Behavioral Responses and Design of Bequest Taxation

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Abstract

This paper studies the optimal design of an intergenerational wealth tax, commonly represented by either inheritance or estate taxation. Depending on the tax schedule, bequest donors can utilize a number of tax reduction strategies ranging from adjustments of wealth accumulation and inter-vivos gifts to changes in the distribution of inheritances among heirs. We leverage a unique and appropriate setup of Swedish inheritance taxation and rich administrative data on bequests. To understand the individual behavior under various tax schemes and to show the effect of alternative tax designs on wealth accumulation in old age, bequest distributions, and government tax revenues, we estimate a comprehensive structural model of wealth accumulation and bequest decisions in old age. We find that comparable inheritance and estate tax result in similar distortions to wealth accumulation and bequest distributions. By limiting strategic avoidance through adjustments in bequest distributions, estate taxation outperforms inheritance taxes in terms of tax revenues. Our model enables policymakers to design a bequest tax that balances distortions, progressiveness, tax revenue and tax incidence according to their social welfare functions.

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1 Introduction

Inherited wealth plays a key role in the intergenerational persistence of wealth inequality across families. In an active policy debate, economists and policy-makers are exploring whether and how to promote social mobility by taxing estates or bequests.[1] While a large body of literature documents the intergenerational and across-family consequences of inherited wealth (Boserup *et al.*, 2016; Elinder *et al.*, 2016; Adermon *et al.*, 2018), the microeconomic behavior of old-age individuals, from here on referred to as *donors*, with respect to bequests and their response to taxation is poorly understood.

There are two types of intergenerational wealth transfer taxes commonly adopted around the world: estate and inheritance taxation. In the case of the estate tax, the tax base is the terminal wealth of a deceased individual, whereas in the latter case tax is levied on the individual bequest that each heir receives. These main differences in the tax structure might lead to different behavioral responses and welfare implications.

When donors choose how to optimally transfer wealth to a heterogeneous set of heirs under bequest taxation, they can utilize several strategies. Applicable to both inheritance and estate taxation, old-age individuals can adjust the wealth accumulation or use inter-vivos gifts to react to the tax (Joulfaian, 2006; Kopczuk & Lupton, 2007; Glogowsky, 2016). In the case of progressive inheritance taxation, donors can alter their preferred bequest distribution among children, i.e. their shares of the terminal estate, in order to allocate one or several individual bequests at lower marginal tax rates.[2]

The trade-off that old-age individuals face under bequest taxation can be characterized as a *donor trilemma*. Depending on the utility weights that the donor puts on current consumption, total after-tax bequest value and preferences for specific bequest distribution, the tax will trigger a trade-off of one of these three objectives against the remaining pair.[3] Consequently, bequest taxation will decrease donor welfare through distortions in wealth accumulation, bequest values and/or bequest distribution. If donor responses are used to legally avoid taxes, e.g. lower

[1]Currently fifteen US states have an estate taxation in place and six states tax inheritances. Maryland and New Jersey have both systems. In Europe, bequest taxation is in place in Denmark, France, Spain, Germany and Finland (inheritance tax) and the UK (estate taxation). A large number of European countries, such as Sweden, Norway, Austria, Hungary, and Portugal as well as several US states have repealed bequest taxation in the last 20 years with ongoing debates about re-introduction.

[2]Additionally, in Sweden (1992-2004), bequests could be classified into lower tax brackets, if heirs decided to cede part or all of the inheritance directly to their offsprings. We discuss this particular tax avoidance strategy in detail in Section 2C.

[3]Under inheritance taxation, a donor objective in this trilemma is traded-off with the remaining pair. Under bequest estate taxation, the problem is essentially reduced to a dilemma, as changing individual bequest shares to children does not affect the tax base.

terminal wealth or tax-minimizing changes in the bequest distribution, then total tax revenue may be negatively affected.

