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BEQUESTS AND THE ESTATE TAX. A REVIEW OF THEORY AND (NEW) EVIDENCE.

Pieter Van Rymenant

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GHENT UNIVERSITY

Department of Economics

Faculty of Economics and Business Administration
Campus Tweekerken, St.-Pietersplein 5, 9000 Ghent - BELGIUM

Bequests and the estate tax.
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Pieter Van Rymenant – Ghent University and Research Foundation (FWO) Flanders

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ABSTRACT

This paper studies the theoretical relationship between the estate tax and the size of pre-tax bequests of (wealthy) donors: the micro elasticity of bequests. I start from the two most popular bequest motives discussed in the literature where this elasticity may be different from zero: warm glow and altruism. For both motives, I study the effects of higher estate taxation across the distribution of wealth and over the entire range of plausible parameterizations regarding preferences over consumption and bequests. I consider a linear estate tax, as well as the case of a progressive estate tax characterized by a high exemption, as in the United States today.

The first key result is that the micro elasticity of bequests exhibits several important heterogeneities across the distribution of wealth (endowments). Heterogeneous effects of estate taxation follow if bequests are modelled as a luxury good (warm glow), if the endowments of the children are significant (altruism), or if the estate tax system is progressive (warm glow and altruism). The second key result is that, for (very) wealthy donors, and under reasonable parameterizations of preferences, the micro elasticity of bequests is not typically negative and large but may well be positive.

These results indicate that there are no reasons to expect large reductions in the pre-tax bequests of (very) wealthy donors, nor to expect large disincentive effects generated by the estate tax. The extra tax revenues generated by the estate tax, by contrast, may be large.

JEL classification: E00, E21, E62, H31
Keywords: Estate tax, bequests, bequest motives, wealth distribution

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1. INTRODUCTION

Over the last four-to-five decades, the U.S. federal estate tax system has experienced a substantial increase in its exemption, a reduction in its top marginal tax rates and a gradual removal of all intermediate tax brackets. As a result, the number of taxable estates decreased dramatically over time. One of the main motivations behind these reforms was the belief that the estate tax (considerably) reduces the size of pre-tax bequests of wealthy and productive households, and hence generates important disincentives earlier in life: reduced labor supply, entrepreneurship, and wealth accumulation.[1,2] Through these behavioral adjustments by (future) donors of taxable bequests, the estate tax may reduce aggregate wealth, aggregate private capital, aggregate labor supply, aggregate economic activity, and aggregate welfare.

Given the concerns about potential negative effects of the estate tax, a large literature has attempted to uncover the true motive(s) behind bequests and the extent to which pre-tax bequests respond to the estate tax, see literature section. The typical starting point in this strand was that the macroeconomic, distributional, and welfare implications of the estate tax critically hinge upon the motivation behind bequests, and whether donors value pre-tax or after-tax bequests.[3] Within this strand, a handful of empirical studies therefore attempted to find out whether, and to what extent, wealthy donors directly respond to the estate tax. Their findings are rather tentative, however. The pre-tax bequests of wealthy donors appear to be somewhat responsive to the estate tax, and the micro elasticity of bequests is most likely negative. Unfortunately, these estimates were generally imprecise because of important identification issues, see Kopczuk and Slemrod (2000), Joulfaian and McGarry (2004), Joulfaian (2006) and Section 2 of this paper. One of the main explanations for these identification issues is that the behavioral response by (future) donors of taxable bequests may be very complex. The present consensus in the literature is that i) bequests are the result of a very long and complex process of wealth accumulation, ii) bequests are most likely driven by a mix of pre-tax and after-tax motives, which are very difficult to disentangle, and iii) bequest motives and lifecycle motives overlap to a large extent. I refer to e.g., Dynan et al. (2002, 2004), Kopecky and Koreshkova (2014), Capatina (2015) and Kopczuk (2007, 2013, 2016).

[1] For now, I define 'wealthy donors' as those households who have pre-tax bequests that are subject to the estate tax. Over the last century in the United States, the estate tax was typically paid by at most 6% of households, hence the focus on the wealthy. Today, less than 0.2% of households pay the estate tax. In the analysis in Section 3, I will define different groups of households based on wealth including 'the wealthy' and 'the very wealthy'.

[2] These estate tax cuts over the last decades were all part of broader tax reforms aimed at, among other objectives, reducing the overall tax burden on households, and boosting labor supply and economic activity, see Gale and Slemrod (2000), Jacobsen et al. (2007) and Public Law (1981 to 2017).

[3] The most popular pre-tax bequest motive is the capitalistic motive, where the stock of pre-tax bequests (or wealth) enters the utility function of donors, see Carroll (1998). The estate tax has then no effect on pre-tax bequests by construction. The two most popular after-tax bequest motives are warm glow (where the stock of bequests after estate tax enters the utility function) and altruism (where characteristics of the recipients enter the utility function of donors). With an after-tax bequest motive, the pre-tax bequests of (wealthy) donors may respond directly to the estate tax, depending on the parameterization of preferences.

In the meantime, the macroeconomic, distributional and welfare effects of the estate tax were also studied in a large strand of theoretical papers. In these studies, as I show in Section 2 of this paper, there is a variety of bequest motives, and a variety of parameterizations of preferences over consumption and bequests. Given the uncertainty surrounding the true nature of bequests and the relationship with the estate tax, this is somewhat unsurprising. However, as I will show in Section 3, this variety of parameterizations of preferences also leads to a variety of assumptions about the relationship between the estate tax and the size of pre-tax bequests, even among theoretical studies that use the same bequest motive and are calibrated to the same country (the United States). This may also produce a variety of findings regarding the effects of higher estate taxation. The focus in these theoretical studies was mainly on the circumstances or conditions under which estate taxation has a larger positive or negative effect on macroeconomic variables, (wealth) inequality, and welfare, and not on the (direct) influence of the parameterization of preferences.

As a first contribution of this paper, I provide an overview of how the relationship between the estate tax and the size of pre-tax bequests was modelled in previous theoretical studies. I show that the assumed micro elasticities vary a lot. Most theoretical papers that study the welfare implications of the estate tax (un)intentionally assumed a zero or negative micro elasticity of bequests. The conclusion in these studies is very often that the estate tax negatively affects welfare, albeit at varying degrees depending on other mechanisms. By contrast, most theoretical studies that focused on the distributional or macroeconomic implications of the estate tax explicitly allowed for a (strong) positive elasticity. Interestingly, these studies typically report small (positive or negative) effects of higher estate taxation on aggregate distributional and macroeconomic measures such as aggregate pre-tax bequests and wealth, aggregate labor supply, aggregate economic activity, and the cross-sectional distributions of (before estate tax) bequests and wealth. The wide variety of imposed values for the micro elasticity of bequests is in contrast with the key findings from empirical studies, namely that the effects of higher estate taxation on wealthy donors' pre-tax bequests and wealth accumulation are most probably small.

The second contribution is that I study the theoretical effects of higher estate taxation on pre-tax bequests provided by (wealthy) donors over the entire range of reasonable parameterizations of preferences over consumption and bequests, and across the distribution of wealth (endowments). I do this for the two most popular after-tax bequest motives: warm glow and altruism. Under the most plausible parameterizations of preferences over consumption and bequests, the micro elasticity of bequests is *not* typically negative and large but may well be positive (and weak) for very wealthy donors. This result applies both to warm glow and altruism. It holds under a linear estate tax system as well as under a progressive estate tax system with a high exemption. By studying the entire range of reasonable parameterizations, I can assess the importance of each of the (preference) parameters that govern the micro elasticity of bequests.

The third contribution is that I show several important heterogeneities in the relationship between the estate tax and the size of pre-tax bequests across the distribution of wealth (endowments). The previous literature has typically assumed, or attempted to estimate, a unique micro elasticity of bequests. I show that this elasticity is not homogeneous, but heterogeneous

across the distribution of wealth. These heterogeneities do not require heterogeneity in the underlying bequest motive: they appear even if all households have the same preferences. They directly follow from heterogeneities in endowments if bequests are modelled as a luxury good (warm glow), if the endowments of the children are significant (altruism), or if the estate tax is progressive (warm glow and altruism). Under the most plausible parameterizations of preferences and under both bequest motives, a given increase in the marginal estate tax rate typically leads to a mix of positive and negative effects on pre-tax bequests across the distribution.

The findings in this paper are in contrast with the common view in policy making and in a large strand of the literature that i) the micro elasticity of bequests is homogeneous, ii) the estate tax (considerably) reduces the pre-tax bequests of wealthy donors, and iii) that the macroeconomic implications of the estate tax critically hinge upon whether households value pre-tax or after-tax bequests. According to my results, negative effects on pre-tax bequests and hence potential disincentives earlier in life are unlikely for the very wealthy. More negative effects of higher estate taxation may occur, but only at lower wealth levels. Given the weak (positive) micro elasticity of bequests at the top of the wealth distribution, and given the strong concentration of bequests and wealth, the effects of higher estate taxation in the cases of warm glow and altruism may not be substantially different from the case of a capitalistic bequest motive and/or accidental bequests only. The additional tax revenues generated by higher estate taxation may be large. My results therefore suggest that the economic case for higher estate taxation is strong, even under the extreme circumstances where all households value after-tax bequests only. I argue that the key results in this paper are not inconsistent with any of the previous empirical findings regarding the micro elasticity of bequests. Heterogeneities in the relationship between the estate tax and the size of pre-tax bequests across the wealth distribution may even be an additional explanation behind the identification issues faced by previous empirical studies.

The focus in this paper is on the United States for several reasons. First, there are only few empirical studies on the effects of the estate tax, most of them concern the United States. Second, theoretical studies are plentiful for the United States, but not for other countries. Third, the case of the United States is particularly interesting because the estate tax exemption has increased dramatically over the last decades. As I show in this paper, a high exemption leads to important heterogeneities in the micro elasticity of bequests across the distribution of wealth. The main results in this paper are nevertheless extendable to other countries.

The paper is organized as follows. Section 2 provides an overview of the previous empirical and theoretical literature regarding the different bequest motives and the effects of estate taxation. In Section 3 I present a simple theoretical model to study the relationship between the estate tax and the size of pre-tax bequests of (wealthy) donors. In Section 3.2 I study the case of warm glow. In Section 3.3 I study the case of altruism. Section 4 concludes the paper.

2. RELATED LITERATURE

We can broadly subdivide the previous literature regarding the effects of estate taxation into two strands. The first strand tried to empirically uncover the true motive(s) behind bequests, and the extent to which pre-tax bequests respond to the estate tax. Within this strand, the common view is that the underlying bequest motive determines the extent to which bequests respond to the estate tax. Studying the relationship between the estate tax and the size of pre-tax bequests was therefore considered as a tool to discover the true motive behind bequests. I refer to section 2.1. The second strand in the literature studied the estate tax in theoretical (calibrated, dynamic, lifecycle) models in which preferences over consumption and bequests including the bequest motive, and their parameterizations, were taken as given. I focus on those studies that assumed a warm glow or an altruistic bequest motive.[4] In section 2.2, I provide an overview of the central findings in these studies about the effects of the estate tax, together with the underlying assumptions that matter for the micro elasticity of bequests.

2.1 Bequest motives and empirical studies regarding the effects of estate taxation

There has been a very long historical discussion in the economic literature regarding the true nature of bequests. I will not review this literature. After all, the present consensus is that bequests are most likely driven by a mix of pre-tax considerations (accidental, capitalistic, charitable) and after-tax motives (warm glow, altruism, exchange/strategic). Bequests appear to be a luxury good, and there may even be considerable heterogeneity in bequest motives across the wealth distribution. Furthermore, the different pre-tax and after-tax bequest motives and lifecycle motives behind wealth overlap to a very large extent and are hence very difficult to disentangle. I refer to Becker and Tomes (1979), Bernheim et al. (1985), Abel and Warshawsky (1988), Andreoni (1989), Laitner and Juster (1996), Carroll (1998), Dynan et al. (2002, 2004), Light and McGarry (2004), Kopczuk and Lupton (2007), Ameriks et al. (2011), Kopczuk (2010, 2013, 2016), De Nardi and Yang (2016), Lockwood (2018) and Bastani and Waldenström (2020).

The pre-tax bequests and wealth of wealthy donors appear to be somewhat responsive to the estate tax. Joulfaian (2006) uses United States' federal estate tax revenue data between 1951 and 2001 to estimate the behavioral response of taxable (pre-tax) bequests to estate taxation by using an equivalent income tax rate on the return to wealth 10 years before death.[5] He finds that a one percentage point increase in the equivalent tax rate reduces the taxable estate by 0.094 percent. However, when this equivalent tax rate is replaced by the marginal estate tax at death itself, the elasticity takes a positive value of 0.11 with a standard error of 0.19. Kopczuk and Slemrod (2000) use United States' estate tax returns between 1916 and 1996 to study the effects

[4] I do not consider previous theoretical studies that assumed accidental bequests and/or a capitalistic bequest motive only, since the micro elasticity of bequests is then zero by construction. Warm glow and altruism are the two most common after-tax bequest motives used in theoretical studies.

[5] The yearly equivalent income tax is calculated such that the individual is indifferent between the true estate tax that applies to bequests at death and a yearly equivalent income tax rate that keeps the size of after-tax bequests unaffected, under the assumption of a warm glow bequest motive.

of the estate tax on the reported taxable bequests of wealthy donors and report an elasticity of -0.16. This relationship, however, is also very sensitive to the set of instruments to capture exogenous variation in the estate tax. Moreover, the analysis does not consider several relevant changes in the tax system, such as the unification of the estate and gift tax system around 1980, and the evolution over time of inheritance taxes at the state level. Holtz-Eakin and Marples (2001) estimate the effects of estate taxation on the wealth of the living population in the United States. They rely on cross-sectional variation in state-level inheritance taxation and effective estate tax rates.[6] Their sample, however, does not include the super-rich. They find elasticities of wealth with respect to the estate tax also in the order of -0.2 and -0.1. A more recent empirical study, for France, also shows small responses in taxable bequests and wealth. Goupille-Lebret and Infante (2018) use bunching and difference-in-difference methods to directly estimate the behavioral effects during life with respect to the estate tax. They show that retired households show considerable procrastination in tax planning, which is inconsistent with the assumption of forward looking and rational households and can only be explained by myopia or a 'denial of death'. For households closer to death, they find some (small) negative responses in wealth.

An important remark concerning these empirical studies is that, unfortunately, neither was able to develop a fully convincing empirical strategy to estimate the effects of the estate tax on pre-tax (taxable) bequests, let alone wealth accumulation earlier in life, because of several important identification issues. I refer to recent reviews by Kopczuk (2013, 2017), Bastani and Waldenström (2020) and OECD (2021). The main structural issues are that death occurs only once while wealth accumulates over many years, in which households experience different tax regimes and may form expectation about future estate taxes, which do not necessarily coincide with the true estate tax regime at death. Moreover, over the last century in the United States, there have been numerous changes in estate tax brackets, in marginal tax rates, and in several important tax rules that matter for the calculation of effective estate tax rates over time, see e.g., Jacobsen et al. (2007), Kaymak and Poschke (2016) and Van Rymenant et al. (2022). Also, bequests are most likely the result of a complex mix of pre-tax and after-tax motives, which overlap to a large extent, and there may even be heterogeneity in bequest motives across the wealth distribution.

Up until today, not much is known about the exact sign and magnitude of the effects of estate taxation. Existing empirical work suggests that the effects on pre-tax bequests are most likely weak. Identification issues, the lack of account for changes in the estate tax system, or the lack of data for the very wealthy, make strong conclusions impossible, however. Wealth and bequests are most likely driven by a complex mix of pre-tax and after-tax motives. The findings from the first strand of the literature are thus rather cautious. This stands in sharp contrast with the overall approach in theoretical studies on the estate tax, in which there is a wide variety of assumptions regarding the micro elasticity of bequests, allowing for very strong positive or negative effects of higher estate taxation on pre-tax bequests. I review these theoretical studies in Section 2.2.

[6] State-level estate or inheritance taxes only apply in 18 states of the United States. The exemptions range between USD 1M and USD 7M and the top marginal tax rates vary between 12% and 20%, see McNichol and Waxman (2021).

2.2 Theoretical studies regarding the estate tax

Numerous papers have studied the estate tax in theoretical models under warm glow or altruism. About half of them study the effects of the estate tax in the context of welfare and optimal policy, most of whom use relatively small theoretical lifecycle models. The other half focusses on the macroeconomic or distributional effects of the estate tax, typically in more advanced (dynamic, calibrated, lifecycle) models. I focus on this broad literature for several reasons. First, I want to provide a complete overview of how the micro elasticity of bequests was modelled in previous theoretical studies. All these studies had to make an assumption regarding the relationship between the estate tax and pre-tax bequests, even though their focus is not on that relationship per se. Second, as I will show in this paper, through their parameterization, many studies have (un)intentionally assumed a very strong positive or negative micro elasticity of bequests.

Tables 1a (warm glow) and 1b (altruism) provide an overview of this literature. The second columns show the parameterization of preferences over consumption and bequests. The third columns describe the estate tax system under consideration: linear or progressive. The final columns show the main findings regarding the effects of higher estate taxation highlighted by these studies. In the fourth columns in Tables 1a and 1b, I provide an overview of the micro elasticity of bequests implied by the combination of assumptions in the second and third columns in these studies. The fourth columns are not findings from the different studies in Tables 1a and 1b, but additional information based on the results from Section 3 of this paper.

Tables 1a and 1b show that the assumptions regarding the micro elasticity of bequests vary a lot, even among papers that assume the same bequest motive. Most studies that focus on welfare and optimal policy assumed a negative or neutral relationship. Either this is a direct result from explicitly imposing a negative micro elasticity of bequests (while keeping the functional form of utility unspecified), or this implicitly follows from assuming Cobb-Douglas utility, or the combination of iso-elastic utility with a coefficient of relative risk aversion below or at unity.[7] By contrast, most studies that focus on the distributional and/or macroeconomic effects of the estate tax typically impose coefficients of relative risk aversion (well) above unity. This allows for a (strong) positive microeconomic relationship between the estate tax and the size of pre-tax bequests. Interestingly, these studies typically find that higher estate taxation leads to very small (positive or negative) effects on key aggregate macroeconomic variables. I refer to the final columns of Tables 1a and 1b.

[7] A coefficient of relative risk aversion equal to unity does not guarantee a neutral relationship between the estate tax and the taxable bequests of wealthy donors. As I will show in sections 3.2 and 3.3, there are many circumstances under which $\omega = 1$ (warm glow) and $\rho = 1$ (altruism) leads to strictly negative effects of higher estate taxation on the size of taxable bequests for many households.

