conclude that the optimal tax rate is zero, however Straub and Werning (2014) have overturned this result, obtaining a positive tax rate.

Farhi and Werning (2010) extend the model of Atkinson and Stiglitz (1976) to explicitly model inheritance taxation considering two generations. The first generation of donors have joy of giving motives and starts with no wealth inequality but heterogeneous productivity, so that the inheritance received by the second generation and labor inequality are perfectly correlated. The second generation only consumes what they inherited and do not work. If the social planner (with a utilitarian SWF) only considers the utility of the first generation, the optimal tax rate is zero. However, when the utility of the second generation is included

[2] This 'externality of giving' differs from a standard atmospheric externality because it is interpersonal, requiring differentiated Pigouvian taxes.

[3] Kopczuk and Lupton (2007) estimate that over 30% of bequests are accidental.

in the social welfare the optimal inheritance tax rate becomes negative. The reason for this is that with joy of giving motives the donors do not fully internalize the positive impact of the bequest in the donees and there is a positive externality that can be internalized with a negative tax.

Cremer and Pestieau (2011) use an overlaping generations model based on Diamond (1965) and extend it to model inheritances, showing how the optimal inheritance tax rate depends on the bequest motives. If bequests are fully accidental, a tax rate of 100% is optimal. If bequest motives are altruistic, the utility function of the representative individual fully captures the utility of next generations, and therefore coincides with the social planner's objective function. In this case, the optimal tax rate in the long run is zero. With joy of giving motives, the positive externality appears and, under a utilitarian weighting of individual's welfare across generations, the optimal tax rate is negative. However, if this positive externality is not considered in the SWF, the tax rate becomes positive. These results show the importance of bequest motives and the SWF for the optimal tax rate.

The model presented by Kopczuk (2013) extends the model of Farhi and Werning (2010), therefore assuming joy of giving motives and a utilitarian SWF, but it includes the response of bequest receivers to changes in the expected after-tax bequest. The model shows that an increase on bequests will reduce total labor supply and revenue from labor income taxes. Hence, this negative 'fiscal externality' should be counteracted with a positive tax on bequest. Kopczuk speculates that the optimal tax system might subsidize the bottom receivers while taxing the top ones.[4]

3 The model of Piketty and Saez

The model presented by PS13 contributes to the literature allowing for alternative SWFs and for a combination of bequest motives. The authors present a dynamic stochastic model with a discrete set of generations that do not overlap, with heterogeneous bequest tastes and labor productivities. There is labor augmenting economic growth at rate $G > 1$ per generation. The government has a given budgetary need E that is financed with linear taxes on labor income at rate τ_{Lt} and on capitalized bequest at rate τ_{Bt}. This revenue is then equally distributed across individuals as a lump-sum grant per individual, E_t.

Each individual, ti, lives in generation t and belongs to dynasty i. Each receives a pre-tax bequest b_{ti} that earns an exogenous gross rate of return R and at death leaves a pre-tax bequest b_{t+1i} to the next generation. There is an unequal initial distribution of bequests b_0 given exogenously. Each individual works l_{ti} hours at a pre-tax wage rate w_{ti} drawn from an arbitrary but stationary distribution, earning $y_{Lti} = w_{ti}l_{ti}$.

Individuals have a utility function $V^{ti}(c_{ti}, b, \underline{b}, l_{ti})$, increasing in consumption c_{ti}, in pre-tax bequest left b (capturing accidental motives), and in after-tax capitalized bequest

[4] For an analysis of intergenerational wealth formation and the effect of saving patterns across generations see Boserup et al. (2015)

left $\underline{b} = R \cdot b_{t+1i}(1-\tau_{Bt+1})$ (capturing joy of giving motives) and decreasing in labor l_{ti}. Note that the donor's utility function includes the after-tax capitalized bequest left but not the utility of the bequest receivers, resulting in a positive externality.[5] Individuals use their net-of-taxes lifetime resources on consumption c_{ti} and bequest left b_{t+1i}. Hence, the individual maximization problem is

$$\max_{l_{ti},\, c_{ti},\, b_{t+1i} \geq 0} V^{ti}(c_{ti}, b, \underline{b}, l_{ti}) \qquad \text{s.t.} \tag{1}$$

$$c_{ti} + b_{t+1i} = Rb_{ti}(1-\tau_{Bt}) + w_{ti}l_{ti}(1-\tau_{Lt}) + E_t$$

The utility functions V^{ti} and the wage rates w_{ti} are assumed to follow an ergodic stochastic process such that with constant tax rates τ_B and τ_L, and government revenue E, the economy converges to a unique ergodic steady-state equilibrium independent of the initial distribution of bequests b_{0i}. In equilibrium individuals maximize utility as in (1) and this results in a steady-state ergodic equilibrium distribution of bequests and earning (b_{ti}, y_{Lti}).