The choice of tax design and taxpayer responses to the policy are therefore inevitably related, as a policymaker trades off equity and efficiency (Piketty & Saez, 2013). In this paper we estimate a comprehensive structural model of donor decision to study this complex nature of donors' behavioral responses to inform on optimal taxation design with a purpose of minimizing distortions created by the tax but, at the same time, maximizing tax revenues. More precisely, using detailed data on bequests, wealth, family structure and characteristics of decedents and heirs in Sweden from 2001 to 2004, we estimate the dynamic model of donors, which involves wealth accumulation, inter-vivos gifts, and end-of-life bequest allocation decisions. There are a number of reasons why this structural approach is appropriate and even necessary in this case. First, given that the question of optimal policy design involves studying regulations which have not been observed before, thus lacking the variation to obtain reduced form responses, estimating policy-invariant individual preferences is required. Second, the model uncovers the interplay between multiple responses to taxation, rather than pinpointing overall elasticities to the tax, e.g. through bunching estimators (Saez, 2010; Glogowsky, 2016). Third, we can inform policymakers by providing counterfactuals for a multitude of policy designs along several dimensions including wealth accumulation, bequest distribution, and tax revenues.

The developed model allows obtaining parameters that govern the donors' dynamic trade-off between consumption, after-tax bequests and bequest distribution. Each period, the old-age individual decides on a fraction of wealth to be consumed or transferred to her/his offspring. The remaining wealth is transferred to the next period, where depending on the survival outcome of the donor, it is either bequeathed or again subject to the de- or accumulation choice. The donor also anticipates that in case of death, she/he will choose on a final distribution of bequests, conditional on the terminal wealth. Finally, the utility from bequeathing derives from a combination of the total after-tax bequest value and a negative component, that punishes the deviation from the preferred undistorted bequest distribution.

The disutility of deviating from the preferred undistorted bequest distribution to children requires the identification of *true* donor bequest preferences in the absence of taxation. To do so, we exploit variation in family structure, wealth and the presence of a ceding rule in the Swedish institutional set-up. The latter allows heirs to cede all or part of a bequest to direct offsprings in order to minimize the tax bill by making a full use of individual exemption levels.[4] We show that a subgroup of donors, whose heirs can cede and potentially avoid the entire donor tax bill, do not distort their bequest distribution away from their *true* preference as a reaction

[4] Ohlsson (2007) documents this incentive for Swedish heirs and shows that it is a widely used practice.

to taxation.

Undistorted *true* donor preferences for the distribution of bequests among children are therefore identified on the first stage before estimating a dynamic structural model. This first stage uses a subsample of decedents in a structural model with switching costs, exploiting variation in family structures and characteristics of donors and heirs. The obtained parameters are then entering the second stage model in the spirit of a two-stage estimation of dynamic life-cycle models (Blundell *et al.*, 2016; Lockwood, 2018).[5]

Finally, using the estimates for the dynamic structural model, counterfactual wealth paths and bequest distributions are simulated under various tax schemes. We create comparable estate and inheritance schemes by equalizing their total tax revenues. We find that comparable in terms of progressiveness inheritance and estate tax schedules perform similarly in terms of distortions. Under bequest taxation, donors accumulate significantly lower levels of wealth in old age. Due to the progressiveness of both taxes, this effect is driven by individuals at the upper tail of the wealth distribution. Consequently, terminal estates are lower and large masses in the bequest distribution are shifted below the kinks of the marginal tax rates. Importantly, due to additional margins of strategic behavior under inheritance taxation, estate taxes lead to higher tax revenue. At the cost of relaxing the control over tax incidence, estate taxation can be designed to further minimize distortions.

This paper contributes to the literature on bequest taxation in several ways. Broadly speaking, this paper is related to a number of papers studying the life-cycle behavior of old-age individuals that among others involve wealth accumulation and bequest decisions (French, 2005; Laitner *et al.*, 2018; Lockwood *et al.*, 2012; Lockwood, 2018). Our contribution is to propose a novel model to analyze inheritance tax designs under multiple behavioral responses and several dimensions of policymaker objectives. The comprehensive structural model covers taxpayer reactions from adjusting the wealth accumulation (Slemrod & Kopczuk, 2000; Joulfaian, 2006; Kopczuk & Lupton, 2007), inter-vivos gifts (Joulfaian, 2005; Ohlsson, 2011) and strategic changes in the bequest distributions. It allows studying consequences of such responses on wealth holdings, bequest distributions, and government tax revenues.