Table 1a: Overview of previous theoretical studies on the estate tax – **Warm glow**

Source	Utility from consumption and bequests	Estate tax system	Micro elasticity of bequests	Overall effects of higher estate taxation
Studies that focus on welfare/optimal estate taxation:				
Michel and Pestieau (2001)	Logarithmic ($\omega = \rho = 1$), cB = 0 Bequests are a normal good	Linear	Zero by construction	The desirability of the estate tax depends on the labor supply elasticity, on the level of aggregate capital accumulation, and on extent to which the utility from bequests is accounted for in the social planner's utility function.
Garriga and Sánchez-Losada (2009)	Cobb-Douglas, cB = 0, Bequests are a normal good	Progressive	Zero by construction	The optimal estate tax is progressive with negative marginal tax rates ranging from -0.80 for the low skilled to -0.40 for the high-skilled. The estate tax poses a trade-off between minimizing distortions and eliminating external effects.
Brunner and Pech (2012b)	Unspecified	Linear	Zero by construction	The overall effect on social welfare is ambiguous, because the estate tax is distortionary, and its optimal level depends on heterogeneities in inherited wealth and on whether labor supply is endogenous.
Broadway and Cuff (2015)	Inverted U-shaped	Linear	Ambiguous	The optimal estate tax depends on the social weight given to donor benefits and on the share of donors of a given skill type.
Studies that focus on wealth inequality:				
Bossmann et al. (2007)	Cobb-Douglas, cB = 0 Bequests are a normal good	Linear	Zero by construction	A higher estate tax with the revenues distributed in a lump-sum fashion will decrease the coefficient of variation of wealth.
Benhabib, Bisin and Zhu (2011)	Iso-elastic with $\omega = \rho = 2$, cB = 0 Bequests are a normal good	Linear	Zero by construction	The estate tax considerably reduces wealth inequality by reducing the capital income risk.
Van Rymenant et al. (2022a)	Iso-elastic with $\omega = 0.75$, $\rho = 1.5$, cB = 0, bequests are a luxury good	Progressive	Heterogeneous	Higher estate taxation strongly reduces after-tax wealth inequality and concentration.
Studies that focus on the macroeconomic effects (wealth, labor, and output):				
Kopczuk and Slemrod (2000a)	Iso-elastic with $\omega = 1$, $\rho = 2$, cB = 0, bequests are a luxury good	Linear	Zero by construction	The sign of the effects on (aggregate) pre-tax bequests and wealth are ambiguous because recipients of bequests may also respond, and because of substitution and price effects related to the estate tax, faced by donors.
Heer (2001)	Iso-elastic with $\omega = \rho = 2$, cB ≥ 0 Bequests are a luxury/normal good	Linear	Overall positive, but heterogeous	Positive effects on aggregate pre-tax bequests. A higher estate tax first leads to a reduction in the capital-output ratio, but for higher levels of the estate tax the capital-output ratio increases.
Johnson and Joulfaian (2007)	Iso-elastic with $\omega = \rho = 2.86$, cB = 0, bequests are a normal good	Linear Progressive	Positive	Positive effects on aggregate wealth and capital, both in case of a linear and progressive estate tax system. Future recipients of taxable bequests accumulate more own wealth as they anticipate lower after-tax bequests received.
De Nardi and Yang (2016)	Iso-elastic with $\omega = \rho = 1.5$, cB > 0 Bequests are a luxury good	Progressive	Positive	A higher marginal estate tax rate first reduces and then increases aggregate capital and output. All these effects are small. The rich increasingly keep up pre-tax bequests to avoid too large reductions in after-tax bequests.
Wan and Zhu (2019)	Iso-elastic with $\omega = \rho = 2$, cB = 0 Bequests are a normal good	Linear	Positive	Positive but small effects on the aggregate capital stock, and negative effects on the wealth Gini.
Van Rymenant et al. (2022a)	Iso-elastic with $\omega = 0.75$, $\rho = 1.5$, cB = 0, bequests are a luxury good	Progressive	Heterogeneous	Very small effects on the pre-tax bequests of the wealthiest donors. Very small effects on aggregate wealth, capital and per capita output.

Notes: ρ and ω indicate the coefficients of relative risk aversion related to consumption and bequests respectively. In models without uncertainty, these coincide with the elasticities of marginal utility of consumption and bequests respectively. $c_B \geq 0$ is the threshold consumption level above which the bequest motive becomes operative. If $c_B = 0$ all individuals have an operative bequest motive, see section 3.2. All studies cited in Table 1a concern (are calibrated to) the United States.

Table 1b: Overview of previous theoretical studies on the estate tax – **Altruism**

Source	Utility from consumption	Estate tax system	Micro elasticity of bequests	Overall effects of higher estate taxation
Studies that focus on welfare/optimal estate taxation:				
Grüner (1995)	Cobb-Douglas	Linear	Negative, except for very wealthy donors.	Positive effect on long-run growth because a higher estate tax raises optimal investments in human capital.
Blumkin and Sadka (2003)	Logarithmic ($\rho = 1$)	Linear	Zero, but negative if the endowments of the children are positive.	The optimal estate tax depends on the relative magnitudes of the altruism parameter, the survival rate, and the degree of social discounting.
Michel and Pestieau (2005)	Unspecified, negative micro elasticity of bequests	Linear	Negative by construction	Estate taxation can be Pareto-worsening, even though the estate tax reduces income inequality.
Alonso-Carrera et al. (2008)	Unspecified	Linear	Unspecified	With consumption externalities and a bequest motive, the optimal policy mix consists of a positive capital income tax and a positive estate tax.
Farhi and Werning (2010)	Logarithmic ($\rho = 1$)	Progressive	Negative, except for very wealthy donors.	The optimal estate tax is progressive, but with negative marginal tax rates. The progressivity reflects mean reversion in productivity. Fortunate parents with higher productivities must face lower net-of-tax returns on bequests.
Cremer and Pestieau (2011)	Iso-elastic with $\rho < 1$	Linear	Negative	A negative relationship between the size of pre-tax bequests and the estate tax under different bequest motives.
Brunner and Pech (2012a)	Unspecified	Linear	Unspecified	Ambiguous effect because the preceding generation responds to the estate tax, but they only partially take into account the welfare of the successive generations if the altruism parameters is below one.
Piketty and Saez (2013)	Unspecified, negative or zero macro elasticity of bequests	Progressive	Negative or zero by construction	The optimal estate tax is progressive, positive, and large if the elasticity of pre-tax bequest with respect to the tax rate is small, if bequests concentration is high, and if the welfare weights on those who receive small bequests are high.
Strawczynski (2014)	Logarithmic ($\rho = 1$)	Progressive	Negative, except for very wealthy donors.	The optimal estate tax is positive, large, and progressive, with a positive exemption level (that directly follows from the indivisibility of education).
Belan et al. (2018)	Logarithmic ($\rho = 1$)	Linear	Negative, except for very wealthy donors.	Negative effects on pre-tax bequests. If the labor supply of the children is endogenous, parents will make more time transfers and fewer bequests if the estate tax increases.
Studies that focus on wealth inequality:				
Zhu (2019)	Iso-elastic with $\rho > 1$	Linear	Positive for very wealthy donors, may be negative below the top.	Decreases wealth inequality by reducing the return to bequests. The idiosyncratic investment risk enables a more negative relationship between the size of pre-tax bequests and wealth and the estate tax.
Studies that focus on the macroeconomic effects (wealth, labor, and output):				
Gale and Perozek (2000)	Iso-elastic with $\rho = 3$	Linear	Positive for very wealthy donors, may be negative and strong below the top.	Ambiguous effect on aggregate savings and in some cases also on the size of pre-tax bequests of wealthy donors. The effects depend on whether parents can credibly commit to future bequests.
Cagetti and De Nardi (2009)	Iso-elastic with $\rho = 1.5$	Progressive	Positive for very wealthy donors, may be negative and strong below the top.	Negative but small effects on aggregate wealth and output. Negative effects occur because the estate tax revenues are used for wasteful government purchases, and because newborn entrepreneurs can now only run smaller firms. The reduction in capital further pushes up the real interest rate.
Castañeda et al. (2003)	Iso-elastic with $\rho = 1.5$	Progressive	Positive for very wealthy donors, may be negative and strong below the top.	Small effects on aggregate capital, output, and wealth inequality. Explained by the fact that the marginal estate tax only jumps from 0% to 16%, and because the demographics imply that the estate tax has a small effect on the effective after-tax return to savings.
Jiang (2010)	Iso-elastic with $\rho = 0.4$ or 2	Linear	Positive or negative	Aggregate wealth drops in response to higher estate taxation, but this negative effect is much stronger with $\rho = 0.4$ than with $\rho = 2$.
Kaymak and Poschke (2016)	Iso-elastic with $\rho = 1.1$	Progressive	Positive and small for very wealthy donors, negative and strong below the top.	Lower estate taxation leads to an decrease in the top 1% wealth share but an increase in the top 10% wealth share. They explicitly link this heterogeneity to the strong increase in the initial exemption, and to the strong reduction in the top marginal tax rate.

Notes: ρ indicates the coefficient of relative risk aversion related to consumption. In models without uncertainty, this parameter coincides with the elasticity of marginal utility of consumption. All studies cited in Table 1b concern (are calibrated to) the United States.

However, the theoretical studies in Tables 1a and 1b did not reflect on the specific role of the underlying parameterization of (preference) parameters in shaping their main findings regarding the estate tax. As shown by the final columns, the focus was mainly on the circumstances or conditions under which the estate tax reduces or increases welfare, efficiency or (wealth) inequality, and on other mechanisms that matter for the macroeconomic, distributional, and/or welfare implications of the estate tax. Only a handful of studies highlighted the theoretical role of the coefficient of relative risk aversion (or the elasticity of marginal utility) of consumption and bequests. However, they have not specifically linked their results to their choices for the preference parameters. I refer to Gale and Perozek (2000), Johnson and Joulfaian (2007) and Kaymak and Poschke (2016).

In this paper I specifically study the theoretical relationship between the estate tax and the size of pre-tax bequests, and the role of the underlying (preference) parameters. In Section 3, I study the elasticity of pre-tax bequests with respect to the (marginal) estate tax rate over the entire range of plausible parameterizations of preferences over consumption and bequests. I show that the wide variety of parameterizations of preferences in the previous literature and the progressivity of the estate tax system leads to a wide variety of micro elasticities of bequests.

I hereby also discover several important heterogeneities in the micro elasticity of bequests, which directly follow from heterogeneities in endowments when bequests are a luxury good (warm glow), when the endowments of the children are significant (altruism), or when the estate tax is progressive (warm glow and altruism). These heterogeneities have only been partially explored in the previous literature. Most studies assumed that bequests are a normal good. Only few studies modeled bequests as a luxury good: Kopczuk and Slemrod (2000), Heer (2001), De Nardi and Yang (2016) and Van Rymenant et al. (2022). Furthermore, most previous studies assume a linear estate tax system, see Tables 1a and 1b. I show that going from a linear estate tax to a progressive estate tax system leads to important heterogeneities, especially when the estate tax exemption is high. Those papers that also studied a progressive estate tax system, a minority, consider a relatively low exemption. Two exceptions are Kaymak and Poschke (2016) and Van Rymenant et al. (2022).[8] Finally, none of the studies in Table 1b explored the heterogeneities that follow from differences in endowments of the children.

[8] Contributions with respect to these studies are that I consider the entire range of plausible parameterizations regarding preferences over consumption and bequests, for warm glow and altruism, and that I highlight the heterogeneities that follow from modeling a high estate tax exemption.

3. BEQUEST MOTIVES AND THEORETICAL EFFECTS OF HIGHER ESTATE TAXATION

In this section, I study the micro elasticity of bequests across a hypothetical distribution of endowments. I do this over the entire range of plausible parameterizations of preferences over consumption and bequests. In section 3.2, I study the case of warm glow. I consider the case where bequests are a normal good, and the case where bequests are a luxury good. In section 3.3 I study the case of altruism. I study the micro elasticity of bequests across the distribution of parents' and children's endowments. For both bequest motives, I study the case of a linear estate tax, as well as the case of a progressive estate tax system with a high exemption, as in the United States today. I start with highlighting some key equations in Section 3.1.

3.1 Some central equations

I restrict the analyses to individuals who are in their final period of life. Individuals face a mortality rate equal to unity. I discuss this assumption at the end of section 3.2.4. Let E_i be the endowments of individual i at the start of the final period of life. Let us denote by c_i the flow of final-period consumption expenditures, and by Ω_i the stock of pre-tax wealth and hence pre-tax bequests at the end of this final period. The final-period budget constraint of individual i is:

$$c_i + \Omega_i = E_i \tag{1}$$

I assume that the endowments E_i are exogenous. E_i can be interpreted as a mix of exogenous final-period income and initial wealth including previously inherited wealth. I abstract from negative bequests: $\Omega_i \geq 0$ for all individuals i.

In sections 3.2 and 3.3 I consider two types of estate tax systems: linear and progressive. Let A denote the estate tax exemption and τ the marginal estate tax rate. In the cases where I consider a progressive estate tax system, A is equal to USD 11.7M, as in the United States today. The focus is then on those individuals with Ω_i (well) above A. Their average estate tax rate, denoted by $\bar{\tau}_i$, depends on Ω_i, A and τ.

$$\bar{\tau}_i(\Omega_i, A, \tau) = \frac{(\Omega_i - A)\tau}{\Omega_i} \tag{2}$$

Equation (2) shows that the average estate tax rate $\bar{\tau}_i$ may be considerably below the marginal estate tax rate τ, especially if A is high, and for individuals with Ω_i above but relatively close to A. In the case of a linear estate tax system, I set $A = 0$. The average and marginal estate tax rates then coincide: $\bar{\tau}_i = \tau$.

Total estate taxes due are $\bar{\tau}_i \Omega_i$, and the after-estate tax bequest B_i left by individual i is:

$$B_i = \Omega_i (1 - \bar{\tau}_i) \tag{3}$$

I assume a hypothetical distribution of endowments E_i. The poorest individual in the analysis has initial endowments of USD 10.000. This is way below the baseline exemption of USD 11.7M, but somewhere at the lower side of the reasonable range for the yearly consumption threshold at which the bequest motive becomes operative (c_B, see section 3.2). The endowments of individual $i + 1$ are always 1.25 times the endowments of individual i. I consider 51 different individuals in terms of E_i. The wealthiest individual in the analysis is a multi-millionaire with endowments of around USD 700M (i.e., 10.000 USD multiplied by 1.25 to the power 50). Individuals at the top of the distribution have endowments that are way above the exemption of USD 11.7M. In between, the hypothetical distribution also explicitly considers those individuals with endowments that result in Ω_i above but relatively close to A.

I restrict the analyses in sections 3.2 and 3.3 to iso-elastic preferences over consumption. This functional form is the most common in previous studies regarding the estate tax, and allows for a positive, neutral, or negative relationship between the estate tax and taxable bequests, see below. With c_i the flow of final-period consumption expenditures, and ρ the elasticity of marginal utility of consumption, utility from final-period consumption of individual i is:[9]

$$U_i(c_i) = \frac{{c_i}^{1-\rho} - 1}{1 - \rho} \tag{4}$$

3.2 Warm glow

Under warm glow, individuals derive utility directly from the after-tax bequests left: $B_i = \Omega_i (1 - \bar{\tau}_i)$. I start from the broadest functional form for utility from bequests used in the literature proposed by Lockwood (2018):

$$V_i(B_i) = \left(\frac{\phi}{1-\phi}\right)^{\omega} \frac{\left(\frac{\phi}{1-\phi} c_B + B_i\right)^{1-\omega} - 1}{1 - \omega} \tag{5}$$

with $0 < \phi < 1$. This functional form nests nearly all the functional forms commonly used in the literature in the context of warm glow, including linear relationships and constant relative risk aversion specifications. Since the model in this paper has no uncertainty, ω can best be

[9] In a model without uncertainty, ρ can best be interpreted as the elasticity of marginal utility of consumption (EMUC) and not as the coefficient of relative risk aversion. In Appendix A, I show that the reasonable range of values for ρ goes from 0.9 to 2.

interpreted as the elasticity of marginal utility of bequests.[10] The parameter $c_B \geq 0$ is the yearly threshold consumption level above which the bequest motive becomes operative. The parameter ϕ is the marginal propensity to bequeath in a one-period problem of allocating an exogenous endowment between consumption and bequests for donors who have high enough endowments to consume at least c_B, see Footnote 7 in Lockwood (2018). The taste-for-bequests parameter $\phi/(1-\phi)$ governs the relative importance of bequests versus own consumption.[11] The flexible functional form of (5) allows modeling bequests as a luxury good, see section 3.2.1.

In case of warm glow, total final-period utility of individual i is given by:

$$U = U_i(c_i) + V_i(B_i) \tag{6}$$

Most studies that assumed a warm glow bequest motive set $c_B = 0$ and $\omega = \rho$, see Table 1a. The utility from bequests is then iso-elastic, and the elasticity of marginal utility of bequests is equal to that of consumption. With $c_B = 0$, all individuals have an operative bequest motive. Under these two assumptions bequests are a normal good.

3.2.1 Bequests as a luxury good

Only when bequests are modelled as a luxury good, the warm glow bequest motive generates several key features from the data: sufficiently high levels of wealth and bequests at the top of the wealth distribution, a realistic concentration of wealth and bequests, and the considerable reluctance by the wealthy to dissave at older age. I refer to e.g., De Nardi (2004), Kopczuk (2013), De Nardi and Yang (2016) and Lockwood (2018). Given the preferences described by Equations (4) to (6), bequests turn into a luxury good whenever $c_B > 0$ or $\omega < \rho$.

Only a handful of studies on the estate tax have modelled bequests as a luxury good. De Nardi (2004), De Nardi and Yang (2016), Yang and Gan (2020) and Lockwood (2018) set $c_B > 0$ and $\omega = \rho$. Kopczuk and Slemrod (2000) and Van Rymenant et al. (2022) set $c_B = 0$ and $\omega < \rho$. The combination of $c_B > 0$ and $\omega < \rho$ may also hold. To keep the analysis in this paper as general as possible, I study the case where bequests are a normal good, as well as all the combinations of c_B, ω and ρ where bequests are a luxury good, see below.

3.2.2 Optimal bequests in the case of warm glow

In this section I study the optimal relationship between pre-tax bequests Ω_i and the estate tax parameters τ and A across the hypothetical distribution of endowments E_i. I start from the most general case of warm glow: Equation (5), which allows for all combinations of $c_B \geq 0$ and $\omega \leq \rho$.

[10] I also refer to Appendix A for a discussion on the reasonable range for this parameter.
[11] I will later denote the taste-for-bequests parameter $\phi/(1-\phi)$ by b.