The steady-state SWF is defined as the sum of individual utilities weighted by Pareto weights $\omega_{ti} \geq 0$. Hence, a normative social welfare criterion must be assumed. The government must solve

$$SWF = \max_{\tau_L, \tau_B} \int_i \omega_{ti} V^{ti}(c_{ti}, b, \underline{b}, l_{ti}) \qquad \text{s.t.} \tag{2}$$

$$E = Rb_{ti}\tau_{Bt} + w_{ti}l_{ti}\tau_{Lt}$$

The derivation of the optimal tax rate on bequests τ_B takes the linear marginal tax on labor income τ_L as given. In the steady-state equilibrium the government's financial needs E will be constant ($dE = 0$) and with no government debt, the two taxes, τ_B and τ_L, will be linked to each other in order to satisfy the government's budget constrain. The optimal linear tax on bequests that maximizes steady-state social welfare is

$$\tau_B = \frac{1 - \left[1 - \frac{e_L \tau_L}{1-\tau_L}\right] \cdot \left[\frac{\bar{b}^{\text{received}}}{\bar{y}_L}(1+\hat{e}_B) + \frac{v}{R/G}\frac{\bar{b}^{\text{left}}}{\bar{y}_L}\right]}{1 + e_B - \left[1 - \frac{e_L \tau_L}{1-\tau_L}\right]\frac{\bar{b}^{\text{received}}}{\bar{y}_L}(1+\hat{e}_B)} \tag{3}$$

where ν is the share of joy of giving bequests and e_B and e_L are the long-run elasticities that capture behavioral responses of bequest flows b_t and of the aggregated labor supply in terms of earning y_{Lt} with respect to the corresponding net-of-tax rates $(1-\tau_B)$ and $(1-\tau_L)$. Because the two taxes, τ_B and τ_L, are linked to satisfy the government budget

[5] PS13 refer to these bequests as altruistic (as opposed to accidental bequests), however it corresponds to joy of giving motives, as defined above.

constraint, the elasticities capture the effect of a joint and budget-neutral change in both taxes. The elasticities are defined as

$$e_B = \frac{1-\tau_B}{b_t}\frac{db_t}{d(1-\tau_B)}\bigg|_E \qquad \text{and} \qquad e_L = \frac{1-\tau_L}{y_{Lt}}\frac{dy_{Lt}}{d(1-\tau_L)}\bigg|_E \tag{4}$$

The distributional parameters $\bar{b}^{\text{received}}$, $\bar{b}^{\text{left}}$ and $\bar{y}_L$ capture two elements. First the degree of inequality of bequest received, bequest left, and labor income for a given economy. And second, the normative weighting of the individuals in the SWF.

$$\bar{b}^{\text{received}} = \frac{\int_i g_{ti} b_{ti}}{b_t}, \qquad \bar{b}^{\text{left}} = \frac{\int_i g_{ti} b_{t+1i}}{b_{t+1}} \qquad \text{and} \qquad \bar{y}_L = \frac{\int_i g_{ti} y_{Lti}}{y_{Lt}} \tag{5}$$

The three parameters are defined as the ratios of the population average weighted by the social welfare weights g_{ti} (defined below) to the unweighted population averages. The ratios will be smaller than 1 if the social welfare weights g_{ti} put more weight on individuals that are worse-off and will be equal to 1 when these weights are equally distributed.

The social welfare weights g_{ti} (Saez and Stantcheva, 2016) are defined as each individual's marginal utility of consumption, V_c^{ti}, weighted by the Pareto weight ω_{ti} and divided by the weighted average of the marginal utility of consumption for the entire population to normalize them. They measure the social value of increasing consumption of individual *ti* by one unit relative to distributing that unit equally across all individuals.

$$g_{ti} = \frac{\omega_{ti} V_c^{ti}}{\int_j \omega_{tj} V_c^{tj}} \tag{6}$$

Calibration

The strategy followed by PS13 for the calibration of the optimal tax rate is to calibrate it for each percentile of the distribution of bequest received. In other words, they sequentially calibrate the optimal tax from the perspective of each 1% interval of the distribution of bequest received, as if the social planner only cared for those individuals. In terms of the social welfare weights g_{ti}, their approach is equivalent to recursively setting the weights of all individuals to zero except for those belonging to percentile p.[6,7]