To our knowledge, this paper is the first to estimate such a comprehensive model of bequeathing with detailed micro-level data. In particular, the structural empirical approach is crucial to overcome the complexity of the problem, to deal with limitations of data availability and to ensure the possibility of studying these policy counterfactuals of interest. By providing a micro-

[5]This approach overcomes the problem of missing information on bequests and estates, that is undistorted by any form of taxation. The main reason for the absence of undistorted estate and bequest data is the cost of collecting such sensitive data. If not collected for the purpose of taxation, data on inherited wealth are at most documented at the aggregated level.

level analysis of old-age individual behavior, we complement macro evidence on life-cycle models (De Nardi, 2004; Piketty & Saez, 2013; De Nardi & Yang, 2014) and reduced form evidence on bequest distribution (Erixson & Ohlsson, 2014; Light & McGarry, 2004).

More generally, we contribute to the literature on intergenerational wealth taxation by empirically studying the equity-efficiency trade-off under taxpayer responses (Piketty & Saez, 2013). We also touch upon research on bequest motives (Barro, 1974; Becker & Tomes, 1979; Behrman *et al.*, 1982; Cox, 2003; Arrondel & Masson, 2006; Lockwood *et al.*, 2012; Lockwood, 2018) by incorporating decedent's altruistic and equality preferences.

The remainder of the paper is structured as follows: Section 2 describes the data, the Swedish institutional background and provides a descriptive analysis of bequest distributions. Section 3 discusses the structural model and Section 4 presents the estimation strategy. Section 5 introduces the counterfactual analysis and reports results. Section 6 concludes.

2 Data, Institutional Context and Sample Selection

A Data Sources

The study draws on a population-wide dataset on all bequests in Sweden between 2001 and 2004 merged with detailed registry data provided by the Central Statistical Bureau (SCB). This so-called *Belinda* Population Database is a complete dataset of inheritances from 2001-2004 including an identifier for the deceased, the value of the terminal estate, the individual bequest, tax payments, and identifiers and characteristics of the heirs.[6] The bequest database is matched with Swedish Registry data to obtain background information on decedents and heirs, such as labor market status, wealth, demographic characteristics, education, and income. The Swedish Multi-generational Registry is used to identify relationships between decedent and heirs and between heirs. To proxy expected conditional survival probabilities, we use life tables provided by SCB.

B Institutional Details

Bequest taxation in Sweden has had a long-standing tradition in Swedish tax policy. From 1885 to 2004 intergenerational wealth transfers were taxed at heir level (Henrekson *et al.*, 2014). After peaking in 1970, tax rates decreased steadily until the abolition, which was motivated by high administrative costs compared to small revenues and long-lasting opposition by entrepreneurial

[6]See Elinder *et al.* (2014) for a detailed description of the database.

interest groups. While fiscally not important, the main purpose was the reduction of intergenerational transfers on the upper end of the wealth distribution. To adhere to the ability-to-pay principle of taxation, the scheme was designed in a progressive fashion (Kendrick, 1939).

The inheritance and gift ordinance (*Lagen om arvs- och gåvoskatt*) stipulate the legislation for intergenerational wealth transfers. If an individual passes away, the decedent's estate is documented in the inventory estate report, which contains real and financial assets, private insurance, consumer durables, and debt. If the decedent is a surviving spouse it may include also part of the spouses' wealth (*giftorätt*).