Given the budget constraint (1) and given the preferences over consumption and bequests described by Equations (4) to (6), optimal behavior of individual i requires that the total derivative of U with respect to c_i equals zero. The marginal utility of own final-period consumption expenditures must be equal to the marginal utility of saving and bequeathing the same amount, considering the relative price of bequests versus consumption:

$$\frac{dU}{dc_i} = 0$$

$\Leftrightarrow$

$$U_i'(c_i) + V_i'(B_i)\frac{\partial B_i}{\partial \Omega_i}\frac{\partial \Omega_i}{\partial c_i} = 0$$

Using Equations (4) and (5), and defining the taste-for-bequests parameter $b = \phi/(1-\phi)$, we obtain:

$$\frac{1}{{c_i}^{\rho}} + \frac{b^{\omega}}{(bc_B + B_i)^{\omega}}\frac{\partial B_i}{\partial \Omega_i}\frac{\partial \Omega_i}{\partial c_i} = 0 \tag{7}$$

To calculate the derivative of B_i with respect to Ω_i, we must consider that $\bar{\tau}_i$ in $B_i = \Omega_i(1-\bar{\tau}_i)$ is also a function of Ω_i, see Equation (2). In the cases where $A > 0$, I focus on those individuals who have endowments that imply $\Omega_i > A$. We can then substitute Equation (2) into Equation (3): $B_i = \Omega_i(1-\tau) + \tau A$. It then follows that $\partial B_i/\partial \Omega_i$ is equal to $1-\tau$. Given the budget constraint (1), we know that $\partial \Omega_i/\partial c_i$ equals -1. Using this in Equation (7), we obtain:

$$\frac{1}{{c_i}^{\rho}} = \frac{b^{\omega}(1-\tau)}{(bc_B + B_i)^{\omega}}$$

Next, using $B_i = \Omega_i(1-\bar{\tau}_i)$ in the denominator, and after rearranging, we obtain the optimal relationship between Ω_i, c_i, $\bar{\tau}_i$ and parameters:

$$\Omega_i = \frac{b\left[(1-\tau)^{1/\omega}{c_i}^{\rho/\omega} - c_B\right]}{(1-\bar{\tau}_i)}$$

Substituting out $\bar{\tau}_i$ by using Equation (2), and after rearranging, we obtain:

$$\Omega_i = \frac{b\left[(1-\tau)^{1/\omega}{c_i}^{\rho/\omega}\right]}{(1-\tau)} - \frac{bc_B}{(1-\tau)} - \frac{\tau A}{(1-\tau)} \tag{7}$$

Equation (7) describes the optimal relationship between the pre-tax bequest Ω_i, own consumption c_i, and parameters including τ and A. Note that Ω_i and c_i are both endogenous, with $c_i + \Omega_i = E_i$. To study the effects of higher estate taxation on Ω_i across the distribution of E_i, I must further solve the model to obtain an expression for Ω_i as a function only of E_i and

other parameters, including those related to the estate tax system. However, given that ω and ρ may deviate from unity, I am unable to obtain an explicit expression for Ω_i analytically.[12] To study the effects on Ω_i of various estate tax reforms involving τ and A across the distribution of E_i, and over the entire plausible range of preference parameters ω, ρ, c_B and b, I therefore numerically solve the model given by Equations (1), (2), (3) and (7), see below.

As I will also further describe below, Equation (7) is nevertheless very useful to analyze several important aspects of the relationship between Ω_i, τ and A. For instance, Equation (7) shows that the effects of τ on Ω_i are ambiguous and depend on A, ω, ρ, c_B and b. The consumption threshold c_B and the exemption A appear to have a similar influence. Both will negatively affect the relationship between τ and Ω_i. As I further show below, there are many circumstances under which higher estate taxation leads to heterogeneous effects on Ω_i across the distribution of endowments. The aim of Section 3.2 is to show how the parameters in Equation (7) affect the relationship between τ and Ω_i across E_i. To study the partial effects of each of these parameters on this relationship, I will study several numerical cases, see Section 3.2.4.

3.2.3 The reasonable range for ω, ρ, c_B and b

In Appendix A, I discuss the reasonable range for these parameters based on the previous theoretical and empirical literature. Reasonable values for the yearly consumption threshold c_B range from 3.500 USD to 112.000 USD. For ω and ρ the plausible range of values goes from 0.9 to 2, and for wealthy Americans the point estimate for ρ is 1.45. The taste-for-bequests parameter $b = \phi/(1-\phi)$ is positive and most often below 20. Its value is typically calibrated in the literature to obtain a certain outcome related to bequests, such as a realistic average level of wealth or bequests at older age, or to match the flow of bequests to private wealth ratio. The level of b therefore depends on other parameters. I refer to the literature cited in Appendix A. To keep the analysis as general as possible, in the numerical examples below I study the effects of higher estate taxation over the entire range of plausible values for each of these parameters.

3.2.4 The effects of higher estate taxation on taxable bequests: warm glow

To gain further insight in the effects of increasing τ on Ω_i, and in the specific influences of the parameters ω, ρ, c_B, b and A, I numerically solve the model described in sections 3.1 to 3.2.2 for different levels of τ, across the hypothetical distribution of E_i described in section 3.1, and over the entire plausible range for the preference parameters: ω, ρ and c_B. I study the case of a linear estate tax ($A = 0$) as well as the case of a progressive estate tax system with a very high exemption ($A = 11.7\text{M}$). I consistently calibrate the taste-for-bequests parameter b such that, in each case, the median individual (in terms of E_i) has a marginal propensity to bequeath out of additional endowments equal to 83.33% when $\tau = 0$. I target this value for two reasons. First,

[12] In the cases where $\omega = \rho$, I will further solve for Ω_i analytically. Doing so does not necessarily provide more information about the separate roles of A, ω, ρ, c_B and b than Equation (7). Even with c_i on the right-hand side of (7), we can very easily interpret the separate roles of each of the parameters for the heterogeneities in the numerical results, see below.

this value is nicely within the reasonable range reported by the literature, see Appendix A. Second, it allows easy comparison with the analysis in Section 3.3 (altruism), where it is convenient to start from that specific value. The value of b has no effects on the main findings. I always calculate the micro elasticity of bequests, denoted by $\varepsilon_{\Omega_i}^{\tau}$, as the percentage change in Ω_i relative to a one percentage point increase in τ, as in most studies. The index i reveals that this elasticity may be heterogeneous across the distribution of E_i.

I study different cases of the effects of higher estate taxation. Case 1 is the simplest case of estate taxation under warm glow: a linear estate tax ($A = 0$) and bequests modelled as a normal good ($c_B = 0$, $\omega = \rho$). In Cases 2a to 2c, the estate tax is also linear, but bequests are a luxury good. The latter can be done in three different ways, hence cases 2a ($c_B = 112.000$, $\omega = \rho$), 2b ($c_B = 0$, $\omega < \rho$) and 2c ($c_B = 112.000$, $\omega < \rho$). The value for c_B of USD 112.000 is the upper limit of its reasonable range, see Section 3.2.3. By comparing the numerical outcomes under Cases 2a, 2b and 2c with those of Case 1, we can study the partial effects on the relationship between τ and Ω_i of modeling bequests as a luxury good. In Case 3, I study the effects of higher estate taxation under a progressive estate tax system ($A = 11.700.000$), and with bequests modelled as a normal good. By comparing the outcomes under Case 3 with those of Case 1, we can study the partial effects on the relationship between τ and Ω_i of setting $A > 0$. Finally, in Case 4, I study the effects of higher estate taxation under a progressive estate tax system ($A = 11.700.000$) with bequests modelled as a luxury good ($c_B = 0$, $\omega < \rho$).[13] By comparing the outcomes under Case 4 with those of Case 2b, we can study the partial effects on the relationship between τ and Ω_i of setting $A > 0$, given that bequests are a luxury good. Table 2a provides an overview.

Table 2a: Overview of the different cases under warm glow.

	Estate tax system	**Bequest modeled as**
Case 1	Linear (A = 0)	Normal good (cB = 0, $\omega = \rho$)
Case 2a	Linear (A = 0)	Luxury good (cB = 112.000, $\omega = \rho$)
Case 2b	Linear (A = 0)	Luxury good (cB = 0, $\omega < \rho$)
Case 2c	Linear (A = 0)	Luxury good (cB = 112.000, $\omega < \rho$)
Case 3	Progressive (A = 11.700.000)	Normal good (cB = 0, $\omega = \rho$)
Case 4	Progressive (A = 11.700.000)	Luxury good (cB = 0, $\omega < \rho$)

With $c_B = 112.000$ and $A = 11.7\text{M}$, we can distinguish four groups of individuals. The first group are those who consume less than $c_B = 112.000$, denoted by 'the poor'. In those cases where $c_B = 112.000$, their optimal Ω_i is zero for all τ. The second group are those individuals who consume more than 112.000 but with levels of Ω_i below 11.7M, the 'moderately wealthy'. About two-thirds of the individuals in the hypothetical distribution have Ω_i below this level. The remaining individuals all have pre-tax bequests above 11.7M. Within this group of individuals, the absolute differences in Ω_i are large, ranging from just above 11.7M to over 600M. The third

[13] With a high initial exemption, even the highest possible value for c_B of USD 112.000 has only a negligible impact on the effects, see below. I therefore restrict the analysis to the case $c_B = 0$, $\omega < \rho$.

group are those individuals whose E_i imply $A < \Omega_i \leq 10A$ if $\tau = 0$, the 'wealthy'. Their taxable bequests are above but relatively close to 11.7M. The fourth group are those with pre-tax bequests levels way above A if $\tau = 0$, i.e., $10A < \Omega_i$, the 'very wealthy'.

Table 2b: Overview of the different types of individuals under warm glow

	Level of consumption (if τ = 0)	**Level of pre-tax bequests (if τ = 0)**
Very wealthy	Above 112.000	Above 10A = 117.000.000
Wealthy	Above 112.000	Between A = 11.700.000 and 10A = 117.000.000
Moderately wealthy	Above 112.000	Below A = 11.700.000
Poor	Below 112.000	Zero if cB = 112.000, positive if cB = 0

Case 1: Linear estate tax ($A = 0$), bequests a normal good ($c_B = 0$, $\omega = \rho$)

With $A = 0$ and $c_B = 0$ the final two terms on the right-hand side of Equation (7) vanish. With $\omega = \rho$, the power on c_i equals 1. Equation (7) becomes:

$$\Omega_i = b\left[(1-\tau)^{(1-\omega)/\omega} c_i\right] \tag{7.1}$$

The parameter ρ then no longer matters for the relationship between Ω_i, c_i and τ. We can now study the separate roles of ω and τ.

The first heterogeneity relates to the initial level of τ. In Table 3, I report the micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) across the distribution of E_i in Case 1 ($A = 0$, $c_B = 0$, $\omega = \rho$) for τ ranging from 0% to 90%, and for the plausible range of values for $\omega = \rho$, see Section 3.2.3. For all values of $\omega = \rho$, the effects become more outspoken at higher levels of τ. If $\omega = \rho > 1$, we have that the power $(1-\omega)/\omega$ in Equation (7.1) is negative. A higher τ then leads to a higher Ω_i/c_i and given $c_i + \Omega_i = E_i$ the relationship between τ and Ω_i will be positive: $\varepsilon_{\Omega_i}^{\tau} > 0$. Also, the micro elasticity of bequests becomes stronger for higher levels of the estate tax rate. With $\omega = \rho > 1$ donors increasingly keep up their pre-tax bequests to avoid too large reductions in their after-tax bequests $B_i = \Omega_i(1-\tau)$, their argument in $V_i(B_i)$. If $\omega = \rho < 1$, by contrast, $\varepsilon_{\Omega_i}^{\tau}$ is always negative. These negative effects also become more outspoken at higher levels of τ. The initial level of the estate tax rate thus matters for the effects: increasing τ from 20% to 40% has very small effects on Ω_i (even for the most extreme values of ω) but increasing τ from 60% to 80% will have much stronger effects on Ω_i (even for more central values of ω).

Table 3.1: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – warm glow. **Case 1**: Linear estate tax ($A = 0$) and bequests a normal good ($c_B = 0$ and $\omega = \rho$).

Case 1 ($A = 0, c_B = 0, \omega = \rho$)		**Elasticity of bequests at marginal estate tax rate τ:**									
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = \rho = 0.9$	All individuals	-0,02	-0,02	-0,02	-0,03	-0,03	-0,04	-0,05	-0,07	-0,11	-0,24
$\omega = \rho = 1$	All individuals	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1.45$	All individuals	0,05	0,06	0,06	0,07	0,08	0,09	0,10	0,13	0,17	0,29
$\omega = \rho = 2$	All individuals	0,08	0,09	0,10	0,10	0,11	0,12	0,14	0,17	0,21	0,31

Note: The elasticities reported in Table 3.1 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ increases from 90% to 91%, all individuals reduce their Ω_i by 0.24% if $\omega = \rho = 0.9$.

'All individuals' in the second column of Table 3.1 indicates that the effects of higher estate taxation are homogeneous across the distribution of wealth (endowments) if $A = 0$, $c_B = 0$ and $\omega = \rho$. Under these assumptions, the sign and magnitude of the effect on Ω_i only depends on ω and on the initial level of τ. The previous literature has highlighted on numerous occasions that the effects of higher estate taxation depend on ω. However, only few studies have highlighted the heterogeneity with respect to the initial level of the estate tax rate.[14] Most previous studies that also started from a warm glow bequest motive assumed logarithmic utility ($\omega = 1$) combined with $A = 0$ and $c_B = 0$, see Table 1a. Under these assumptions, the estate tax has no effect on pre-tax bequests.[15] Once we relax one of these assumptions, i.e., when we assume $\omega < \rho$ (with $\omega \neq 1$), $c_B > 0$, or $A > 0$, the effects of higher estate taxation become heterogeneous across the distribution of wealth (endowments), see below.

Case 2: Linear estate tax ($A = 0$), bequests a luxury good ($c_B > 0$ and/or $\omega < \rho$)

Modeling bequests as a luxury good has become relatively standard in theoretical studies that attempt to generate realistic concentrations of wealth and bequests, see section 3.2.1. It can be done in three different ways: ($c_B > 0$, $\omega = \rho$), ($c_B = 0$, $\omega < \rho$) and ($c_B > 0$, $\omega < \rho$). However, the separate roles of ω and ρ (when $\omega < \rho$) and c_B have not yet been explored before in previous studies on the estate tax. In Case 2a I set $c_B = 112.000$ and $\omega = \rho$. With $A = 0$, $c_B > 0$ and $\omega < \rho$, Equation (7) becomes:

$$\Omega_i = b\left[(1-\tau)^{(1-\omega)/\omega} c_i\right] - bc_B(1-\tau)^{-1} \tag{7.2a}$$

[14] The only studies that discussed this heterogeneity are Heer (2001), who considers a linear estate tax ranging from 0% to 95% under $\omega = \rho = 2$, and De Nardi and Yang (2016), who consider a progressive estate tax system with τ ranging from 0% to 60% and an exemption between USD 219.000 and USD 1.095.000, further assuming $\omega = \rho = 1.5$ and $c_B = 112.000$.

[15] With $\omega = 1$, $A = 0$ and $c_B = 0$, Equation (7) simplifies to $\Omega_i = bc_i{}^{\rho}$.

In Case 2b I set $c_B = 0$ and $\omega < \rho$. With $A = 0$, $c_B = 0$ and $\omega < \rho$, Equation (7) becomes:

$$\Omega_i = b\left[(1-\tau)^{(1-\omega)/\omega} {c_i}^{\rho/\omega}\right] \tag{7.2b}$$

Below, I discuss the separate roles of c_B and ρ for the effects of higher estate taxation.

In Case 2c the combination $c_B = 112.000$, $\omega < \rho$ holds. I show the numerical effects under these assumptions in Appendix B. The partial roles of c_B and ρ in Case 2c are similar to those in Cases 2a and 2b respectively.

The second heterogeneity follows from modeling bequests as a luxury good: $c_B > 0$ or $\omega < \rho$

I first focus on the partial role of c_B, starting from Equation (7.2a). The role of c_B is double. First, $c_B > 0$ makes the ratio Ω_i/E_i heterogeneous across the distribution of E_i. With $c_B = 112.000$, individuals with endowments that lead to $c_i \leq c_B$ have no operative bequest motive: $\Omega_i = 0$. For individuals with higher E_i and hence $c_i > c_B$, the ratio Ω_i/E_i is increasing in E_i.[16] Second, $c_B > 0$ implies an additional negative effect of τ on Ω_i, via the term $-bc_B(1-\tau)^{-1}$. The relative importance of this negative effect is, however, declining in E_i.[17] This finding is also confirmed by the numerical results in Table 3.2. The negative effect of $c_B = 112.000$ is strong mainly for individuals with consumption levels above but relatively close to this consumption threshold c_B (the 'moderately wealthy'). For them, the micro elasticity of bequests is negative, even if $\omega = \rho$ exceeds unity. The large negative elasticities at high levels of τ in Table 3.2a occur because individuals quickly reduce their pre-tax bequests.[18] For wealthier individuals (the 'wealthy' and the 'very wealthy'), the reported elasticities are virtually the same as under Case 1.[19] Modeling bequests as a luxury good by setting $c_B > 0$ leads to stronger negative (and weaker positive) effects of τ on Ω_i, albeit mainly (only) for the moderately wealthy.

[16] I consistently recalibrate the taste-for-bequests parameter b to obtain that the median individual (in terms of endowments) has a marginal propensity to bequeath of 83.33%, see first paragraph of the present section. With $c_B > 0$, I obtain a slightly higher value for b than in Case 1. The level of b has no effect on my main findings.

[17] For consumption-bequests bundles that exceed $(c_B, 0)$, both c_i and Ω_i are increasing in E_i. Consumption is then a necessary good (an income elasticity between 0 and 1) and bequests a luxury good (an income elasticity above 1). The second term on the right-hand side of (7.2a) therefore loses importance as E_i increases.

[18] Very low levels of Ω_i imply more extreme elasticities: $(\Delta\Omega_i/\Omega_i)/\Delta\tau$. Also, $\tau = 100\%$ always results in $\Omega_i = 0$.

[19] To illustrate the partial effects of modeling bequests as a luxury good by setting $c_B = 112.000$, we can compare the elasticities under Case 2a in Table 3.2a with those of Case 1 ($A = 0$, $c_B = 0$, $\omega = \rho$) in Table 3.1.

Table 3.2a: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – warm glow. **Case 2a**: Linear estate tax ($A = 0$) and bequests a luxury good ($c_B = 112.000$ and $\omega = \rho$).