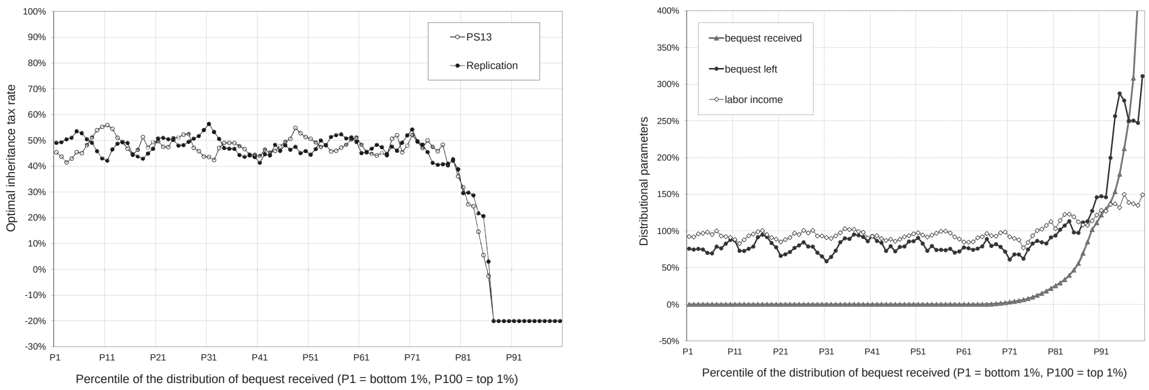
Using U.S. micro-data from the Survey of Consumer Finances (SCF) 2010 and focusing on individuals aged 70+, PS13 obtain the optimal tax rate by percentile of bequest received, which is shown in Figure 1a along with my own replication.[8] The figure reports the optimal linear tax rate τ_B from the point of view of each percentile of bequest receivers based on (3) and given the benchmark parameters $e_b = 0.2$, $e_L = 0.2$, $\tau_L = 30\%$, $\nu = 1$, $R/G = 1.8$

[6] In their own words: "To be agnostic and explore heterogeneity in optimal τ_B across the distribution, we consider percentile p-weights which concentrate uniformly the weights g_{ti} on percentile p of the distribution of *bequest received*." (PS13, p.1873).

[7] PS13 also calibrate the optimal tax rate for larger groups of de distribution of bequest received (0-50, 50-70, 70-90 and 90-95).

[8] Note that the replication for the first 70 percentiles cannot be exact because individuals are randomly assigned to each percentile, as discussed in Section 5.

and a capitalization rate $r = 3$. We observe that the optimal tax rate remains constant around 50% until percentile 70, corresponding to individuals who have not received any bequest. It then drops rapidly as the inheritance received, and presumably wealth and income, increase. For percentiles above 85 the optimal tax turns negative (a subsidy), growing to minus infinity. Note that the figure is constructed with a lower bound of -20%.



(a) Optimal linear inheritance tax rate by percentile of bequest received. Calibration of PS13 for the U.S. and replication.

(b) Distributional parameters by percentile of bequest received for the U.S. using data from SCF 2010. Own calculations.

Figure 1: Replication for the U.S. including the distributional parameters by percentile.

Figure 1b shows the three distributional parameters $\bar{b}_p^{\text{received}}$, $\bar{b}_p^{\text{left}}$, and $\bar{y}_{Lp}$ that underlie the replication of the optimal tax rate. We observe that they remain fairly constant until percentile 70, causing the constant 50% optimal tax rate for the first 70 percentiles. In Section 5, I account for heterogeneity in wealth and labor income, obtaining a different result.

4 Calibration of the Full Social Optimum

This section shows the results from calibrating the full social optimal tax rate under three standard social welfare criteria. First, the *utilitarian* criterion, which corresponds to a social planer with no preference for redistribution that weights individuals equally in the SWF, with ω_{ti} equally distributed. Second, the *responsibility and compensation criterion*, which sets the ω_{ti} to 1 for individuals who did not receive any bequests, and to zero for those who did, arguing that this source of inequality is unmerited. And third, the *Rawlsian* criterion, which has the strongest preference for redistribution, considering only the worst-off individual in the SWF, and sets the ω_{ti} to zero for all individuals except for the individual with the lowest utility.[9]

[9] PS13 calibrate the optimal tax rate under a "meritocratic Rawlsian" criterion, which is equivalent to the responsibility and compensation criterion but setting the welfare weights to zero for about half the population.

The individual utility V^{ti} enters the social welfare weights g_{ti} through the individual marginal utility of consumption V_c^{ti}. I consider first a linear utility function with marginal utility $V_c^{ti} = \alpha$.[10] And second, an isoelastic utility function with $V_c^{ti} = c_{ti}^{1-\rho}$ which is concave for $\rho > 0$.