Inheritance rules define the default succession order and distribution of bequests. If the decedent is survived by his/her spouse, she/he inherits the entire estate, except if the decedent has children from a different partner. The spouse has free disposal of the inheritance but cannot alter the bequest distribution set by the decedent. Such inheritances from previous decedents are separately marked in our data and we will consequently exclude spousal bequests from the analysis. Otherwise, the first non-empty parentelic group inherits equal splits of the final estate. Adoptive children are equal to biological offsprings before the law. Further groups are considered only if there are no heirs in the previous group. Any inheritance intended to a minor under 18 is directed towards the legal guardian of the child. Therefore we will focus on heirs older than 18 years.

A stipulated will can redefine the order and distribution of bequests with the limitation that a fraction is still reserved for direct descendants (*laglotter* reserves the right to a minimum of 50% of the inheritance without a will). *Laglotter* puts institutional non-binding boundaries on the set of potential unequal splits across heirs. Clearly, wills are also set up for other purposes than unequal splits, for instance, the inclusion of further heirs or specific property transfer. A will is, therefore, a necessary, but not sufficient condition for unequal bequests. The inheritance tax, contrary to an estate tax, regards each heir's received amount. It is, therefore, possible to include gifts and insurance claims into the legislation. In our study period, gifts were taxed independently of their intergenerational character and gifts 10 years prior to the death were taxed jointly with inheritances under the *summation rule*. Both measures were introduced to counteract tax avoidance. Furthermore, gifts represent a way to transfer wealth to a set of heirs unequally in the absence of a testament. If an heir receives an inheritance, she/he can decide to cede part of or the total amount of the value to direct heirs, e.g. grandchildren of the decedent. This practice was widely used as a legal form of tax avoidance (Ohlsson, 2007).

The tax scheme was made up by three brackets. Inheritances to the first parentelic group (except spouse) over 70.000 SEK were taxed with 10%, followed by 20% and 30% rates for bequests exceeding 300.000 and 600.000 SEK. We focus on the tax scheme for most direct descendants, further schemes for relatives, friends and institutional recipients differ in exemption values, but not in marginal tax rates. Figure 1 depicts how the changes in marginal tax rates result in kinks in the overall tax scheme.

[Insert Table 2 and Figure 1 here]

C Possible Responses to Taxation

The Swedish inheritance tax, in its 1992-2004 specification, allows for multiple options to legally avoid taxes. Individuals can adjust terminal wealth, such that individual bequests to heirs fall into low tax brackets. This is possible either by decumulation through consumption or wealth transfer by gifts, which have a yearly tax exemption of 10,000 SEK. Wealth adjustment requires a high planning effort and is costly due to the timing uncertainty regarding death and the loss of control over wealth.

For example, a donor with preference for equal bequest splits for two children and wealth above SEK 140.000 can decumulate wealth via gifts or consumption, such that the terminal wealth of 140.000 lands both individual bequests of 70.000 below the first tax bracket.

Alternatively, the non-linearity of the inheritance tax allows old-age individuals to reduce the tax bill by changing the distribution of bequests. By stipulating a will, a donor can change the relative shares to heirs in order to place individual bequests at or under the thresholds of tax brackets. This strategy involves welfare costs to the decedent because changing the distribution of bequests implies a deviation from his/her true optimal, bequest distribution in the absence of taxation.

For example, a donor who wants to leave SEK 50.000 and 100.000 to her/his two children, may want to switch to a SEK 70.000/80.000 split in order to save SEK 2.000 in taxes.

Last but not least ceding is a modification of the bequest distribution conducted by the heir under the Swedish inheritance law. Inheritances are dissipated downstream within the family line. Ceding is therefore limited to heirs who have descendants of their own. If the possibility of ceding is available, the donor does not face any welfare costs, if ceding was coordinated or if bequest distributions are over family lines rather than individuals.

For example, an heir that receives a bequest SEK 200.000 may want to cede SEK 70.000 to each of her/his own children (the donor's grandchildren), such that, due to the individual exemption levels, all three individual bequests then fall below the first tax-bracket Table 3 summarizes all potential donor responses and alternatives for legal tax avoidance.

If the bequest taxation takes on the form of an estate tax, adjusting the terminal estate through wealth decumulation or inter-vivos gifts is the only available response to old-age individuals.