Case 2a ($A = 0, c_B = 112.000, \omega = \rho$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = \rho = 0.9$	Very Wealthy	Wealthiest	-0,01	-0,02	-0,02	-0,02	-0,03	-0,03	-0,04	-0,06	-0,09	-0,22
		Bottom	-0,02	-0,02	-0,02	-0,02	-0,03	-0,03	-0,05	-0,07	-0,11	-0,31
	Wealthy	Median	-0,02	-0,02	-0,02	-0,03	-0,03	-0,04	-0,06	-0,09	-0,18	-0,62
		Bottom	-0,02	-0,03	-0,03	-0,04	-0,05	-0,07	-0,10	-0,16	-0,35	-1,44
	Moderately wealthy	Median	-0,13	-0,16	-0,21	-0,28	-0,40	-0,60	-1,03	-2,18	-7,68	0,00
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,02
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,02	-0,09
	Wealthy	Median	0,00	0,00	0,00	-0,01	-0,01	-0,01	-0,02	-0,03	-0,07	-0,30
		Bottom	-0,01	-0,01	-0,01	-0,01	-0,02	-0,03	-0,05	-0,08	-0,19	-0,85
	Moderately wealthy	Median	-0,10	-0,13	-0,17	-0,22	-0,31	-0,47	-0,78	-1,56	-4,66	-26,45
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1.45$	Very Wealthy	Wealthiest	0,04	0,04	0,05	0,05	0,06	0,07	0,08	0,10	0,13	0,21
		Bottom	0,04	0,04	0,05	0,05	0,06	0,07	0,08	0,09	0,12	0,19
	Wealthy	Median	0,04	0,04	0,04	0,05	0,05	0,06	0,07	0,08	0,10	0,12
		Bottom	0,04	0,04	0,04	0,04	0,05	0,05	0,06	0,06	0,05	-0,05
	Moderately wealthy	Median	-0,03	-0,04	-0,06	-0,08	-0,12	-0,18	-0,30	-0,55	-1,30	-6,21
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 2$	Very Wealthy	Wealthiest	0,07	0,07	0,07	0,08	0,09	0,10	0,11	0,13	0,16	0,23
		Bottom	0,06	0,07	0,07	0,08	0,09	0,09	0,11	0,12	0,15	0,22
	Wealthy	Median	0,06	0,07	0,07	0,08	0,08	0,09	0,10	0,12	0,14	0,19
		Bottom	0,06	0,06	0,07	0,07	0,08	0,09	0,09	0,10	0,12	0,11
	Moderately wealthy	Median	0,01	0,01	0,00	-0,01	-0,03	-0,06	-0,11	-0,22	-0,53	-2,04
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Note: The elasticities reported in Table 3.2a are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.22% if $\omega = \rho = 0.9$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

Starting from Equation (7.2b), I now turn to the partial role of $\omega < \rho$, which is also double. First, $\omega < \rho$ also makes the ratio Ω_i/E_i heterogeneous across E_i.[20] Second, the micro elasticity of bequests is also heterogeneous. The heterogeneities are different than in the $c_B > 0$ case, however. For the wealthy and the very wealthy, both the positive and the negative effects of higher estate taxation on Ω_i are smaller compared to the case where bequests are a normal good. The negative effects are weaker because of the high marginal utility of bequeathing: if an

[20] With $\omega < \rho$, targeting a median marginal propensity to bequeath of 83.33% results in a much lower b than in Case 1 where $\omega = \rho$.

individual were to substitute c_i for Ω_i, the high marginal utility from bequests implies that the reduction in Ω_i will be dampened. The positive effects are weaker because the initial ratios Ω_i/E_i (at $\tau = 0$) are now higher for the (very) wealthy: the scope of reducing c_i is much lower compared to the case where bequests are a normal good. For the moderately wealthy and the poor, by contrast, both the positive and the negative effects of higher estate taxation are stronger compared the case where bequests are a normal good. With $\omega < \rho$, lower E_i result in lower initial Ω_i/E_i and hence more scope to adjust Ω_i and c_i if the estate tax increases.[21] I refer to the elasticities in Table 3.2b.

Table 3.2b: Micro elasticity of bequests ($\varepsilon^{\tau}_{\Omega_i}$) for different levels of τ – warm glow. **Case 2b**: Linear estate tax ($A = 0$) and bequests a luxury good ($c_B = 0$ and $\omega < \rho$).

Case 2b ($A = 0, c_B = 0, \omega < \rho$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = 0.9$, $\rho = 1.125$	Very Wealthy	Wealthiest	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02	-0,03	-0,07
		Bottom	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,04	-0,09
	Wealthy	Median	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,03	-0,05	-0,12
		Bottom	-0,01	-0,01	-0,01	-0,02	-0,02	-0,02	-0,03	-0,04	-0,06	-0,14
	Moderately wealthy	Median	-0,02	-0,02	-0,02	-0,03	-0,03	-0,04	-0,05	-0,07	-0,10	-0,22
		Bottom	-0,03	-0,03	-0,03	-0,04	-0,05	-0,06	-0,07	-0,10	-0,15	-0,32
	Poor	Median	-0,03	-0,04	-0,04	-0,05	-0,06	-0,07	-0,09	-0,12	-0,18	-0,39
		Poorest	-0,04	-0,04	-0,05	-0,06	-0,07	-0,08	-0,10	-0,14	-0,22	-0,46
$\omega = 1$, $\rho = 1.25$	All households		zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 1.45$, $\rho = 1.8125$	Very Wealthy	Wealthiest	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,04	0,05	0,09
		Bottom	0,02	0,02	0,02	0,03	0,03	0,03	0,04	0,05	0,07	0,12
	Wealthy	Median	0,03	0,03	0,03	0,03	0,04	0,04	0,05	0,07	0,09	0,16
		Bottom	0,03	0,03	0,04	0,04	0,05	0,05	0,06	0,08	0,11	0,19
	Moderately wealthy	Median	0,05	0,05	0,06	0,07	0,07	0,09	0,10	0,13	0,18	0,31
		Bottom	0,07	0,08	0,09	0,10	0,11	0,13	0,15	0,19	0,27	0,47
	Poor	Median	0,09	0,10	0,11	0,12	0,13	0,16	0,19	0,24	0,33	0,58
		Poorest	0,11	0,12	0,13	0,14	0,16	0,19	0,23	0,29	0,40	0,71
$\omega = 2$, $\rho = 2.5$	Very Wealthy	Wealthiest	0,02	0,03	0,03	0,03	0,03	0,04	0,04	0,05	0,07	0,10
		Bottom	0,03	0,04	0,04	0,04	0,05	0,05	0,06	0,07	0,09	0,14
	Wealthy	Median	0,04	0,04	0,05	0,05	0,06	0,06	0,07	0,09	0,11	0,18
		Bottom	0,05	0,05	0,06	0,06	0,07	0,08	0,09	0,11	0,14	0,22
	Moderately wealthy	Median	0,08	0,09	0,09	0,10	0,11	0,12	0,14	0,17	0,22	0,35
		Bottom	0,12	0,13	0,14	0,15	0,17	0,19	0,22	0,26	0,35	0,55
	Poor	Median	0,14	0,15	0,17	0,18	0,20	0,23	0,27	0,33	0,43	0,68
		Poorest	0,17	0,19	0,20	0,22	0,25	0,28	0,33	0,40	0,53	0,85

Note: The elasticities reported in Table 3.2b are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon^{\tau}_{\Omega_i} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. The top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.07% if $\omega = 0.9$ and $\rho = 1.125$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

[21] To illustrate the partial effects of modeling bequests as a luxury good by setting $\omega < \rho$, we can compare the elasticities under Case 2b in Table 3.2b with those of Case 1 ($A = 0$, $c_B = 0$, $\omega = \rho$) in Table 3.1.

Case 3: Progressive estate tax ($A = 11.7M$), bequests a normal good ($c_B = 0$ and $\omega = \rho$)

With $c_B = 0$ and $\omega = \rho$, Equation (7) can be simplified to:

$$\Omega_i = b\left[(1-\tau)^{(1-\omega)/\omega} c_i\right] - \tau A (1-\tau)^{-1} \tag{7.3}$$

The third heterogeneity follows from $A > 0$. I will now discuss the partial role of A for the relationship between τ and Ω_i. Recall that under Case 1 ($A = 0$) the effects of τ on Ω_i are homogeneous across the distribution of E_i. Going to a progressive estate tax system ($A = 11.7\text{M}$) leads to a heterogeneous relationship between τ and Ω_i. I refer to the numerical results in Table 3.3a.

Table 3.3a: Micro elasticity of bequests ($\varepsilon^{\tau}_{\Omega_i}$) for different levels of τ – warm glow. **Case 3**: Progressive estate tax ($A = 11.700.000$) and bequests a normal good ($c_B = 0$ and $\omega = \rho$).

Case 3 ($A = 11.700.000, c_B = 0, \omega = \rho$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = \rho = 0.9$	Very Wealthy	Wealthiest	-0,02	-0,03	-0,03	-0,04	-0,04	-0,06	-0,08	-0,12	-0,23	-0,79
		Bottom	-0,03	-0,04	-0,05	-0,06	-0,08	-0,12	-0,18	-0,31	-0,70	-3,34
	Wealthy	Median	-0,07	-0,09	-0,12	-0,15	-0,21	-0,31	-0,51	-0,98	-2,67	-9,09
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1$	Very Wealthy	Wealthiest	0,00	0,00	-0,01	-0,01	-0,01	-0,01	-0,02	-0,04	-0,09	-0,38
		Bottom	-0,02	-0,02	-0,03	-0,03	-0,05	-0,07	-0,10	-0,19	-0,45	-2,07
	Wealthy	Median	-0,06	-0,07	-0,09	-0,12	-0,16	-0,24	-0,38	-0,72	-1,85	-10,15
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1.45$	Very Wealthy	Wealthiest	0,05	0,05	0,06	0,06	0,07	0,08	0,09	0,11	0,13	0,16
		Bottom	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,03	-0,03	-0,37
	Wealthy	Median	0,00	-0,01	-0,02	-0,03	-0,04	-0,07	-0,13	-0,24	-0,58	-2,50
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 2$	Very Wealthy	Wealthiest	0,08	0,09	0,09	0,10	0,11	0,12	0,13	0,15	0,18	0,24
		Bottom	0,07	0,07	0,07	0,08	0,08	0,09	0,10	0,10	0,09	-0,01
	Wealthy	Median	0,03	0,03	0,03	0,02	0,01	0,00	-0,02	-0,07	-0,21	-0,91
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Note: The elasticities reported in Table 3.3a are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon^{\tau}_{\Omega_i} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.79% if $\omega = \rho = 0.9$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

Note: The large negative elasticities at higher levels of τ in Table 3.3a occur because donors quickly reduce their pre-tax bequests. Very low levels of Ω_i imply more extreme elasticities: $(\Delta\Omega_i/\Omega_i)/\Delta\tau$. The case $\tau = 100\%$ always results in $\Omega_i = 0$.

First, the poor and the moderately wealthy are no longer affected by the estate tax: their Ω_i is always below A. Second, the negative effects of higher estate taxation (if $\omega = \rho < 1$) are stronger, albeit mainly for those individuals with Ω_i above but relatively close to A: the wealthy. Third, the partial negative effect of setting $A = 11.7\text{M}$ is strong mainly for the wealthy: for them, the micro elasticity of bequests under $\omega = \rho > 1$ is now even negative. Fourth, the negative impact of A on the very wealthy, and especially the wealthiest individuals, is much smaller. For them, the reported elasticities are like those under Case 1 (except for very high levels of τ and for the lowest values of ω).[22] The central finding is that the negative impact of setting $A > 0$ is declining in E_i. If $\omega = \rho > 1$, a higher τ now leads to a mix of positive, neutral, and negative effects on Ω_i across the distribution of E_i.

The explanation for the heterogeneities reported in Table 3.3a is the relationship between the average estate tax rate $\bar{\tau}_i$ and the marginal estate tax rate τ. Starting from Equation (2), we know that if Ω_i is above but relatively close to A, the average tax rate $\bar{\tau}_i$ is (considerably) below the marginal tax rate τ. By contrast, for the very wealthy, a progressive estate tax system in practice becomes a linear estate tax system.[23] The heterogeneous effects on Ω_i can most clearly be illustrated starting from Equation (7) before having substituted out $\bar{\tau}_i$:

$$\Omega_i = \frac{b\left[(1-\tau)^{1/\omega} {c_i}^{\rho/\omega} - c_B\right]}{(1-\bar{\tau}_i)}$$

With $c_B = 0$ and $\omega = \rho$ this simplifies to:

$$\Omega_i = \frac{b\left[(1-\tau)^{1/\omega} c_i\right]}{(1-\bar{\tau}_i)} \tag{7'}$$

Equation (7') allows for the easiest interpretation of the roles of $\bar{\tau}_i$ and τ. It shows that both have a different impact on Ω_i. Also, there appears to be a positive relationship between $\bar{\tau}_i$ and Ω_i: a higher $\bar{\tau}_i$ increases the optimal ratio Ω_i/c_i.[24] How do we rationalize a positive relationship between $\bar{\tau}_i$ and Ω_i? Recall that under warm glow B_i matters for utility and each individual chooses Ω_i that is consistent with the desired level of B_i. Given that $\Omega_i = B_i/(1-\bar{\tau}_i)$, the higher $\bar{\tau}_i$, the higher the required increase in Ω_i. In Equation (7'), the average estate tax rate reflects the

[22] To illustrate the partial effects of setting $A = 11.700.000$ across the distribution of endowments we can compare the elasticities under Case 3 in Table 3.3a with those of Case 1 ($A = 0$, $c_B = 0$, $\omega = \rho$) in Table 3.1.

[23] Starting from Equation (2), we can see that if E_i and hence Ω_i become very high, $\bar{\tau}_i$ converges to the marginal estate tax rate: $\lim_{\Omega_i \to \infty} \bar{\tau}_i(\Omega_i, A, \tau) = \frac{(\infty - A)\tau}{\infty} = \tau$.

[24] I acknowledge that in Equation (7') both $\bar{\tau}_i$ and c_i are endogenous. To study the partial role of A for the relationship between τ and Ω_i across the distribution of E_i I must further solve the model to obtain an explicit expression for Ω_i as a function of τ, A, E_i and other parameters. For the most general case of warm glow ($\omega \leq \rho$), this would result in a very complex expression. For the special case where bequests are a normal good, however, we can easily solve for Ω_i. Even though both $\bar{\tau}_i$ and c_i are endogenous, Equation (7') allows us to interpret the heterogeneities from Table 3.2 very easily and link them to differences between $\bar{\tau}_i$ and τ across the distribution of endowments, see next footnote.

strength of this positive mechanical effect on Ω_i. How can differences between $\bar{\tau}_i$ and τ explain the heterogeneities in Table 3.3a?[25] The intuition is that for individuals with Ω_i above but relatively close to A, we have that $\bar{\tau}_i$ is (considerably) below τ. Moreover, at the margin, a given increase in τ will lead to a less than proportional increase in $\bar{\tau}_i$. For the very wealthy, by contrast, a given increase in τ leads to a quasi-proportional increase in $\bar{\tau}_i$. As a result, the positive mechanical effect of $\bar{\tau}_i$ on Ω_i is typically much stronger for the very wealthy than for the wealthy. Table 3.3b illustrates this.

Table 3.3b: Average estate tax rate ($\bar{\tau}_i$) for different levels of τ – warm glow. **Case 3**: Progressive estate tax ($A = 11.700.000$) and bequests a normal good ($c_B = 0$ and $\omega = \rho$).

Case 3 ($A = 11.700.000, c_B = 0, \omega = \rho$)			**Average estate tax rate ($\bar{\tau}_i$) for levels of τ equal to:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = \rho = 0.9$	Very Wealthy	Wealthiest	0,0%	9,8%	19,6%	29,4%	39,2%	49,0%	58,8%	68,6%	78,3%	88,0%
		Bottom	0,0%	9,0%	18,1%	27,1%	36,1%	45,1%	54,0%	62,8%	71,5%	78,9%
	Wealthy	Median	0,0%	6,7%	13,3%	19,8%	26,2%	32,3%	37,9%	42,4%	43,1%	17,7%
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1$	Very Wealthy	Wealthiest	0,0%	9,8%	19,6%	29,4%	39,2%	49,0%	58,8%	68,6%	78,4%	88,1%
		Bottom	0,0%	9,0%	18,1%	27,1%	36,1%	45,1%	54,1%	63,1%	71,8%	80,0%
	Wealthy	Median	0,0%	6,7%	13,3%	19,9%	26,4%	32,6%	38,5%	43,6%	46,3%	30,5%
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 1.45$	Very Wealthy	Wealthiest	0,0%	9,8%	19,6%	29,4%	39,2%	49,0%	58,8%	68,7%	78,5%	88,3%
		Bottom	0,0%	9,0%	18,1%	27,2%	36,2%	45,3%	54,4%	63,5%	72,6%	81,5%
	Wealthy	Median	0,0%	6,7%	13,4%	20,1%	26,8%	33,4%	39,9%	46,1%	51,7%	54,2%
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = \rho = 2$	Very Wealthy	Wealthiest	0,0%	9,8%	19,6%	29,4%	39,2%	49,0%	58,9%	68,7%	78,5%	88,4%
		Bottom	0,0%	9,1%	18,1%	27,2%	36,3%	45,4%	54,5%	63,7%	72,9%	82,0%
	Wealthy	Median	0,0%	6,7%	13,5%	20,2%	27,0%	33,8%	40,5%	47,1%	53,6%	58,9%
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

Another implication of the heterogeneity related to A, and the mechanical effect of $\bar{\tau}_i$, is that reducing A (keeping τ constant) will also lead to heterogeneous effects on Ω_i. For individuals with Ω_i above A, a reduction in the estate tax exemption A increases their average estate tax

[25] Starting from Equation (7') and after substituting out $\bar{\tau}_i$ using Equation (2), we obtain Equation (7.3). The second term on the right-hand-side of Equation (7.3) is a function only of τ and A. This shows that the heterogeneities arising from $A > 0$ can be rationalized by looking at differences between the average and marginal estate tax rates. Starting from Equation (7.3) and further solving for Ω_i by substituting out c_i using Equation (1), and after rearranging, we obtain:

$$\Omega_i = \frac{\left[b\left[(1-\tau)^{(1-\omega)/\omega}E_i\right] - \tau A(1-\tau)^{-1}\right]}{1 + b(1-\tau)^{(1-\omega)/\omega}}$$

rate $\bar{\tau}_i$ but keeps their marginal estate tax rate unaffected. Trough the positive mechanical effect of $\bar{\tau}_i$ on Ω_i, which is most clearly illustrated by Equation (7'), a lower A increases Ω_i. The closer Ω_i was to the pre-reform level of A, the stronger the increase in $\bar{\tau}_i$ and hence the stronger the increase in Ω_i. For the very wealthy, the effects of reducing A are also positive, but negligible. I show the effects on pre-tax bequests across the distribution of E_i of gradually reducing A from USD 11.7M to 0M in Appendix C.