The social welfare weights g_{ti} resulting from the different combinations of the three social welfare criteria and the two utility functions are shown in the appendix (Figure A1).[11] These welfare weights are then used to calibrate the distributional parameters of bequest received, bequest left, and labor income, which determine the full social optimal tax rate defined in (3) and presented in Table 1.

Table 1: Full social optimal tax rate under standard welfare criteria

	Utilitarian		Respons. & comp.		Rawlsian
	linear	isoelastic	linear	isoelastic	linear/isoelastic
$\bar{b}_p^{\text{received}}$	1.00	0.99	0.00	0.00	0.00
$\bar{b}_p^{\text{left}}$	1.00	0.88	0.83	0.72	0.00
$\bar{y}_{Lp}$	1.00	0.91	0.99	0.91	0.23
Optimal tax	**-582%**	**-900%**	**48.1%**	**50.0%**	**83.3%**

Source: Own calculations using survey data from the SCF 2010 // Lower bound -900%
Benchmark parameters: $e_b = 0.2$, $e_L = 0.2$, $\tau_L = 30\%$, $\nu = 1$, $R/G = 1.8$, and $\rho = 0.3$.

Under the utilitarian criterion with linear utility the welfare weights are equally distributed for all individuals and the optimal tax rate is negative. With an isoelastic utility function the welfare weights are smaller for richer individuals but the optimal tax remains negative. This negative-tax result is mostly driven by the positive externality that originates in the joy of giving motive. Note that $V^{ti}(c_{ti}, b, \underline{b}, l_{ti})$ increases with the after-tax bequest left $\underline{b}$, that is, the utility of the donors increases due to the act of bequeathing alone, regardless of its effect on the utility of the donees. In a steady-state equilibrium with a social planner that cares about the utility of all generations, this produces a positive externality and the optimal tax rate internalizes it by means of a negative tax.

Importantly, this result hinges also on the assumption of a utilitarian SWF. The reason is that the positive externality grows proportionally with bequest received and the latter is highly concentrated in the top of the distribution, leading to very large positive externalities for individuals who receive the largest bequests. Because all individuals are weighted equally by the utilitarian criterion, the positive externality present at the top of the distribution dominates the full social optimum. Therefore, when the full social optimum derived by PS13 is calibrated under a utilitarian criterion it reaches the same result as previous models who derived the optimal tax rate under joy of giving motives and utilitarian criterion (Farhi and Werning, 2010).

[10] In this case, the marginal utility of bequest left must be non-constant to obtain an interior solution.

[11] Note that under a Rawlsian criterion, the welfare weights are the same for both specifications of individual utilities, since only one individual has a positive weight.

Under the responsibility and compensation criterion, individuals who received a positive bequest (around 30%) are weighted out of the SWF and those who did not, have positive weights either equally distributed when the utility function is linear or diminishing in labor income when the utility function is isoelastic. The optimal tax rates become 48.1% and 50% respectively.

This result highlights the importance of the SWF for the optimal tax rate. By excluding individuals from the top percentiles the externality of giving disappears. The distributional parameter of bequest received, by definition, drops to zero.

The Rawlsian criterion assigns the full Pareto weight ω_{ti} to the worst-off individual and sets it to zero elsewhere. Since only one individual has a positive weight, the specification of this individuals's utility function is redundant, and therefore the welfare weights g_{ti} are identical for both the linear and the isoelastic specifications. Hence, the full social optimal tax rate under any specification of the individual's utility is the same, in this case, 83.3%. Note that even though this worse-off individual does not receive or leave any bequest, the optimal tax rate from his/her perspective is not 100% because with a positive bequest elasticity bequests would drop to zero and the revenue loss would have to be compensated with a rise in the labor income tax rate.

Variants of the benchmark case

Table 2 presents the full social optimal tax rate calibrated under different values of the benchmark parameters used in Table 1.

The first panel shows the full social optimal tax rate under different bequest elasticities, e_b.[12] Estimations by Kopczuk and Slemrod (2001) find this elasticity to be around 0.2 and PS13 consider that a value of 1 is implausibly high. However some theoretical models such as Chamley (1986) and Judd (1985) are derived under a setup where the elasticity of bequests is infinite. I therefore test the effect of higher elasticities in the optimal tax rate.