[Insert Table 3 here]

In this paper, we focus on the two main strategies to avoid taxation: wealth adjustment through decumulation and gifts and changes to the bequest distributions. As we document, these responses are widely used in Sweden 2001-2004 and are available to donors in most countries with bequest taxation.

The ceding rule is very specific to the Swedish context and plays a key rule in identifying the interaction of the remaining responses to inheritance taxation. For simplicity and due to the extremely low incidence and special tax exemptions, we exclude the strategic component of bequeathing to non-children heirs and assume a constant share per donor that is left to these type of heirs.

D Aggregation to Family Lines and True Bequest Preferences

To understand behavioral responses to bequest taxation, it is necessary to understand the preferences that old-age individuals with more than one child have over the distribution of bequests to their children. Due to the ceding rule in Swedish institutional set-up, heirs could transfer part or all of their bequests to direct descendants upon receipt and thereby minimize the tax bill. Clearly, this bequest distribution does not allow to assess *true* donor bequest preferences as it is significantly distorted by taxation. By aggregating bequests over family lines that originate at the children of the donor, we can eliminate any such distortions from the ceding rule. The resulting distribution reflects *true* donor bequest preferences for children's family lines, if i) all children of the donor had the possibility to cede, ii) these children were, on the own, able to eliminate the entire tax bill of the donor through ceding and iii) after aggregating over family lines, donors' bequest distributions are smooth, in particular at the kinks of the tax schedule.

Figure 3 shows that before the aggregation there is a massive bunching of individual bequests at the first tax kinks (70,000 SEK) of 3.5 times the average height of neighboring distribution bins. After aggregating, it becomes clear that ceding makes out 90,6% of this excess mass. According to the set of potential legal avoidance mechanisms, the remaining bunching at the kink could originate from wealth adjustment or distortions in the optimal bequest distribution of donors.

Figure 4 shows that donors, whose heirs who do not fulfill conditions i) and ii) (right graph), are concentrated over-proportionally at the tax kink compared to the bequest distribution of heirs, who can eliminate the entire donor tax bill through ceding (left graph). The bunching excess mass of 0.358 (0.134) for heirs, who cannot fully cede exceeds the value of their ceding counterparts of 0.286 (0.138). Furthermore, the right bequest distribution exhibits non-smoothness at several intervals.

Finally, the left graph of Figure 5 provides evidence that any remaining bunching of donors, whose heirs fulfill conditions i) and ii), is entirely explained by wealth adjustments. These are decedents, whose estates divided by the number of children falls within 1,000 SEK left of the tax kink. Since wealth adjustment will be captured in the donor's wealth accumulation part of our model, the bequest distribution aggregated over family lines provides the *true* optimal distribution desired and intended by the donor. The right graph of figure 5 shows that heirs who cannot cede and fully avoid the tax bill do not show a smooth bequest distribution, even after accounting for strategic wealth adjustments by donors. Their distribution is therefore distorted by the tax and does not represent the *true* bequest distribution.

In the following, we proceed by estimating *true* undistorted bequest preferences on a subsample, which excludes those donors, for which at least one child is unable to cede to a direct offspring. Notice that while we estimate undistorted, optimal preferences with this selected sample, the estimation of the dynamic problem including wealth accumulation and bequest shares as well as all counterfactual simulations are conducted on the full sample of aggregate family line bequests.

[Insert Figures 3, 4 and 5 here]

E Samples

After restricting the universe of decedents to surviving spouses over the age of 65 (to capture intentional bequests) with up to four children, we are left with a sample of 61.044 decedents. Summary statistics on decedents and heirs a presented in Table 1. Estates are on average 226.519 SEK, bequests received by a child's family line amount to 115.068 SEK. Around 3% of decedents distribute the inheritance unequally across the children's family lines (within family standard deviation greater than 1000 SEK). A fifth of decedents have stipulated a will and about 9% have transferred wealth to their heirs via inter-vivos gifts within ten years prior to their death.