Case 4: Progressive estate tax ($A = 11.7M$), bequests a luxury good ($c_B = 0$, $\omega < \rho$)

The final case combines $A = 11.7M$ and $\omega < \rho$. I do not consider the cases where $c_B > 0$. Even with the highest plausible value for c_B equal to USD 112.000, the impact of c_B on the elasticities is very small. Recall from Case 2a that setting $c_B = 112.000$ under a linear estate tax system implies stronger negative effects of τ on Ω_i, albeit mainly for the moderately wealthy: those with c_i above but relatively close to c_B. However, with $A = 11.7\text{M}$, the pre-tax bequests of the moderately wealthy are no longer taxed. The impact of $c_B = 112.000$ on the (very) wealthy is very small.[26] I therefore only study the combination $A = 11.7\text{M}, c_B = 0$, $\omega < \rho$. This allows studying the partial effect of setting $A = 11.7\text{M}$ given that bequests are a luxury good (a comparison of the outcomes under Case 4 with those of Case 2b), as well as the partial effect of setting $\omega < \rho$ given that the estate tax system is progressive (a comparison of the outcomes under Case 4 with those of Case 3).

I first study the partial effect of setting $A = 11.7\text{M}$ given that bequests are a luxury good. A comparison of Table 3.4 ($A = 11.7\text{M}$, $c_B = 0$ and $\omega < \rho$) and Table 3.2b ($A = 0$, $c_B = 0$ and $\omega < \rho$) shows that the impact of going to $A = 11.7\text{M}$ leads to stronger negative and weaker positive effects of higher estate taxation. The strong positive effects on Ω_i as in Table 3.2b for the poor and the moderately wealthy if $\omega > 1$ are no longer present. With $A = 11.7\text{M}$, these individuals are no longer affected by the estate tax. For the wealthy, the micro elasticity of bequests is now negative even if ω is considerably above 1. For the very wealthy, I still observe positive elasticities if ω is far above one, but the effects are again small. The heterogeneities from setting $A = 11.7\text{M}$ for the wealthy and very wealthy are similar to the case where bequests are a normal good. However, these additional negative effects are smaller if $\omega < \rho$, because of the high marginal utility of bequeathing.

I now turn to the partial effects of setting $\omega < \rho$ given that the estate tax system is progressive with a high exemption. A comparison of the elasticities in Table 3.4 ($A = 11.700.000$, $c_B = 0$ and $\omega < \rho$) and Table 3.3a ($A = 0$, $c_B = 0$ and $\omega < \rho$) shows that both the positive and the negative effects of higher estate taxation on pre-tax bequests are now (much) weaker. The positive effects are weaker because those who are affected by the estate tax now have higher Ω_i/E_i. The negative effects are weaker because $\omega < \rho$.

[26] Only for the wealthy and for marginal tax rates above 70%, the negative impact of setting $c_B = 112.000$ is somewhat stronger. I refer to the outcomes under Case 2a (Table 3.2a) and Case 1 (Table 3.1).

Table 3.4: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – warm glow. **Case 4**: Progressive estate tax ($A = 11.700.000$) and bequests a luxury good ($c_B = 0$ and $\omega < \rho$).

Case 4 ($A = 11.700.000, c_B = 0, \omega < \rho$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = 0.9$, $\rho = 1.125$	Very Wealthy	Wealthiest	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,06	-0,20
		Bottom	-0,01	-0,02	-0,02	-0,02	-0,03	-0,04	-0,06	-0,10	-0,22	-0,91
	Wealthy	Median	-0,03	-0,04	-0,05	-0,07	-0,09	-0,13	-0,21	-0,37	-0,87	-4,12
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 1$, $\rho = 1.25$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,01	-0,02	-0,09
		Bottom	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,04	-0,06	-0,14	-0,60
	Wealthy	Median	-0,03	-0,03	-0,04	-0,05	-0,07	-0,10	-0,16	-0,28	-0,64	-2,75
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 1.45$, $\rho = 1.8125$	Very Wealthy	Wealthiest	0,01	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,04	0,05
		Bottom	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,00	-0,12
	Wealthy	Median	0,00	0,00	0,00	-0,01	-0,02	-0,03	-0,05	-0,10	-0,22	-0,85
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 2$, $\rho = 2.5$	Very Wealthy	Wealthiest	0,02	0,03	0,03	0,03	0,03	0,04	0,04	0,05	0,06	0,08
		Bottom	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,00
	Wealthy	Median	0,02	0,02	0,01	0,01	0,01	0,01	0,00	-0,03	-0,09	-0,35
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Note: The elasticities reported in Table 3.4 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.20% if $\omega = \rho = 0.9$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

3.2.5 Conclusions (warm glow)

The **first key result from Section 3.2.4** is that the effects of higher estate taxation on the size of pre-tax bequests under warm glow are characterized by several important heterogeneities:

- The effect of higher estate taxation on pre-tax bequests is homogeneous across the wealth distribution only if the estate tax is linear and if bequests are a normal good (Case 1). The effect then solely depends on ω and on the initial (pre-reform) level of τ. The higher ω, the less negative (more positive) the effects. The higher τ, the more outspoken the effects of a given increase in τ. This is the first heterogeneity.
- If bequests are a luxury good because $\omega < \rho$, wealthy and very wealthy individuals react more moderately, both in positive and in negative direction, when the estate tax rates increase. The response of the moderately wealthy and the poor, by contrast, will be more outspoken (positively and negatively) compared to the case where bequests are a normal good. By contrast, if bequests are a luxury good, considered only after individuals have ensured a minimum consumption level ($c_B > 0$), the negative effects become stronger, albeit mainly if the estate tax is linear and for the moderately wealthy. For the (very) wealthy, the negative effect of having $c_B > 0$ on the micro elasticity of bequests is small. Different elasticities depending on ω, ρ and c_B constitute the second heterogeneity.
- If the estate tax is progressive due to the presence of a tax exemption for lower levels of bequests, a given increase in τ generally leads to strong(er) negative effects on Ω_i for individuals with pre-tax bequests above but relatively close to the exemption. For the very wealthy, the introduction of a progressive estate tax system has only (very) small effects on the reported elasticities. For them, the increase in $\bar{\tau}_i$ and hence the positive mechanical effect on Ω_i is maximal. Different elasticities depending on A constitute the third heterogeneity. This heterogeneity applies to all estate tax systems where the average estate tax rate $\bar{\tau}_i$ may be considerably below the marginal estate tax rate τ for many individuals.
- Another implication of the third heterogeneity is that reducing the estate tax exemption also leads to heterogeneous effects on Ω_i. For all individuals with pre-reform levels of Ω_i above A, a reduction in A leads to strictly positive effects on pre-tax bequests. This positive effect is declining in E_i. For the very wealthy, the effect of reducing the exemption is negligible.

These heterogeneities do not require heterogeneity in the underlying bequest motive, nor in preferences in general. They directly follow from heterogeneities in endowments if bequests are modelled as a luxury good, or if the estate tax is progressive.

Because of the heterogeneities driven by c_B and A, values for ω at or above unity do not guarantee a positive relationship between the marginal estate tax rate and the size of pre-tax bequests. If $\omega > 1$ and with $c_B > 0$ and/or $A > 0$, a higher marginal tax rate typically leads to a mix of positive and negative effects on pre-tax bequests across the distribution of wealth (endowments).

The **second key result from Section 3.2.4** is that the effects of higher estate taxation on the pre-tax bequests of very wealthy donors are *not* typically negative and large under warm glow. For the entire range of reasonable values for ω and ρ, $0.9 \leq \omega = \rho \leq 2$, the most extreme micro elasticities of bequests reported for the very wealthy (those with endowments that lead to levels of Ω_i of at least 10 times $A = 11.7\text{M}$) over the interval $0\% \leq \tau \leq 50\%$ are -0.12 and 0.12. Over the interval $50\% \leq \tau \leq 70\%$ the most extreme elasticities for the very wealthy are -0.31 to 0.15. I refer to Tables 3.1 to 3.4. Overall, these elasticities are in line with those reported in the empirical literature, where the same range for τ was studied.[27] Only for marginal tax rates above 70%, the negative effects of higher estate taxation may become more outspoken, also for the very wealthy. For the wealthiest individual in the hypothetical distribution (an endowment of around USD 700M), the negative elasticities are always smaller (in absolute terms) than the numbers reported earlier in this paragraph. Somewhat stronger negative effects of higher estate taxation on the wealthiest donors occur only if $\omega < 1$, if the estate tax system has a very high exemption, and only for the highest marginal tax rates. I refer to Tables 3.3a and 3.4. For central values of ω and ρ (the point estimate for wealthy Americans is 1.45, see Appendix A), the effects of higher estate taxation on the pre-tax bequests of the wealthiest donors are typically positive and weak over the entire range $0\% \leq \tau \leq 90\%$.

The overall weak relationship between the estate tax and the size of pre-tax bequests of very wealthy donors holds even under the extreme assumptions that bequests are only motivated by warm glow, and that individuals face a mortality rate equal to 1. In reality, bequests and wealth are most probably driven by a combination of lifecycle motives and (pre-tax and after-tax) bequest motives, see introduction. The true elasticities of bequests will always be smaller in absolute terms than those reported in Tables 3.1 to 3.4. Moreover, I have shown that if bequests are a luxury good because $\omega < \rho$, both the positive and the negative effects of higher estate taxation on the size of pre-tax bequests are weaker for the (very) wealthy.[28] The fact that bequests are most probably a luxury good thus supports the main conclusion that higher estate taxation does *not* typically lead to strong negative effects on pre-tax bequests for (very) wealthy donors in the case of warm glow.

[27] The highest marginal estate tax rate over the last century in the United States was 77%, see Jacobsen et al. (2007).
[28] When bequests are modelled as a luxury good by setting $c_B = 112.000$, the effects of higher estate taxation for the very wealthy are the virtually the same as in the case where bequests are a normal good.

3.3 Altruism

The altruistic bequest motive is somewhat more complicated than warm glow because the utility of the parent now directly depends on the utility of the child.

Again, consider individuals i currently living in their final period of life. Their endowments are given by E_i, for which I assume the same hypothetical distribution as in Section 3.1. Let their flow of final-period consumption expenditures again be denoted by c_i, and their pre-tax bequests by Ω_i. The final period budget constraint of individual i is given by Equation (1). Let the estate tax system again be characterized by an exemption $A \geq 0$ and a marginal tax rate τ. The average estate tax rate of individual i, τ_i, is then given by Equation (2). After-tax bequests are $B_i = \Omega_i(1 - \bar{\tau}_i)$. Preferences over consumption are again iso-elastic, given by Equation (4).

Now also consider individual k, the child of individual i, who is exactly five periods younger. Let $s = 1, \dots, 5$ indicate the period of life of individual k, counting from the death of the parent. At the start of period $s = 1$, individual k inherits the after-tax bequests from the parent i, namely B_i. Let E_k be the exogenous endowments of the child at the start of $s = 1$, see below. Let $c_{k,s}$ be the flow of consumption expenditures of the child in periods of life $s = 1, \dots, 5$, and $\Omega_{k,s}$ wealth at the end of these periods. I assume that all individuals k reach the end of their period $s = 5$ with certainty, and then face a mortality rate equal to 1. Assuming a zero interest rate, the budget constraints of the child k in period $s = 1$ and in periods $s = 2, \dots, 5$ are then respectively:

$$c_{k,1} + \Omega_{k,1} = E_k + B_i \tag{8a}$$

$$c_{k,s} + \Omega_{k,s} = \Omega_{k,s-1} \qquad \text{, for } s = 2, \dots, 5. \tag{8b}$$

Note the difference between E_i in Equation (1) and E_k in Equation (8a): the endowments of the parent already contain inherited wealth while the child's endowments do not. E_k must thus be lower, on average, and have a more equal distribution than E_i, see below. I restrict the analysis to a two-generations context by assuming that the child has no bequest motive: $\Omega_{k,5} = 0$.[29] Assuming that preferences are time separable and with no time discounting, the lifetime utility function of the child is:

$$U_k = \sum_{s=1}^{5} U_{k,s}(c_{k,s}) \tag{9a}$$

[29] In previous versions of this paper, I also studied a three-generations framework by adding the grandchildren of individual i, i.e., the child of individual k, and endogenizing $\Omega_{k,5} \geq 0$. I have noticed, however, that the main results in a three-generations context are not substantially different than those from the two-generations context. I refer to Section 3.3.6.

I assume that the child's preferences over $c_{k,s}$ are also iso-elastic, with the same elasticity of marginal utility of consumption (ρ) as the parent. The child's consumption will then be constant over time: $c_{k,s} = c_{k,s+1}$, for all $s = 1, \dots, 4$. Denoting this constant consumption level by c_k, and with $\Omega_{k,5} = 0$, the lifetime budget constraint of the child becomes:

$$5c_k = E_k + B_i \tag{8c}$$

Using the result that $c_{k,s} = c_k$ for all $s = 1, \dots, 5$, the lifetime utility of the child becomes:

$$U_k(c_k) = 5\frac{{c_k}^{1-\rho} - 1}{1-\rho} \tag{9b}$$

If the bequests of individual i are motivated by altruism towards the child k, the final period utility function of individual i is:

$$U = U_i(c_i) + zU_k(c_k) \tag{10}$$

Therein, $0 < z \leq 1$ is the altruism parameter. With $z = 1$, the child's consumption c_k will contribute in the same way to individual i's utility as the own consumption c_i.

3.3.1 Optimal bequests in the case of altruism

Given the preferences described by Equations (4), (9b) and (10), optimal behavior by the parent requires that the total derivative of U with respect to c_i is equal to zero. Given that U is also a direct function of c_k and that the parent can affect c_k via Ω_i (through B_i), the marginal utility of the parent's final-period consumption, c_i, must be equal to the marginal utility of the child's consumption, c_k, evaluated through U_k, and considering their relative prices:

$$\frac{dU}{dc_i} = 0$$

$\Leftrightarrow$

$$U_i'(c_i) + zU_k'(c_k)\frac{\partial c_k}{\partial B_i}\frac{\partial B_i}{\partial \Omega_i}\frac{\partial \Omega_i}{\partial c_i} = 0$$

$\Leftrightarrow$

$$\frac{1}{{c_i}^{\rho}} + z\frac{5}{{c_k}^{\rho}}\frac{\partial c_k}{\partial B_i}\frac{\partial B_i}{\partial \Omega_i}\frac{\partial \Omega_i}{\partial c_i} = 0$$

From Equation (1) we know $\partial\Omega_i/\partial c_i = -1$, and from Equation (8c) that $\partial c_k/\partial B_i = 1/5$. From the warm glow case, we know that the derivative of B_i with respect to Ω_i is equal to $1 - \tau$, see

Section 3.2.2. Using these results in the above first-order condition, we obtain a standard intergenerational Euler equation, see e.g., Davies (1982), Becker and Tomes (1986) and Farhi and Werning (2010):

$$\frac{1}{{c_i}^{\rho}} = \frac{z(1-\tau)}{{c_k}^{\rho}} \tag{11}$$

Equation (11) shows that the marginal utility of the child's consumption evaluated by the parent is increasing in the altruism parameter z and decreasing in the marginal estate tax rate τ. The factor $1-\tau$ reflects the relative price of the child's consumption relative to own consumption. After rearranging, we obtain:

$$c_k = [z(1-\tau)]^{1/\rho} c_i$$

Using Equation (8c) and $B_i = \Omega_i(1-\bar{\tau}_i)$, and after rearranging:

$$\Omega_i = \frac{5[z(1-\tau)]^{1/\rho} c_i - E_k}{(1-\bar{\tau}_i)} \tag{11'}$$

Equation (11') describes the optimal relationship between the parent's pre-tax bequest Ω_i, the parent's own consumption c_i, the parent's average estate tax rate $\bar{\tau}_i$, and other parameters including the child's endowments E_k and the marginal estate tax rate τ. In terms of the effects of τ and $\bar{\tau}_i$, Equation (11') very much resembles Equation (7') from the warm glow case. Equation (11') shows that the marginal tax rate and the average tax rate may again have a different impact on optimal pre-tax bequests. The relationship between $\bar{\tau}_i$ and Ω_i again appears to be positive.

Substituting out c_i and $\bar{\tau}_i$ using Equations (1) and (2), we obtain, for individuals with levels of Ω_i above A:

$$\Omega_i = \frac{5[z(1-\tau)]^{1/\rho} E_i - E_k - \tau A}{(1-\tau+5[z(1-\tau)]^{1/\rho})} \tag{12}$$

Equation (12) shows the compensatory nature of bequests in the case of altruism: the optimal Ω_i is a positive function of the parent's exogenous endowments E_i and a negative function of the child's exogenous endowments E_k. An important implication is that now only parents with high enough E_i leave positive bequests. As in the warm glow case, I impose $\Omega_i \geq 0$. Contrary to the case of warm glow, large bequests now only occur in those families where the parent's endowments are considerably above the child's endowments.

Equation (12) also shows that the effects of τ depend on the parameters E_i, E_k, z, ρ and A. At first sight, E_k appears to have a similar role as c_B in the warm glow case, and the role of A is also

similar. I discuss the numerical effects of higher estate taxation under altruism in Section 3.3.4. As in the case of warm glow, I consider several cases with respect to the parameters E_k, ρ, z and A. I first discuss to the reasonable range for these parameters ρ and z.

3.3.2 The reasonable range for ρ and z

From Section 3.2, we know that the reasonable range for ρ runs from 0.9 to 2, and that the point estimate for wealthy Americans is $\rho = 1.45$. Table 1b in Section 2 provides an overview of the range of values for ρ applied in the previous theoretical studies regarding the estate tax.

As to the altruism parameter z, the previous literature highlighted that its value is bounded from above. A value $z = 1$ implies perfect altruism: the child's consumption then has the same weight in the parent's utility as the own consumption, and consumption will be (perfectly) smoothed between successive generations of a family. However, the perfect altruism behind bequests has been soundly rejected on several occasions, see e.g., Altonji et al. (1997), Wilhelm (1996) and Laitner and Ohlsson (2001).[30,31] Based on the previous empirical literature, we can conclude that altruism is most certainly not the single motive behind bequests. If bequests were motivated by altruism, the altruism parameter is most likely (considerably) below 1. To keep the analysis as general as possible, I study the effects of higher estate taxation under $z = 1$ and $z = 0.5$.[32]

3.3.3 The value for z and the average characteristics of donors

Equation (12) show that only parents with endowments that well exceed their children's endowments leave large bequests in the case of altruism. The value of z therefore indirectly determines the average characteristics of families who are affected by the estate tax. With $z = 1$ many parents leave positive bequests: $\Omega_i > 0$ requires that E_i is at least somewhat above E_k. However, for lower values of z, positive levels of Ω_i only occur in those families where E_i is sufficiently high relative to E_k. The lower the altruism parameter, the higher the endowments of those who report positive bequests.

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[30] With perfect altruism, and if altruism were the only motive behind bequests, parents will perfectly compensate for any intergenerational redistribution by the government: each dollar of redistribution from the child to the parent will lead to a one dollar increase in the parent's bequests, which seems somewhat extreme. For instance, Altonji et al. (1997) estimate that redistributing one dollar from the recipient of bequests to the donor leads to a 13-cent increase in the size of bequests.