As expected, higher bequest elasticities reduce the optimal tax rate. Under the utilitarian criteria, the size of the negative tax rate increases as the elasticity rises. Under the responsibility and compensation criterion and the Rawlsian criterion the tax rate decreases with the bequest elasticity and it converges to 0% as the elasticity increases. Note that under the Rawlsian criterion with an elasticity $e_B = 0$ the optimal tax rate is 100%, since the social planner only cares for the worst-off individual and there are no efficiency costs from taxing bequests due to the zero elasticity. However, so long as the elasticity of bequests is larger than zero, the optimal tax is smaller than 100%.

The second panel of Table 2 shows the effect on the optimal tax rate of different labor supply elasticities to labor income taxes, e_L. We observe that higher labor elasticities increase the optimal tax rate on bequests. The intuition for this result is that the higher the elasticity of labor supply, the larger the efficiency loss from taxing labor income. Hence, to satisfy the government's budget constraint for a given labor income tax rate,

[12] Note that the elasticities e_b and e_L are defined with respect to the net-of-tax rates $(1 - \tau_B)$ and $(1 - \tau_L)$ and therefore take positive values.

Table 2: Variants of the benchmark full social optimum

	Utilitarian		Respons. & comp.		Rawlsian
	linear	isoelastic	linear	isoelastic	linear/isoelastic
Benchmark	**-582%**	**-900%**	**48.1%**	**50.0%**	**83.3%**
$e_B = 0$	-485%	-900%	57.7%	60.1%	100.0%
$e_B = 0.3$	-620%	-900%	44.4%	46.2%	76.9%
$e_B = 0.7$	-725%	-900%	33.9%	35.3%	58.8%
$e_B = 1$	-776%	-900%	28.8%	30.0%	49.9%
$e_B = 3$	-900%	-900%	14.4%	15.0%	24.9%
$e_B = 5$	-900%	-900%	9.6%	10.0%	16.6%
$e_B = 30$	-900%	-900%	1.8%	1.9%	3.1%
$e_L = 0.1$	-900%	-900%	46.4%	48.5%	83.3%
$e_L = 0.3$	-340%	-900%	49.7%	51.6%	83.3%
$e_L = 0.5$	-145%	-900%	53.0%	54.7%	83.3%
$\nu = 0$	-94%	-900%	83.3%	83.3%	83.3%
$\nu = 0.2$	-192%	-900%	76.3%	76.7%	83.3%
$\nu = 0.7$	-436%	-900%	58.7%	60.0%	83.3%
$\rho = 0.5$	–	-900%	–	50.4%	83.3%

Source: Own calculations using survey data from the SCF 2010 // Lower bound -900%
Benchmark parameters: $e_b = 0.2$, $e_L = 0.2$, $\tau_L = 30\%$, $\nu = 1$, $R/G = 1.8$, and $\rho = 0.3$.

a higher tax rate on bequests is needed. Under the responsibility and compensation criterion the sensitivity of the optimal tax rate to changes in e_L is moderate, and this result holds across different values of e_B. Under the Rawlsian criterion the optimal tax rate is unaffected by changes in e_L. Actually, under this criterion the only parameter that affects the optimal tax rate is the elasticity of bequest, as discussed above, because the distributional parameters of bequest received and bequest left are equal to zero and the optimal tax formula (3) is reduced to $\tau_B = \frac{1}{1+e_B}$.

The third panel shows the sensitivity of the optimal tax rate to bequest motives. As the share of accidental bequests increases (lower ν) the optimal tax rate becomes larger. This is because taxation of accidental bequests does not impact the utility of the donors since the after-tax bequests left b do not enter their utility function. Note that, for the responsibility and compensation criterion and for the Rawlsian, when bequest motives are fully accidental ($\nu = 0$), the optimal tax rate is positive but remains under 100%. This result differs from previous models, like Cremer and Pestieau (2011), in which fully accidental bequest motives are taxed at a 100% rate. The reason is that the flexibility of the model of PS13 allows for the unconventional case of fully accidental bequest motives and positive bequest elasticities. However, if the bequest elasticity is assumed zero and the bequest motives are fully accidental, the optimal tax rate becomes 100% for the three social welfare criteria. Also note that with $\nu = 0$ the optimal tax rate under the utilitarian criterion is negative despite the absence of joy of giving motives. This result is again caused by the positive bequest elasticity, which causes a negative effect of the tax in the utility of the generation of donors that adds to the negative impact on the receivers.

The fourth panel shows that increasing the concavity of the isoelastic utility function (an increase in ρ) moderately increases the optimal tax rate for the responsibility and compensation criterion since the social welfare weights decrease faster and the distributional parameters are lower.