[31] Other papers even rejected the altruistic motive behind bequests in general. Wilhelm (1996), McGarry (1999), Hochguertel et al. (2009) show that the altruistic motive only applies to inter-vivos transfers, and not to bequests.

[32] Most papers that study the welfare effects of the estate tax in an altruistic framework typically study different cases, namely $z = 0$, $z = 1$, and $0 < z < 1$. I refer to the papers cited in the first part of Table 1b. In theoretical studies that focus on the distributional and/or macroeconomic effects of the estate tax, there is also a mix of assumptions regarding z. In Gale and Perozek (2000) and Jiang (2010) the altruism parameter is equal to 0.5. In Castañeda et al. (2003), Cagetti and De Nardi (2009) and Kaymak and Poschke (2016) the altruism parameter is equal to 1. My main findings under altruism also hold when I choose alternative values for $0 < z \leq 1$.

3.3.4 The effects of higher estate taxation on taxable bequests: altruism

In this section, I numerically solve the model described by Equations (1) to (4), (8c) and (12). I then study the effects of higher estate taxation on the size of pre-tax bequests left by parents i across the hypothetical distribution of E_i, and over the reasonable range of values for z and ρ. I study different cases of the effects of higher estate taxation. Case 5 is the simplest case: a linear estate tax ($A = 0$) and the children have zero endowments ($E_k = 0$). In Case 6, I study the case of a linear estate tax ($A = 0$) with significant endowments for the children ($E_k = 2.65\text{M}$). This value for E_k is the median of E_i, the distribution of which ranges from USD 10.000 to over USD 700M, see section 3.1.[33] By comparing the outcomes under Case 6 with those of Case 5, we can study the partial effects on $\varepsilon_{\Omega_i}^{\tau}$ of setting $E_k = 2.65\text{M}$. In Case 7, I study the effects of higher estate taxation under a progressive estate tax system ($A = 11.7\text{M}$) and with zero endowments for the children ($E_k = 0$). By comparing the outcomes under Case 7 with those of Case 5, I can study the partial effects on $\varepsilon_{\Omega_i}^{\tau}$ of setting $A = 11.7\text{M}$. In Case 8, the combination of $A = 11.7\text{M}$ and $E_k = 2.65\text{M}$ holds. Table 4a provides an overview.

Table 4a: Overview of the different cases under altruism.

	Estate tax system	**Children's endowments**
Case 5	Linear (A = 0)	Ek = 0
Case 6	Linear (A = 0)	Ek = 2.650.000
Case 7	Progressive (A = 11.700.000)	Ek = 0
Case 8	Progressive (A = 11.700.000)	Ek = 2.650.000

As in the case of warm glow, I classify donors (individuals i) into four groups based on Ω_i. The first group, the 'poor', have endowments that are not sufficiently above E_k to obtain positive bequests in those cases where $E_k = 2.65\text{M}$, hence $\Omega_i = 0$. The poor are only affected by the estate tax if $A = 0$ and if $E_k = 0$. The second group are the 'moderately wealthy': those with positive levels of Ω_i, also if $E_k = 2.65\text{M}$, but below A. The moderately wealthy are only affected by τ if the estate tax is linear. The third group, the 'wealthy', have endowments that result in levels of Ω_i between one and ten times A if $\tau = 0$. The fourth group, the 'very wealthy', have Ω_i that are at least ten times A if $\tau = 0$.

Table 4b: Overview of the different types of individuals under altruism

	Level of pre-tax bequests (if τ = 0)
Very wealthy	Above 10A = 117.000.000
Wealthy	Between A = 11.700.000 and 10A = 117.000.000
Moderately wealthy	Below A = 11.700.000
Poor	Zero if Ek = 2.650.000, below A if Ek = 0

[33] Since E_k does not include previously inherited wealth, while E_i does, see Equations (1) and (8c), E_k must be lower on average, and be more equally distributed than E_i.

Case 5: Linear estate tax ($A = 0$), zero endowments for the children ($E_k = 0$)

With $A = 0$ and $E_k = 0$ the final two terms on the right-hand side of Equation (12) vanish:

$$\Omega_i = \frac{5[z(1-\tau)]^{1/\rho} E_i}{(1-\tau+5[z(1-\tau)]^{1/\rho})} \tag{12.5}$$

Note that, starting from $A = 0$, $E_k = 0$ and with perfect altruism ($z = 1$) and zero estate taxation, I obtain that $\Omega_i = 5/6\, E_i$, and hence $\Omega_i/E_i = 83.33\%$. This value is intuitive. If the consumption of the child is equally important as the own consumption, and with $\tau = 0$, it directly follows from Equation (11) that $c_i = c_k$. Since the parent is in its final period of life, but the child lives for five more periods, each parent i consumes only one-sixth of E_i, and bequeaths five-sixth. The ratio Ω_i/E_i at $\tau = 0$ is then the same as in the warm glow case, see Section 3.2. This allows easier comparison between the results of both bequest motives. We can now study the effects of higher estate taxation across the distribution of E_i for different levels of ρ and z under Case 5 ($A = 0, E_k = 0$).

The first heterogeneity relates to the initial level of τ. If the estate tax is linear ($A = 0$) and the child has zero endowments ($E_k = 0$), the effects of a change in the estate tax rate are homogeneous across the distribution of E_i, as shown by Table 5.1. They will be negative if $\rho < 1$ and positive if $\rho > 1$. As in the warm glow case, both the positive and the negative effects of higher estate taxation become more outspoken for higher initial levels of the estate tax. If $\rho > 1$, donors increasingly keep up Ω_i to avoid too large reductions in the children's consumption. If $\rho < 1$, the reduction in Ω_i also becomes more outspoken for higher levels of τ. Table 5.1 furthermore shows that the altruism parameter z has no effect on the sign of the effects on Ω_i, but it somewhat affects their magnitude: both the positive and the negative effects of higher estate taxation become more outspoken if z is lower.[34]

While the previous literature has highlighted on numerous occasions that the effects of higher estate taxation depend on ρ in case of altruism, none of the previous studies cited in Table 1b highlighted the heterogeneity with respect to the initial level of τ, nor did they explicitly highlight the (indirect) role of z.

[34] The lower z, the less important the child's consumption for the parent's utility. The lower z, the stronger the change c_i (and hence in Ω_i) for a given reduction in c_k. This directly follows from Equation (11): $c_k = z^{1/\rho}(1-\tau)^{1/\rho} c_i$. Whether the change in c_i is positive or negative depends on ρ.

Table 5.1: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – altruism. **Case 5**: Linear estate tax ($A = 0$) and the children have zero endowments ($E_k = 0$).

Case 5 ($A = 0, E_k = 0$)		**Elasticity of bequests at marginal estate tax rate τ:**									
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$z = 1, \rho = 0.9$	All individuals	-0,02	-0,02	-0,02	-0,03	-0,03	-0,04	-0,05	-0,07	-0,11	-0,24
$z = 1, \rho = 1$	All individuals	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 1.45$	All individuals	0,05	0,06	0,06	0,07	0,08	0,09	0,10	0,13	0,17	0,29
$z = 1, \rho = 2$	All individuals	0,08	0,09	0,10	0,10	0,11	0,12	0,14	0,17	0,21	0,31
$z = 0.5, \rho = 0.9$	All individuals	-0,03	-0,04	-0,04	-0,05	-0,06	-0,07	-0,09	-0,12	-0,19	-0,42
$z = 0.5, \rho = 1$	All individuals	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 1.45$	All individuals	0,08	0,08	0,09	0,10	0,11	0,13	0,15	0,19	0,26	0,44
$z = 0.5, \rho = 2$	All individuals	0,11	0,12	0,13	0,14	0,15	0,17	0,19	0,23	0,29	0,42

Note: The elasticities reported in Table 5.1 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.24% if $z = 1$, $\rho = 0.9$.

Case 6: Linear estate tax ($A = 0$), significant endowments for the children ($E_k > 0$)

I now turn to the partial effects of setting E_k equal to USD 2.65M. Starting from Equation (12) and with $A = 0$ and $E_k > 0$ the optimality condition for Ω_i becomes:

$$\Omega_i = \frac{5[z(1-\tau)]^{1/\rho}E_i - E_k}{(1 - \tau + 5[z(1-\tau)]^{1/\rho})} \tag{12.6}$$

The second heterogeneity relates to the children's endowments E_k. A comparison of Equations (12.6) and (7.2a) shows that E_k has a similar double role as c_B from the warm glow case, see Case 2a in Section 3.2.4. First, $E_k > 0$ makes the ratio Ω_i/E_i heterogeneous across the distribution of E_i, also in case of zero estate taxation. Second, E_k leads to additional negative effects of τ on Ω_i via the second term on the right-hand-side of Equation (12.6). I show the effects of higher estate taxation across the distribution of E_i for different levels of ρ and z under Case 6 ($A = 0$, $E_k = 2.650.000$) in Table 5.2. The poor are not included, though. They leave no bequests and are not affected by changes in the estate tax rate if $E_k = 2.65\text{M}$.

Table 5.2: Micro elasticity of bequests ($\varepsilon^{\tau}_{\Omega_i}$) for different levels of τ – altruism. **Case 6**: Linear estate tax ($A = 0$) and the children have significant endowments ($E_k = 2.65\text{M}$).

Case 6 ($A = 0, E_k = 2.650.000$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$z = 1, \rho = 0.9$	Very wealthy	Wealthiest	-0,02	-0,02	-0,03	-0,03	-0,04	-0,04	-0,06	-0,08	-0,14	-0,36
		Bottom	-0,02	-0,03	-0,03	-0,04	-0,04	-0,06	-0,08	-0,12	-0,24	-0,85
	Wealthy	Median	-0,03	-0,04	-0,05	-0,06	-0,07	-0,10	-0,15	-0,26	-0,58	-2,60
		Bottom	-0,06	-0,07	-0,09	-0,11	-0,15	-0,22	-0,34	-0,63	-1,58	-9,72
	Moderately wealthy	Ei = 2.65M	-0,30	-0,38	-0,51	-0,71	-1,06	-1,77	-3,59	-12,36	0,00	0,00
$z = 1, \rho = 1$	Very wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,02	-0,08
		Bottom	0,00	0,00	-0,01	-0,01	-0,01	-0,01	-0,02	-0,04	-0,10	-0,42
	Wealthy	Median	-0,01	-0,02	-0,02	-0,03	-0,04	-0,05	-0,08	-0,15	-0,35	-1,57
		Bottom	-0,04	-0,04	-0,06	-0,07	-0,10	-0,15	-0,23	-0,43	-1,06	-5,61
	Moderately wealthy	Ei = 2.65M	-0,25	-0,32	-0,42	-0,58	-0,85	-1,36	-2,56	-6,90	-100,00	0,00
$z = 1, \rho = 1.45$	Very wealthy	Wealthiest	0,05	0,06	0,06	0,07	0,07	0,09	0,10	0,12	0,16	0,26
		Bottom	0,05	0,05	0,06	0,06	0,07	0,08	0,09	0,11	0,13	0,15
	Wealthy	Median	0,04	0,05	0,05	0,05	0,06	0,06	0,06	0,06	0,03	-0,20
		Bottom	0,03	0,03	0,03	0,02	0,02	0,01	-0,02	-0,07	-0,24	-1,20
	Moderately wealthy	Ei = 2.65M	-0,12	-0,16	-0,20	-0,28	-0,39	-0,58	-0,96	-1,88	-5,40	-100,00
$z = 1, \rho = 2$	Very wealthy	Wealthiest	0,08	0,09	0,09	0,10	0,11	0,12	0,14	0,16	0,20	0,29
		Bottom	0,08	0,09	0,09	0,10	0,11	0,12	0,13	0,15	0,19	0,24
	Wealthy	Median	0,08	0,08	0,09	0,09	0,10	0,11	0,12	0,13	0,13	0,09
		Bottom	0,07	0,07	0,07	0,07	0,07	0,07	0,07	0,05	0,00	-0,34
	Moderately wealthy	Ei = 2.65M	-0,04	-0,06	-0,09	-0,12	-0,18	-0,28	-0,45	-0,82	-1,90	-9,03
$z = 0.5, \rho = 0.9$	Very wealthy	Wealthiest	-0,04	-0,04	-0,05	-0,05	-0,06	-0,08	-0,10	-0,15	-0,25	-0,69
		Bottom	-0,04	-0,05	-0,06	-0,07	-0,08	-0,11	-0,15	-0,24	-0,48	-1,80
	Wealthy	Median	-0,06	-0,08	-0,09	-0,12	-0,15	-0,21	-0,32	-0,56	-1,31	-7,00
		Bottom	-0,12	-0,15	-0,19	-0,24	-0,33	-0,49	-0,81	-1,59	-4,67	-100,00
	Moderately wealthy	Ei = 2.65M	-0,89	-1,22	-1,79	-2,94	-6,09	-31,77	0,00	0,00	0,00	0,00
$z = 0.5, \rho = 1$	Very wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	-0,01	-0,01	-0,02	-0,04	-0,17
		Bottom	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,05	-0,08	-0,20	-0,86
	Wealthy	Median	-0,03	-0,03	-0,04	-0,05	-0,07	-0,11	-0,17	-0,31	-0,74	-3,67
		Bottom	-0,07	-0,09	-0,12	-0,15	-0,21	-0,32	-0,52	-0,99	-2,66	-22,67
	Moderately wealthy	Ei = 2.65M	-0,67	-0,90	-1,27	-1,93	-3,39	-8,16	-100,00	0,00	0,00	0,00
$z = 0.5, \rho = 1.45$	Very wealthy	Wealthiest	0,08	0,08	0,09	0,10	0,11	0,13	0,15	0,18	0,25	0,40
		Bottom	0,07	0,08	0,08	0,09	0,10	0,12	0,13	0,16	0,19	0,22
	Wealthy	Median	0,06	0,07	0,07	0,07	0,08	0,08	0,08	0,08	0,03	-0,38
		Bottom	0,04	0,03	0,03	0,03	0,02	-0,01	-0,05	-0,15	-0,45	-2,29
	Moderately wealthy	Ei = 2.65M	-0,26	-0,33	-0,44	-0,60	-0,88	-1,39	-2,57	-6,56	-100,00	0,00
$z = 0.5, \rho = 2$	Very wealthy	Wealthiest	0,11	0,12	0,13	0,14	0,15	0,17	0,19	0,22	0,28	0,40
		Bottom	0,11	0,11	0,12	0,13	0,15	0,16	0,18	0,21	0,26	0,33
	Wealthy	Median	0,10	0,11	0,11	0,12	0,13	0,14	0,15	0,17	0,18	0,10
		Bottom	0,09	0,09	0,09	0,09	0,10	0,09	0,09	0,06	-0,02	-0,54
	Moderately wealthy	Ei = 2.65M	-0,09	-0,12	-0,17	-0,23	-0,34	-0,51	-0,84	-1,60	-4,20	-45,60

Notes: The elasticities reported in Table 5.2 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon^{\tau}_{\Omega_i} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.36% if $z = 1$, $\rho = 0.9$. 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category. I now also explicitly consider the donors who have $E_i = E_k = 2.65\text{M}$. The poor are not affected if $E_k = 2.65\text{M}$, results not shown due to space constraints. The large negative elasticities at high levels of τ in Table 5.2 occur because donors quickly reduce their pre-tax bequests. Very low levels of Ω_i imply more extreme elasticities: $(\Delta\Omega_i/\Omega_i)/\Delta\tau$. Afterwards, the elasticity turns zero because Ω_i remains at zero.

The intuition behind the negative impact of E_k on the effects of τ on Ω_i is as follows. If the children have no own endowments, their lifetime consumption equals the after-tax bequest received: $5c_k = B_i = \Omega_i(1-\tau)$. A given increase in τ and hence a given reduction in B_i then leads to a proportional decline in $5c_k$. The negative income effect on the child, evaluated by the parent through the reduction in $5c_k$ (or c_k), is then maximal. The positive compensatory effect on Ω_i is then also maximal. By contrast, if the child also has another source of income, a given reduction in B_i leads to a relatively small decline in $5c_k = E_k + B_i = E_k + \Omega_i(1-\tau)$ compared to the $E_k = 0$ case. The positive compensatory effect on the parent's pre-tax bequests and hence the net effect on Ω_i are then smaller as well. This explains the negative relationship between E_k and Ω_i in Equations (12) and (12.6). Setting $E_k > 0$ leads to stronger negative (and weaker positive) effects of higher estate taxation, especially for donors with E_i above but relatively close to E_k. The lower E_i, the stronger the impact of E_k on the level of $5c_k$, and hence the more negative the effects of τ on Ω_i. By contrast, the higher E_i, the more important B_i for the child's consumption and the weaker the impact of E_k.[35]

Case 7: Progressive estate tax ($A = 11.7\text{M}$), zero endowments for the children ($E_k = 0$)

Starting from Equation (12) and with $A > 0$ and $E_k = 0$, the optimality condition for Ω_i becomes:

$$\Omega_i = \frac{5[z(1-\tau)]^{1/\rho}E_i - \tau A}{(1-\tau+5[z(1-\tau)]^{1/\rho})} \tag{12.7}$$

The third heterogeneity follows from $A > 0$. I now turn to the partial effects of setting $A = 11.7\text{M}$. With a high estate tax exemption, only the wealthy and very wealthy are affected by the estate tax. Table 5.3 shows the micro elasticity of bequests across the distribution of E_i for different levels of ρ and z under Case 7 ($A = 11.700.000$, $E_k = 0$). We can then compare the outcomes from Case 7 in Table 5.3 with those of Case 5 ($A = 0$, $E_k = 0$) in Table 5.1.

As in the case of warm glow, the strongest negative effects occur for those donors with Ω_i above but relatively close to A: the 'wealthy'. The very wealthy are only mildly affected. As explained in section 3.2, a high A implies that for donors with Ω_i above but relatively close to A, the 'wealthy', $\bar{\tau}_i$ is (considerably) below τ, and a given increase in τ leads to a less than proportional increase in $\bar{\tau}_i$. The positive mechanical effect on Ω_i is then relatively weak. For higher levels of Ω_i, the average estate tax rate much closer follows the marginal estate tax rate, leading to stronger positive mechanical effects on pre-tax bequests. Overall, the partial effects of setting $A = 11.7\text{M}$ on the elasticities across the distribution of wealth (endowments) in the case of altruism are comparable to those of the warm glow case, see Section 3.2.

[35] A comparison between the elasticities reported in Table 5.2. (Case 6, $A = 0$, $E_k = 2.65\text{M}$) with those in Table 5.1 (Case 5, $A = 0$, $E_k = 0$) illustrates the partial effects of setting $E_k = 2.65\text{M}$ across the distribution of E_i. For very wealthy parents, the effects of setting $E_k > 2.65\text{M}$ are very small and the effects of higher estate taxation are like those from Case 5. For the wealthy and especially the moderately wealthy, the negative effect of E_k is much stronger.

Table 5.3: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – altruism. **Case 7**: Progressive estate tax ($A = 11.7\text{M}$) and the children have zero endowments ($E_k = 0$).

Case 7 ($A = 11.700.000, E_k = 0$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$z = 1, \rho = 0.9$	Very wealthy	Wealthiest	-0,02	-0,03	-0,03	-0,04	-0,04	-0,06	-0,08	-0,12	-0,23	-0,79
		Bottom	-0,03	-0,04	-0,05	-0,06	-0,08	-0,12	-0,18	-0,31	-0,70	-3,34
	Wealthy	Median	-0,07	-0,09	-0,12	-0,15	-0,21	-0,31	-0,51	-0,98	-2,67	-9,09
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 1$	Very wealthy	Wealthiest	0,00	0,00	-0,01	-0,01	-0,01	-0,01	-0,02	-0,04	-0,09	-0,38
		Bottom	-0,02	-0,02	-0,03	-0,03	-0,05	-0,07	-0,10	-0,19	-0,45	-2,07
	Wealthy	Median	-0,06	-0,07	-0,09	-0,12	-0,16	-0,24	-0,38	-0,72	-1,85	-10,15
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 1.45$	Very wealthy	Wealthiest	0,05	0,05	0,06	0,06	0,07	0,08	0,09	0,11	0,13	0,16
		Bottom	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,03	-0,03	-0,37
	Wealthy	Median	0,00	-0,01	-0,02	-0,03	-0,04	-0,07	-0,13	-0,24	-0,58	-2,50
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 2$	Very wealthy	Wealthiest	0,08	0,09	0,09	0,10	0,11	0,12	0,13	0,15	0,18	0,24
		Bottom	0,07	0,07	0,07	0,08	0,08	0,09	0,10	0,10	0,09	-0,01
	Wealthy	Median	0,03	0,03	0,03	0,02	0,01	0,00	-0,02	-0,07	-0,21	-0,91
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 0.9$	Very wealthy	Wealthiest	-0,04	-0,05	-0,05	-0,07	-0,08	-0,11	-0,15	-0,23	-0,45	-1,67
		Bottom	-0,07	-0,08	-0,10	-0,13	-0,17	-0,24	-0,37	-0,66	-1,61	-9,49
	Wealthy	Median	-0,15	-0,19	-0,25	-0,33	-0,46	-0,70	-1,21	-2,59	-3,84	-0,20
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 1$	Very wealthy	Wealthiest	-0,01	-0,01	-0,01	-0,01	-0,02	-0,03	-0,04	-0,08	-0,18	-0,79
		Bottom	-0,03	-0,04	-0,05	-0,07	-0,09	-0,13	-0,21	-0,40	-0,96	-4,96
	Wealthy	Median	-0,11	-0,14	-0,18	-0,24	-0,33	-0,50	-0,84	-1,70	-5,20	-0,22
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 1.45$	Very wealthy	Wealthiest	0,07	0,08	0,08	0,09	0,10	0,11	0,13	0,16	0,19	0,23
		Bottom	0,05	0,05	0,05	0,06	0,06	0,06	0,05	0,03	-0,07	-0,68
	Wealthy	Median	-0,01	-0,02	-0,03	-0,05	-0,08	-0,13	-0,23	-0,44	-1,08	-5,20
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 2$	Very wealthy	Wealthiest	0,11	0,11	0,12	0,13	0,14	0,16	0,18	0,21	0,25	0,33
		Bottom	0,09	0,09	0,10	0,10	0,11	0,12	0,13	0,13	0,12	-0,03
	Wealthy	Median	0,03	0,03	0,03	0,02	0,01	-0,01	-0,04	-0,12	-0,34	-1,45
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Notes: The elasticities reported in Table 5.3 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.79% if $z = 1$, $\rho = 0.9$. 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

As in the case of warm glow, the positive mechanical effect of $\bar{\tau}_i$ on Ω_i also implies that reducing A (keeping τ constant) leads to positive and heterogeneous effects on the pre-tax bequests of wealthy and very wealthy donors. The effects on Ω_i of reducing A across the distribution of E_i in the case of altruism very much resemble those from the warm glow case, see Section 3.2.4 and Appendix C (results in the case of altruism therefore not shown).

Case 8: Progressive estate tax ($A = 11.7M$), significant endowments for the children ($E_k = 2.65M$)

If both A and E_k are significant, the optimal pre-tax bequests are given by Equation (12). If $A = 11.7\text{M}$, we know from Case 7 that only the wealthy and the very wealthy pay the estate taxes. The moderately wealthy, who faced the strongest negative effect of setting $E_k = 2.65\text{M}$ in Case 6, are no longer affected by the estate tax in Case 8. From Case 6 ($A = 0$, $E_k = 2.65\text{M}$), we also know that the negative impact of setting $E_k = 2.65\text{M}$ on the pre-tax bequests of the wealthy and especially the very wealthy are relative weak. This also holds in Case 8. By comparing the reported elasticities in Table 5.4 (Case 8, $A = 11.7\text{M}$, $E_k = 2.65\text{M}$) with those in Table 5.3 (Case 7, $A = 11.7\text{M}$, $E_k = 0$), we can study the partial impact setting $E_k = 2.65\text{M}$ given that the estate tax system is progressive with a high exemption. We can then compare these partial effects with those from the comparison between Table 5.2 (Case 5, $A = 0$, $E_k = 2.65\text{M}$) and Table 5.1 (Case 5, $A = 0$, $E_k = 0$). The partial effects of setting $E_k = 2.65\text{M}$ do not depend on the level of A.

Table 5.4: Micro elasticity of bequests ($\varepsilon^{\tau}_{\Omega_i}$) for different levels of τ – altruism. **Case 8**: Progressive estate tax ($A = 11.7\text{M}$) and the children have significant endowments ($E_k = 2.65\text{M}$).

Case 8 ($A = 11.700.000, E_k = 2.650.000$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$z = 1, \rho = 0.9$	Very wealthy	Wealthiest	-0,02	-0,03	-0,03	-0,04	-0,05	-0,06	-0,08	-0,13	-0,25	-0,92
		Bottom	-0,04	-0,05	-0,06	-0,07	-0,10	-0,13	-0,21	-0,37	-0,86	-4,28
	Wealthy	Median	-0,09	-0,11	-0,14	-0,19	-0,26	-0,39	-0,64	-1,26	-3,62	-0,23
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 1$	Very wealthy	Wealthiest	0,00	-0,01	-0,01	-0,01	-0,01	-0,02	-0,03	-0,05	-0,11	-0,47
		Bottom	-0,02	-0,02	-0,03	-0,04	-0,06	-0,08	-0,13	-0,24	-0,56	-2,64
	Wealthy	Median	-0,07	-0,09	-0,11	-0,14	-0,20	-0,30	-0,49	-0,93	-2,47	-7,43
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 1.45$	Very wealthy	Wealthiest	0,05	0,05	0,06	0,06	0,07	0,08	0,09	0,10	0,12	0,13
		Bottom	0,03	0,03	0,04	0,04	0,04	0,03	0,03	0,01	-0,07	-0,53
	Wealthy	Median	-0,01	-0,02	-0,03	-0,04	-0,07	-0,11	-0,18	-0,33	-0,78	-3,41
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 1, \rho = 2$	Very wealthy	Wealthiest	0,08	0,08	0,09	0,10	0,11	0,12	0,13	0,15	0,18	0,23
		Bottom	0,07	0,07	0,07	0,08	0,08	0,08	0,09	0,09	0,07	-0,08
	Wealthy	Median	0,02	0,02	0,02	0,01	0,00	-0,02	-0,05	-0,12	-0,31	-1,24
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 0.9$	Very wealthy	Wealthiest	-0,04	-0,05	-0,06	-0,07	-0,09	-0,11	-0,16	-0,25	-0,51	-1,99
		Bottom	-0,08	-0,09	-0,12	-0,15	-0,20	-0,28	-0,44	-0,81	-2,04	-13,80
	Wealthy	Median	-0,19	-0,23	-0,30	-0,41	-0,59	-0,91	-1,62	-3,72	-0,24	-0,19
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 1$	Very wealthy	Wealthiest	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,05	-0,10	-0,22	-0,98
		Bottom	-0,04	-0,05	-0,06	-0,08	-0,11	-0,17	-0,27	-0,50	-1,23	-6,77
	Wealthy	Median	-0,14	-0,17	-0,23	-0,30	-0,43	-0,65	-1,12	-2,35	-3,25	-0,21
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 1.45$	Very wealthy	Wealthiest	0,07	0,08	0,08	0,09	0,10	0,11	0,13	0,15	0,18	0,18
		Bottom	0,05	0,05	0,05	0,05	0,05	0,04	0,03	-0,01	-0,14	-0,97
	Wealthy	Median	-0,03	-0,04	-0,06	-0,08	-0,13	-0,19	-0,32	-0,61	-1,50	-7,81
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$z = 0.5, \rho = 2$	Very wealthy	Wealthiest	0,11	0,11	0,12	0,13	0,14	0,16	0,18	0,20	0,25	0,31
		Bottom	0,09	0,09	0,09	0,10	0,11	0,11	0,12	0,11	0,09	-0,13
	Wealthy	Median	0,02	0,02	0,01	0,00	-0,01	-0,04	-0,09	-0,20	-0,50	-2,01
	Moderately wealthy and poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Notes: The elasticities reported in Table 5.4 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon^{\tau}_{\Omega_i} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.92% if $z = 1$, $\rho = 0.9$. 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

3.3.5 Conclusions (altruism)

The **first key result from section 3.3.4** is that the effects of higher estate taxation on the size of pre-tax bequests under altruism are characterized by several important heterogeneities:

- The effect of higher estate taxation on pre-tax bequests is homogeneous across the wealth distribution only if the estate tax is linear and if the children have zero endowments (Case 5). The effect then solely depends on ρ, on the pre-reform level of τ, and on z. The higher the initial level of τ, and the lower z, the more outspoken the positive and negative effects of a given increase in τ. Different elasticities depending on τ and z constitute the first heterogeneity.
- If the endowments of the children are significant, a given increase in τ leads to stronger negative (weaker positive) effects on Ω_i, mainly at lower levels of wealth (endowments). The behavior of very wealthy parents is barely affected. Different elasticities depending on E_k constitute the second heterogeneity.
- If the estate tax is progressive, a given increase in τ leads to stronger negative (weaker positive) effects on Ω_i, especially for donors with pre-tax bequests above but relatively close to the exemption. For the very wealthy, the effects of going from a linear estate tax to a progressive estate tax system has only (very) small effects on the reported elasticities. For them, the increase in $\bar{\tau}_i$ and hence the positive mechanical effect on Ω_i is maximal. Different elasticities depending on A constitute the third heterogeneity. It applies to all estate tax systems where the average estate tax rate $\bar{\tau}_i$ may be considerably below the marginal estate tax rate τ for many donors.
- Another implication of the third heterogeneity is that reducing the estate tax exemption also leads to heterogeneous effects on Ω_i. For all donors with pre-reform levels of Ω_i above A, a reduction in A leads to strictly positive effects on pre-tax bequests. This positive effect is declining in E_i. For the very wealthy, the effect of reducing the exemption is negligible.

These heterogeneities do not require heterogeneity in the underlying bequest motive, nor in preferences in general. They directly follow from heterogeneities in endowments if the endowments of the children are significant, or if the estate tax is progressive. Overall, the heterogeneities from Section 3.3.4 (altruism) are similar to those from the case of warm glow.

The **second key result from section 3.3.4** is that, for very wealthy donors, the micro elasticities of bequests are *not* typically negative and large under altruism. For the entire range of reasonable values for the elasticity of marginal utility of consumption, $0.9 \leq \rho \leq 2$, and for values of z of 0.5 or 1, the most extreme micro elasticities of bequests reported for those with Ω_i of at least 10 times $A = 11.7\text{M}$ over the interval $0\% \leq \tau \leq 50\%$ are -0.28 and 0.17. Over the interval $50\% \leq \tau \leq 70\%$ the most extreme elasticities for these very wealthy are -0.81 and 0.24. For the wealthiest donor in the hypothetical distribution (who has endowments of around USD 700M), the most extreme negative elasticities are -0.11 over the interval $0\% \leq \tau \leq 50\%$ and -0.25 over the interval $50\% \leq \tau \leq 70\%$ if $\rho = 0.9$. I refer to Tables 5.1 to 5.4. For more central values of elasticity of marginal utility of consumption (the point estimate for wealthy Americans is $\rho =$

1.45, see Appendix A), the effects of higher estate taxation on pre-tax bequests are typically positive and weak for very wealthy donors. Stronger negative elasticities for the very wealthy are found only for the lowest ρ and for the highest marginal tax rates. This result holds even under the extreme assumptions that altruism is the sole motive behind bequests.[36] This supports the main conclusion that higher estate taxation does *not* typically lead to strong negative effects on the size of pre-tax bequests at the top of the wealth distribution in the case of altruism.

Because of the heterogeneities driven by E_k and A the effects of higher estate taxation on pre-tax bequests under altruism may well be negative for many donors, even with ρ at or above unity. The negative effects under these circumstances may be strong especially for parents whose endowments are above but relatively close to their children's endowments and/or whose average estate tax rate is considerably below the marginal estate tax rate. The implied micro elasticities of bequests thus depend on the extent to which $\bar{\tau}_i$ is below τ, and how the endowments of the parents relate to those of the children. Table 1b shows that a handful of previous studies already considered estate tax reforms in a theoretical framework with altruism under a progressive estate tax system. Farhi and Werning (2010) and Strawczynski (2014) assume $\rho = 1$. Given that the estate tax system is progressive, the effects of higher estate taxation on taxable bequests are (implicitly) assumed to be negative. Piketty and Saez (2013) impose an exogenous negative micro elasticity of bequests. Castañeda et al. (2003) and Cagetti and De Nardi (2009) both set $\rho = 1.5$, while Kaymak and Poschke (2016) set $\rho = 1.1$. Especially in the latter study, the effects of higher estate taxation may well be negative even though ρ is somewhat above 1.

Compared to the warm glow case, the negative effects of higher estate taxation on the size of pre-tax bequests of wealthy donors are somewhat more outspoken under altruism. There are three main explanations. First, if bequests are a luxury good because of $\omega < \rho$, the negative effects of higher estate taxation are typically smaller (warm glow). Second, in the case of altruism it is consumption of the children that matters, a variable that may be affected by many variables, including the endowment of the child and the after-tax bequest received, in reality. In case of warm glow, it is the after-tax bequest that directly enters the utility function. As a result, the positive mechanical effect of $\bar{\tau}_i$ is maximal in the case of warm glow. Third, in case of altruism, E_k is much higher than c_B from the warm glow case. As explained in Sections 3.2.4 and 3.3.4, both have negative effects on the reported elasticities.

3.3.6 A three-generations framework ($\Omega_k \geq 0$)

When the model with an altruistic bequest motive is extended by adding a third generation (the grandchild of individual i) and by assuming that the child k also has an altruistic bequest motive (leading to $\Omega_k \geq 0$), the positive and negative effects of higher estate taxation on Ω_i may become more outspoken. If circumstances are such that taxing the children's bequests imply a reduction in $\Omega_{k,5}$ and hence higher c_k (compared to the untaxed $\Omega_{k,5}$, or $\Omega_{k,5} = 0$ cases), the negative

[36] The true elasticities of bequests across the distribution of wealth (endowment) will always be smaller (in absolute terms) than those reported in Tables 5.1 to 5.4, see the discussion at the end of Section 3.2.4.

(positive) effects of higher estate taxation on the pre-tax bequests of wealthy individuals i become more (less) outspoken. This is intuitive: if endogenizing Ω_k implies an increase in the child's consumption, for a given increase in τ, an altruistic parent will partially compensate this by reducing pre-tax bequests Ω_i. Using the same logic, also the positive effects on Ω_i will then become more outspoken.[37] The general rule is as follows: if the micro elasticity of the child's bequests has the same (opposite) sign as the micro elasticity of the parent's bequests, $\varepsilon_{\Omega_i}^{\tau}$ will become more (less) outspoken.

Overall, the central result that the effects of higher estate taxation on very wealthy donors are typically small also holds in a three (or more) generations framework, although there are some combinations of circumstances where $\varepsilon_{\Omega_i}^{\tau}$ becomes negative and stronger. The main explanation why the pre-tax bequests of the very wealthy are relatively insensitive to the circumstances is simply because their endowments and hence pre-tax bequests are so high: changes in A, E_k and $\Omega_{k,5}$ have only small effects on Ω_i.

4. CONCLUSIONS

The main motivation behind this paper is the remarkable discrepancy between the assumptions in different strands of the literature as to the micro elasticity of bequests in the United States.

In empirical studies on the effects of higher estate taxation, the micro elasticity of bequests is most likely weak, but estimates for this elasticity are very imprecise. In the broad (theoretical) literature on the motives behind bequests, the present consensus is that bequests are most likely driven by a complex mix of pre-tax and after-tax motives. These findings are consistent with the weak elasticities from empirical studies. Meanwhile, theoretical studies regarding the effects of estate taxation used a variety of micro elasticities of bequests, including zero, very strong positive and very strong negative elasticities. Most theoretical studies have explicitly imposed, or (un)intentionally assumed, a negative relationship between the estate tax and size of pre-tax bequests for many donors. Many of these studies furthermore argued that the implications for welfare, efficiency, and inequality of the estate tax critically hinge upon whether households have a pre-tax or after-tax bequest motive. In policy making, and in the media, the estate tax was often criticized for its potential disincentive effects, which is also consistent with a negative micro elasticity. At the same time, and contrary to all the findings from this paragraph, empirical estimates for the elasticity of marginal utility of consumption (and bequests) go from 0.9 to 2, with a point estimate of 1.45 for wealthy Americans. These findings are consistent with a positive micro elasticity of bequests.

[37] If circumstances are such that the child k increases $\Omega_{k,5}$ and hence reduces c_k if the marginal estate tax increases, which may occur for standard values of ρ, the wealthy parent will increase pre-tax bequests by even more compared to the $\Omega_{k,5} = 0$ case.

In this paper, I study the theoretical relationship between the (marginal) estate tax rate and the size of pre-tax bequests of (wealthy) donors for the two most popular after-tax bequest motives from the previous literature: warm glow and altruism. Under both motives, I study this micro elasticity of bequests across the distribution of wealth (endowments), over the entire range of plausible parameterizations of preferences over consumption and bequests, and for two types of estate tax systems: linear and progressive.