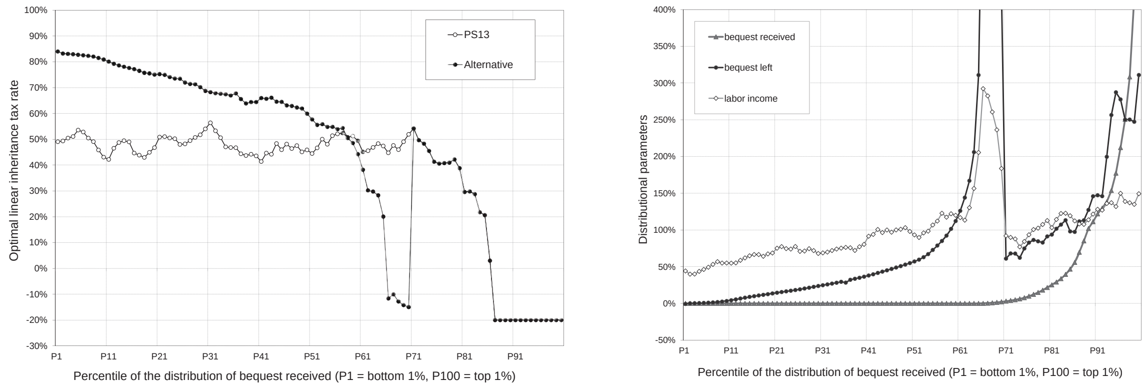
From these calibrations we conclude that the main determinant of the optimal tax rate is the social welfare criterion assumed, leading to very different tax rates. Positive full social optimal tax rates under PS13's framework appear only if wealthier individuals are weighted less in the SWF. The distributional parameters of bequest received and bequest left are the main drivers of the full social optimal tax rate. This is partly due to the social welfare weights being set as a function of bequest received, and partly to the higher inequality in both bequest received and left with respect to labor income. Finally, we observe that criteria with an intermediate preference for redistribution, such as responsibility and compensation, are the most sensitive to variations of the benchmark parameters.

5 Introducing heterogeneity in wealth and labor income

The calibration approach of PS13 exploits heterogeneity in bequests received, ordering individuals by the amount of bequest received and calculating the optimal tax rate from the perspective of each percentile. In doing so, the large share of individuals who did not receive any bequest, about 70%, are randomly assigned to each of the first 70 percentiles. These individuals differ in accumulated wealth (future bequests left) and in labor income, but since they are ordered randomly, the average value of wealth and labor income becomes approximately the same for each of the first 70 percentiles and so do the two corresponding distributional parameters and the resulting optimal tax rate. This leads PS13 to conclude that the optimal tax rate by percentile is constant for the first 70 percentiles (see Figures 1a and 1b).

In this section, I further exploit individual heterogeneity by sub-ordering individuals by their wealth and labor income. This avoids the random assignment of non-receivers to any of the 70 first percentiles, as in PS13, and offers a more realistic description of the different optimal tax rates from the perspective of each percentile and about the drivers of the optimal tax across the population of non-receivers. In a way, this approach makes each percentile more representative of the different individuals of the population, incorporating the heterogeneity present in the main variables of PS13's model. Furthermore, this calibration approach is consistent with the assumptions of the model, which explicitly include heterogeneous wealth and wages, and emphasizes the connexion among these variables (e.g. individuals accumulate wealth through labor income, which is likely to be bequeathed) and between their taxes (which must fulfill the government's budgetary needs).

The methodology followed to calculate the new distributional parameters is the same as in PS13, that is, giving uniform social welfare weights g_{ti} to all individuals within each percentile. The distributional parameters $\bar{b}^{\text{received}}$, $\bar{b}^{\text{left}}$ and $\bar{y}_L$ are then the average of bequest left, bequest received, and labor income for each percentile relative to population averages. The change with respect to PS13's calibration is that the individuals contained in each percentile are now different, as a result of the sub-ordination.