The first key result of this paper is that the micro elasticity of bequests exhibits several important heterogeneities across the distribution of wealth (endowments). These heterogeneities directly follow from heterogeneities in endowments if the estate tax system is progressive (warm glow and altruism), when bequests are a luxury good (warm glow), or when the endowments of the children are significant (altruism). A given increase in the marginal estate tax rate leads to a mix of positive and negative effects on pre-tax bequests across the wealth distribution. This holds both under warm glow and under altruism. If the tax system is progressive with a high exemption, such as in the U.S. today, poor and moderately wealthy individuals are not affected. Under most parameterizations, wealthy donors will then react negatively to a rise of the estate tax rate. Very wealthy donors, however, typically respond positively and increase their pre-tax bequest when the estate tax rate rises. Positive and negative effects on taxable bequests may thus occur even when all households have identical preferences. Strong negative micro elasticities of bequests can be an indirect result of (a combination of) the following assumptions: an elasticity of marginal utility of consumption or bequests below, at, or slightly above unity (warm glow and altruism), a progressive estate tax system (warm glow and altruism), a positive consumption threshold above which the bequest motive becomes operative (warm glow only), and/or significant endowments of the children (altruism only).

That the micro elasticity of bequests of very wealthy donors is not typically negative and large, is the second key result of this paper. I highlight several explanations. First, central values for the elasticities of marginal utility of consumption and bequests imply that the positive mechanical effect of the (average) estate tax rate is strong, implying a positive net effect on pre-tax bequests. Second, in those circumstances (parameterizations) where the micro elasticities of bequests are negative, the very wealthy are always those who respond the least: the pre-tax bequests of the very wealthy are the least sensitive to the circumstances under which an estate tax reform takes place. Third, the previous literature highlighted that, in the class of after-tax bequest motives, warm glow is the best candidate to describe the behavior of the very wealthy, and that bequests are most likely a luxury good. I show that under these preferences any negative effects on the pre-tax bequests of very wealthy donors are typically weak. A fourth reason (outside my model) is that, in reality, wealth and bequests are most likely driven by a mix of lifecycle motives and (after-tax and pre-tax) bequest motives. Both the positive and the negative effects on pre-tax bequests are therefore smaller in the real world than those reported in this paper. Under plausible parameterizations of preferences over consumption and bequests (including central values for the elasticity of marginal utility of consumption and bequests above unity), there are no reasons to assume negative micro elasticities of bequests per se, especially for the very wealthy.

I do not argue that the overall effects of higher estate taxation on pre-tax bequests of donors are positive and large. The effects are heterogeneous in most circumstances: positive elasticities for very wealthy donors do not exclude negative elasticities for less wealthy households. Positive micro elasticities of bequests at the top of the wealth distribution are not inconsistent with the small negative micro elasticities reported in previous empirical studies. The heterogeneities highlighted in this paper may even be an additional explanation behind the identification issues faced by these empirical studies. Also, the presence of heterogeneities may be a natural way to reconcile standard parameterizations of preferences over consumption and bequests (including elasticities of marginal utility of consumption and bequests above unity), allowing for positive effects on the pre-tax bequests for very wealthy donors, with the weak (average) micro elasticities of bequests reported in the previous empirical literature.

Nor do I argue that positive and weak micro elasticities for very wealthy donors imply that the macro elasticity of bequests, i.e., the aggregate relationship between the estate tax and the size of pre-tax bequests, is also positive and weak. First, less wealthy donors typically respond more negatively. Second, after-tax bequests always respond negatively to higher estate taxation: a higher estate tax ceteris paribus makes the children of the wealthy poorer.

From a policy perspective, I argue that the economic case of higher estate taxation is strong, because potential negative effects on the bequest decisions of very wealthy (and productive) households are typically small, and because I do not expect large disincentive effects following from higher estate taxation. The findings in this paper also suggest that the overall relationship between the estate tax and the size of pre-tax bequests in case of an after-tax bequest motive (altruism and warm glow) is similar to the effects in case of a (pre-tax) capitalistic bequest motive and/or in the case of accidental bequests only, especially for (very) wealthy donors. In the context of key macroeconomic outcomes, policy makers should not worry too much about the true nature of bequests. Because of the weak responses by (very) wealthy donors, the additional tax revenues generated by higher estate taxation may be large.

The focus in this paper is on the United States. The main results are nevertheless very easily extendable to other countries. First, the heterogeneity that follows in the theoretical example from setting the estate tax exemption equal to USD 11.7M (as in the United States today), may also apply in other estate tax systems, even those with a lower exemption. This heterogeneity will apply in all estate tax systems where the average estate tax rate is considerably below the marginal estate tax rate for many donors. Second, the heterogeneities that follow from modeling bequests as a luxury good automatically apply to other countries. Third, the second main result that the micro elasticity of bequests is not typically negative and strong for very wealthy donors may also hold in other countries. The point estimates for the elasticity of marginal utility of consumption (and bequests) in other countries are typically above unity as well, see Evans (2004, 2005). This implies that the micro elasticity of bequests may well be positive in other countries too, especially for very wealthy donors.

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Bequests and the estate tax.
A review of theory and (new) evidence.

APPENDICES A to C

Pieter Van Rymenant – Ghent University and Research Foundation (FWO) Flanders

Appendix A: The reasonable ranges for c_B, $\phi/(1-\phi)$, ω and ρ.

c_B and $\phi/(1-\phi)$

From a purely theoretical point of view, c_B may become very high, such that only very few donors consume enough to provide positive bequests. However, given the very high levels of wealth and bequests at the top of the distribution, and given the considerable reluctance of wealthy individuals to decumulate their wealth at old age, the value for c_B must be bounded from above. Indeed, starting from Equation (7), we know that very high levels of bequests Ω_i can only occur if the difference between $(1-\tau_i)^{1/\omega} {c_i}^{\rho/\omega}$ and c_B is positive.

$$\Omega_i = \left(\frac{\phi}{1-\phi}\right)\frac{\left[(1-\tau_i)^{1/\omega} {c_i}^{\rho/\omega} - c_B\right]}{(1-\bar{\tau}_i)} \tag{7}$$

Several studies have estimated or calibrated the threshold consumption level c_B starting from a quantitative lifecycle framework. For instance, De Nardi, French and Jones (2016) develop a quantitative endogenous medical spending model, where the utility from bequests is:

$$V_i(B_i) = \frac{\phi_1(\phi_2 + B_i)^{\,1-\omega}}{1-\omega}$$

They then estimate several model parameters including ϕ_1 and ϕ_2 based on the Asset and Health Dynamics Among the Oldest Old (AHEAD) datasets between 1994 and 2010 and the Medicare Current Beneficiary Surveys (MCBS) between 1996 and 2010. Their point estimates for ϕ_1 and ϕ_2 are 39.7 and USD 13.000 (yearly) respectively. Given that their ϕ_1 coincides with my $[\phi/(1-\phi)]^{\omega}$ and given that ω is equal to 2.83 in their model, the implied value for the taste for bequest parameter from my model, $\phi/(1-\phi)$, is $[39.7]^{1/2.83} \approx 3.67$.[38] Since ϕ_2 in De Nardi, French and Jones (2016) coincides with $\phi/(1-\phi)\,c_B$ from my model, the implied value for the yearly c_B is around USD 3500 in De Nardi et al. (2016).

[38] In the main paper I renamed the taste-for-bequests parameter $\phi/(1-\phi)$ by b.

In a model without medical expenses, De Nardi and Yang (2016) jointly calibrate the same two preference parameters to match the bequests to wealth ratio and the 90th percentile of the bequest distribution normalized by income. Using the same reasoning as earlier and given that their framework has model periods of five years, the implied yearly c_B is USD 112.000.

In De Nardi (2004) the parameters in the utility-from-bequests function are calibrated to match a transfer wealth share of 60% and to match the true ratio between the average bequest left by single decedents in the lowest 30-th percentile and median household income. The implied value for the yearly c_B is USD 58.500. Yang and Gan (2020) also take these values from De Nardi (2004) and apply them to China.

In the quantitative lifecycle model of Lockwood (2018), which also incorporates health risk, medical expenses, and long-term care insurance, $\phi/(1-\phi)$ and c_B are estimated based on the Health and Retirement Studies (HRS) between 1998 and 2008. He reports a reasonable range for the yearly c_B between USD 19.000 and USD 24.000, and these values are robust across different specifications. According to the summary statistics reported in this paper, 22% of households aged 65+ declare that bequests are very important, while 46% finds that bequests are somewhat important.

Estimated or calibrated values for the yearly c_B from other studies are always below 50.000 USD. De Nardi, French and Jones (2010) report values between USD 31.500 and USD 43.000. Ameriks et al. (2011) find a terminal bequest threshold equal to USD 7.100. Kopczuk and Lupton (2007) find that around three quarters of the population has a bequest motive, and when death is certain, households bequeath all their wealth above USD 29.700.

Based on previous studies, the reasonable range for the yearly c_B is between USD 3.500 and USD 58.500, with only De Nardi and Yang (2016) reporting a value beyond that range: USD 112.000. In the numerical examples in the main paper, I study the two extreme cases $c_B = 0$ and $c_B =$ 112.000, and for the plausible range of values for ω and ρ. I show that even the highest possible value for c_B has a negligible effect on the pre-tax bequests of the very wealthy. Moreover, with relatively high initial exemption levels, the value for c_B also loses importance for a broader group of wealthy donors.

As to the taste-for-bequests parameter, the above studies all report values for $\phi/(1-\phi)$ below 20. In my numerical examples I consistently calibrate the taste-for-bequests parameter $\phi/(1-\phi)$ to obtain a marginal propensity to bequeath for the median individual of 83.33%, nicely within the range of values reported in the literature. De Nardi, French and Jones (2016) report a marginal propensity to bequeath equal to 0.78. In their 2010 paper, the estimated range is 0.88 to 0.89. In Lockwood (2018) the marginal propensity to bequeath ranges between 0.95 and 0.96. In the numerical examples where I set $\omega < \rho$ or $c_B > 0$, the marginal propensity to bequeath becomes heterogeneous across the distribution of endowments and may well be above 0.90 for the wealthiest donors, given the recalibration of $\phi/(1-\phi)$. My calibrated value for $\phi/(1-\phi)$ is always below 20. Its value only determines the magnitude of the response, not the sign. It does not affect the two central results in the main paper that the effects of higher

estate taxation on the size of taxable bequests are heterogeneous, and not typically strong and negative for very wealthy donors.

In all numerical examples from Section 3.2, the sign and magnitude of the effects of higher estate taxation on the size of taxable bequests critically hinge upon the values for ω and ρ.

ω and ρ

What is the common range for ω and ρ based on previous lifecycle models that study the effects of the estate tax under warm glow? Does this strand in the literature also allow for positive effects on pre-tax bequests? And what are the reasonable ranges for ω and ρ based on empirical studies? I start with the first two questions.

In theoretical lifecycle models that study the estate tax in a warm glow setting, there is a variety of values for ω and ρ. I refer to Table 1a of the main paper. Most studies assume $\omega = \rho$. Interestingly, in all these papers there are no empirical studies cited regarding the determination of ω. A more relevant question may therefore be what the reasonable range for ρ is, the coefficient of relative risk aversion in consumption. From a purely theoretical perspective, the only formal restriction on this parameter is $\rho > 0$. In the context of the estate tax however, the question is mainly whether ρ and ω are below or above unity, see main paper.

In a model without uncertainty, the coefficient of relative risk aversion coincides with the elasticity of marginal utility of consumption (EMUC). Few empirical studies have estimated this elasticity. Chetty (2006) estimates ρ for the United States based on observed work time responses to wage changes and finds an upper bound of 2 for this parameter. Asplund (2017) performs a numerical sensitivity analysis with respect to the Chetty model by developing a model with home production that leads to unbiased estimates for the EMUC. She finds a lower bound for the EMUC of 0.9 and a reasonable range of 0.9 to 1.6, also for the United States. Evans (2005) estimates that the average value in OECD countries for the EMUC is 1.4, and that the value is typically above unity. Specifically for high income households in the United States he finds a value of 1.45. Evans (2004) furthermore finds a value for the EMUC of 1.6 for the United Kingdom.

I wish not to take a stance regarding the true values of ω and ρ. I therefore take a cautious approach in the main paper by studying the effects of higher estate taxation over the entire plausible range for ω and ρ. I nevertheless want to highlight the remarkable discrepancy between the assumption in many studies that a higher estate taxation reduces pre-tax bequests of wealthy donors (see Tables 1a and 1b of the main paper), but that standard values for ω and ρ from the economic literature imply a positive relationship. I also argue that there are no reasons to assume values for ω and ρ below unity per se. The relationship between wealthy donors' pre-tax bequests and the estate tax also depends on the type of estate tax system and on other parameters. I show in the main paper that even with values of ω and ρ above unity, the micro elasticity of bequests may still be negative and large for a large group of donors (but not for the very wealthy).

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Appendix B: The effects of a higher (marginal) estate tax on optimal pre-tax bequests: warm glow

Table B1: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{\tau}$) for different levels of τ – warm glow. **Case 2c**: Linear estate tax ($A = 0$) and bequests a luxury good ($c_B = 112.000$ and $\omega < \rho$).

Case 2c ($A = 0, c_B = 112.000, \omega < \rho$)			**Elasticity of bequests at marginal estate tax rate τ:**									
			0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
$\omega = 0.9$, $\rho = 1.125$	Very Wealthy	Wealthiest	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02	-0,03	-0,07
		Bottom	-0,01	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,04	-0,10
	Wealthy	Median	-0,01	-0,01	-0,01	-0,01	-0,02	-0,02	-0,03	-0,04	-0,06	-0,15
		Bottom	-0,01	-0,01	-0,02	-0,02	-0,02	-0,03	-0,04	-0,05	-0,09	-0,27
	Moderately	Median	-0,04	-0,05	-0,06	-0,07	-0,10	-0,13	-0,20	-0,35	-0,81	-3,75
	wealthy	Bottom	-0,52	-0,68	-0,93	-1,34	-2,14	-4,07	-12,41	0,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 1$, $\rho = 1.25$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01
	Wealthy	Median	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,03
		Bottom	0,00	0,00	0,00	0,00	0,00	0,00	-0,01	-0,01	-0,02	-0,10
	Moderately	Median	-0,02	-0,03	-0,03	-0,04	-0,06	-0,08	-0,13	-0,23	-0,54	-2,40
	wealthy	Bottom	-0,45	-0,58	-0,78	-1,10	-1,69	-2,99	-7,15	-100,00	0,00	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 1.45$, $\rho = 1.8125$	Very Wealthy	Wealthiest	0,01	0,02	0,02	0,02	0,02	0,02	0,03	0,04	0,05	0,09
		Bottom	0,02	0,02	0,02	0,03	0,03	0,03	0,04	0,05	0,07	0,11
	Wealthy	Median	0,02	0,03	0,03	0,03	0,04	0,04	0,05	0,06	0,08	0,14
		Bottom	0,03	0,03	0,03	0,04	0,04	0,05	0,06	0,07	0,09	0,14
	Moderately	Median	0,03	0,03	0,03	0,04	0,03	0,03	0,02	0,00	-0,08	-0,55
	wealthy	Bottom	-0,25	-0,32	-0,41	-0,56	-0,80	-1,23	-2,14	-4,85	-28,81	0,00
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero
$\omega = 2$, $\rho = 2.5$	Very Wealthy	Wealthiest	0,02	0,02	0,03	0,03	0,03	0,04	0,04	0,05	0,06	0,10
		Bottom	0,03	0,03	0,04	0,04	0,04	0,05	0,06	0,07	0,09	0,13
	Wealthy	Median	0,04	0,04	0,05	0,05	0,05	0,06	0,07	0,08	0,11	0,16
		Bottom	0,05	0,05	0,05	0,06	0,07	0,07	0,08	0,10	0,13	0,18
	Moderately	Median	0,06	0,07	0,07	0,08	0,08	0,09	0,09	0,09	0,07	-0,10
	wealthy	Bottom	-0,13	-0,16	-0,22	-0,30	-0,42	-0,62	-1,00	-1,88	-4,88	-67,93
	Poor	All	zero	zero	zero	zero	zero	zero	zero	zero	zero	zero

Note: The elasticities reported in Table B1 are the percentage change in pre-tax bequests Ω_i relative to a one percentage point increase in the marginal tax rate: $\varepsilon_{\Omega_i}^{\tau} = (\Delta\Omega_i/\Omega_i)/\Delta\tau$, with $\Delta\tau = 0.01$. For instance, the top right cell indicates that if τ rises from 90% to 91%, the wealthiest donor reduces Ω_i by 0.07% if $\omega = 0.9$, $\rho = 1.125$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.

Appendix C: The effects of reducing the initial exemption on optimal pre-tax bequests: warm glow

Table C1: Micro elasticity of bequests ($\varepsilon_{\Omega_i}^{A}$) for different levels of A – warm glow. **Case 3**: Progressive estate tax ($\tau = 40\%$) and bequests a luxury good ($c_B = 0$, $\omega < \rho$).

Case 3 ($A = 11.700.000, c_B = 0, \omega = \rho$)			**Elasticity of bequests at exemption A (in Millions):**						
			0,0	**2,0**	**4,0**	**6,0**	**8,0**	**10,0**	**11,7**
$\omega = \rho = 0.9$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		Bottom	0,00	0,00	0,00	0,01	0,01	0,01	0,01
	Wealthy	Median	0,00	0,01	0,01	0,02	0,03	0,03	0,04
		Bottom	0,00	0,01	0,03	0,04	0,06	0,08	0,09
	Moderately wealthy and poor	All	negative	negative	negative	negative	negative	negative	negative
$\omega = \rho = 1$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		Bottom	0,00	0,00	0,00	0,01	0,01	0,01	0,01
	Wealthy	Median	0,00	0,01	0,01	0,02	0,03	0,03	0,04
		Bottom	0,00	0,01	0,03	0,04	0,06	0,07	0,09
	Moderately wealthy and poor	All	negative	negative	negative	negative	negative	negative	negative
$\omega = \rho = 1.45$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		Bottom	0,00	0,00	0,00	0,00	0,01	0,01	0,01
	Wealthy	Median	0,00	0,01	0,01	0,02	0,02	0,03	0,03
		Bottom	0,00	0,01	0,02	0,04	0,05	0,06	0,07
	Moderately wealthy and poor	All	negative	negative	negative	negative	negative	negative	negative
$\omega = \rho = 2$	Very Wealthy	Wealthiest	0,00	0,00	0,00	0,00	0,00	0,00	0,00
		Bottom	0,00	0,00	0,00	0,00	0,01	0,01	0,01
	Wealthy	Median	0,00	0,00	0,01	0,01	0,02	0,02	0,03
		Bottom	0,00	0,01	0,02	0,03	0,04	0,06	0,07
	Moderately wealthy and poor	All	negative	negative	negative	negative	negative	negative	negative

Note: The elasticities reported in Table C1 are the percentage change in pre-tax bequests Ω_i relative to a one percent decline in the estate tax exemption: $\varepsilon_{\Omega_i}^{A} = (\Delta\Omega_i/\Omega_i)/(-\Delta A/A)$.

Note: 'Median' indicates the median individual (in terms of endowments and hence wealth) in that specific category. 'Bottom' indicates the poorest individual (in terms of endowments and hence wealth) in that specific category.