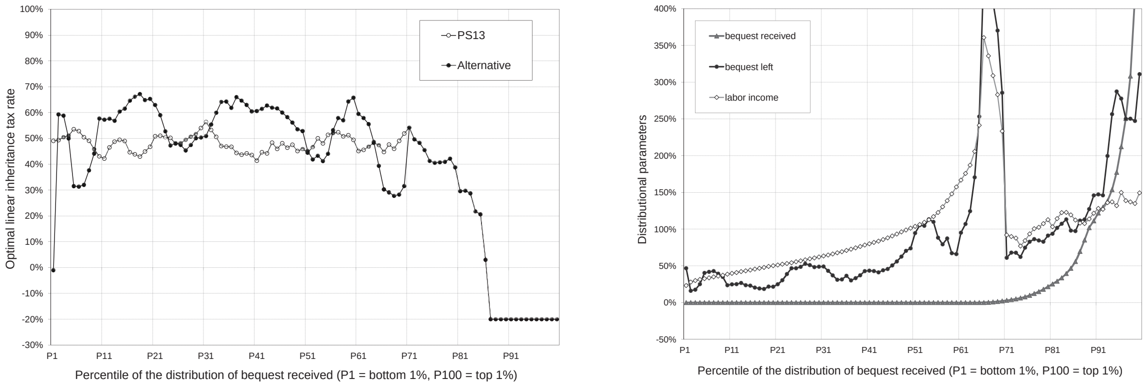
(a) Optimal inheritance tax rate by percentile of bequest received sub-ordering by wealth. Compared to PS13.

(b) Distributional parameters by percentile of bequest received sub-ordering individuals by wealth.

Figure 2: Optimal tax and distributional parameters sub-ordering by wealth.

Figures 2a and 2b show the optimal tax rate and the distributional parameters resulting from sub-ordering by wealth. Compared to the original calibrations of PS13 we observe that the optimal tax rate is not constant for the first 70 percentiles, and neither are the distributional parameters of bequest left, which by construction increases monotonically for the first 70 percentiles, and labor income. Now the optimal tax rate decreases for the first 70 percentiles, as the individuals' wealth rises. It starts with an optimal tax rate of 83.3% for the bottom 1% (coinciding with the Rawlsian full social optimum) and turns negative, to -14%, for percentiles 66 to 70. This evolution reflects the intuitive idea that those individuals who did not receive any inheritance but have accumulated wealth (which they will probably bequeath) might prefer a low or even negative inheritance tax rate. On the other hand, individuals from the bottom percentiles who own no wealth but earn labor income prefer a tax on inheritances that collects as much as possible (only bounded by the elasticity of bequests), since the remaining financial needs of the government will have to be covered by a rise in labor income taxes.

The results from sub-ordering individual observations by labor income are presented in Figure 3. In this case the distributional parameter that increases monotonically until percentile 70 is labor income. The distributional parameter of bequest left also tends to increase, but it oscillates more, causing the optimal tax rate to behave more erratically. This shows that the behavior of the distributional parameter of bequest left dominates the



(a) Optimal inheritance tax rate by percentile of bequest received sub-ordering by labor income. Compared to PS13.

(b) Distributional parameters by percentile of bequest received sub-ordering individuals by labor income.

Figure 3: Optimal tax and distributional parameters sub-ordering by labor income.

effect of labor income, as we observed when calibrating the different full social optimums.

Unlike the case where individuals were sub-ordered by bequest left, now there are no percentiles within the first 70 that would prefer a negative inheritance tax. The reason is again that the main driver of that result is the distributional parameter of bequest left but its effect is now more diluted among different percentiles due to sub-ordering by labor income. The only exemption to this is the first percentile, which has a negative tax rate caused by outlying individuals who have accumulated wealth despite not earning labor income (through prizes or reducing their reported income using capital losses). These individuals are willing to take a very high tax on labor income as long as the tax rate on bequests is reduced.

6 Conclusion

This papers shows the crucial role of the assumed SWF for the derivation of the full social optimal inheritance tax rate, with results ranging from negative to large and positive tax rates. The sensitivity of the optimal tax rate to the assumed social welfare criterion is particularly relevant for the case of inheritance taxation because it is is amplified by the existence of positive externalities originated in joy of giving motives and by the high concentration of inheritances at the top of the distribution.

Under a utilitarian criterion the optimal inheritance tax rate is negative. Therefore, this result does not differ from other theoretical models derived under the same implicit assumptions. On the other hand, under social welfare criteria that favor redistribution the tax rate becomes positive. For example, under the responsibility and compensation criterion, which weights out of the SWF the 30% of individuals who received positive bequests, the optimal tax rate is about 50%. Under this criterion, the elasticity of bequests to taxation and the share of accidental bequests become relevant for the determination of the optimal tax rate. Assuming a Rawlsian criterion that cares only about the welfare of the worst-off individual, the optimal tax rate rises to 83.3%, bounded by the elasticity of bequests to taxation.

In their paper, PS13 opt for calibrating the optimal tax rate from the perspective of each percentile of the distribution of bequests received. This approach allows them to exploit heterogeneity in bequest received among individuals, and leads the authors to conclude that the optimal tax rate by percentile remains fairly constant for the first 70 percentiles (those who do not receive any bequest). However, extending this methodology to also account for heterogeneity in wealth and in labor income, the optimal tax rate obtained for the same 70 percentiles is not constant, varying from 83% for percentile 1 to a negative tax rate of -14% for percentile 70. This new approach offers a richer description of the heterogeneous individuals of the population, in line with the assumptions of PS13's model, which introduce heterogeneous wages and wealth, and accounts for the interrelation between bequest received, bequest left, and labor income.

These results help explain the heated debate around taxation of inheritances. First, by pointing out how preferences for redistribution, captured by the SWF, are crucial for the determination of the optimal tax rate, particularly in the case of inheritance taxation. And second, by demonstrating the large variation that exists among individuals' preferred tax rate, as shown in the calibration by percentiles. From a policy perspective, these two elements should be taken into account in the design and implementation of the tax.

Future research could calibrate the full social optimum under more complex and realistic SWF that consider not only the bequest received but also labor income, wealth, sociodemographic variables, and the relationship to the deceased. It would also be interesting to evaluate other models of optimal taxation, particularly those where externalities and other market failures are present, under alternative SWFs.

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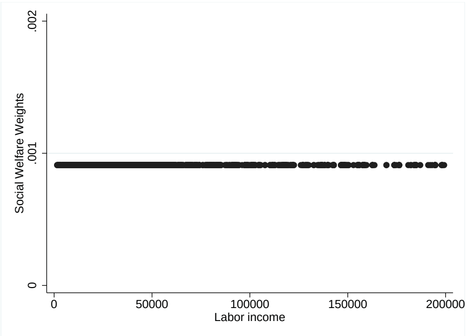
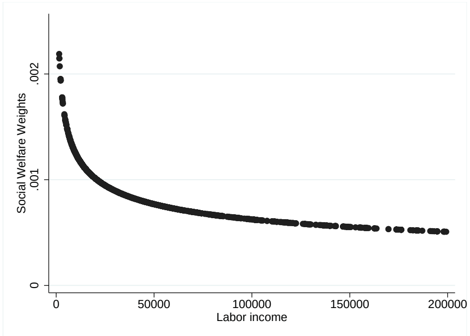
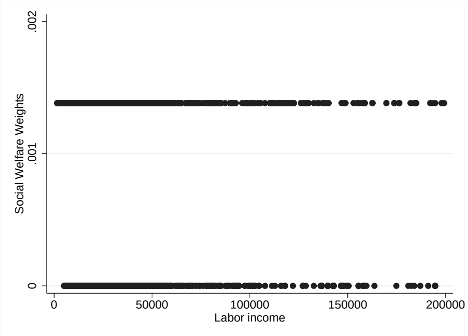
A Appendix



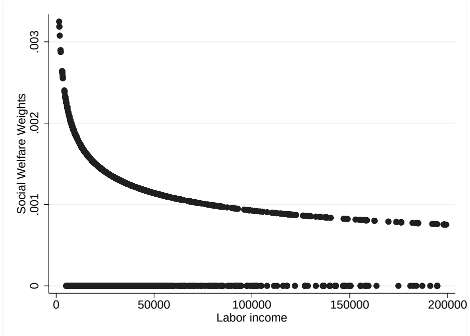
(a) Utilitarian criterion and linear utility



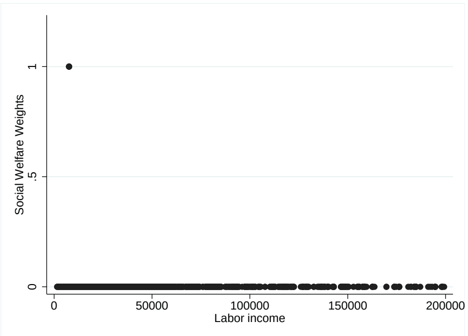
(b) Utilitarian criterion and isoelastic utility



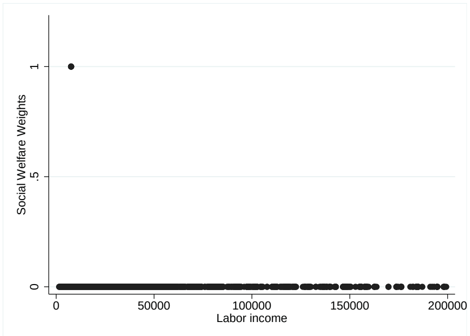
(c) Resp. and compensation criterion and linear utility



(d) Resp. and compensation criterion and isoelastic utility



(e) Rawlsian criterion and linear utility



(f) Rawlsian criterion and isoelastic utility

Figure A1: Social welfare weights under standard SWF. Own elaboration.

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