Next, we construct a subsample for estimation, which is restricted to old-age individuals, of whom all heirs had the possibility to cede and eliminate the tax bill of the maximum bequest that they could get. We identify these heirs by matching them to their direct offsprings via the Swedish Multi-generational Register. Clearly, this subsample is selected and shows on average smaller estate and bequest values. This is due to two main reasons. First, rich donors would require the heirs to have a large number of descendants to enter this subsample and second, heirs with numerous direct offsprings may receive higher values of inter-vivos gifts. The full and ceding subsample are however well-balanced with respect to all other covariates.

[Insert Table 1 here]

3 Wealth Accumulation and Bequest Model

A Model Overview

This section introduces a model of individual behavior in old age. An important feature of the institutional setting of Sweden is a generous social security system, which includes elderly and health care. It allows recovering bequest incentives and behavioral patterns arguably to a less extent contaminated by precautionary saving behavior. Therefore, this institutional set-up is particularly suitable to study this question in comparison to, for instance, the US where precautionary saving motives must be an important determinant of the end-of-life wealth decisions (Lockwood, 2018).

In such an environment, old-age individuals jointly optimize their overall utility from consumption and the warm-glow utility from bequeathing. The latter is derived from the total amount of after-tax bequests and the preferred distribution to children, i.e. who gets which share of the estate. The presence of a bequest tax forces the individual to trade off these three objectives. In the absence of any behavioral response by the old-age individual, the tax reduces the utility from after-tax bequests. The possible responses to taxation, i.e. a change in the wealth accumulation and a change in the distribution of bequests, allow the individual to control the trade-off among these three objectives.

Figure 2 shows this 'trilemma' of an old-age individual when the bequests are subject to taxation. If the individual decides to keep his/her wealth path and bequest distribution unchanged, then the tax will reduce utility from post-tax bequests value. If the preferences for specific wealth/consumption path and the value of the after-tax sum of bequests dominate the preferences over specific bequest allocation, then only a deviation from the preferred bequest distribution can deliver the necessary tax-relief. Finally, if the preferred split and after-tax bequest sum ought to be undistorted, wealth adjustments through decumulation or inter-vivos gifts are needed in order to decrease the tax bill. It would also yield additional utility from an increase in consumption needed to de-accumulate wealth.

[Insert Figure 2 here]

Consequently, individual behavior is summarized by three groups of parameters. The first group of parameters describes the trade-off outlined above and represents the object of interest in this paper. More precisely, these parameters represent the weight an old-age individual places on after-tax bequests and preferences over specific bequest distribution to children. The second group of parameters is solely related to the *true* preferences over how bequests are distributed to children, conditionally on donor and heir characteristics. The third group includes parameters of a standard life-cycle model without labor choice, namely a discounting rate and risk aversion. The remainder of this section formalizes the model and describes the estimation procedure.

B Structural Model

This section presents a dynamic life-cycle model of an after retirement individual who plans the use of her/his wealth path and end-of-life bequests in the event of death. The model is in the spirit of De Nardi *et al.* (2010) and Lockwood (2018).

Essentially there are three building blocks to the model: A dynamic problem of wealth de- and accumulation in old age, a utility from bequeathing that depends on absolute values and distributions of bequests and an undistorted distribution rule for bequests, which reflects the decedent's *true* preferences.

B.1 Life-Cycle Problem of Old-Age Individuals

Individuals maximize expected discounted utility of consumption and bequests by choosing the consumption path $\{c\}_{t=1}^{T}$ and how the estate should be split among children $1...J$ in case the individual dies in the following period s. This implies that the model assumes that individuals can costlessly adjust the allocation every new period.[7] By consumption in this model, we broadly mean either regular consumption or inter-vivos gifts to children using the yearly tax exemption of SEK 10.000 or higher.[8] The utility of holding wealth at $t+1$ depends on the probability of surviving $(1-D)$ and the utility of bequeathing (B) in case of death (D). The value function of this dynamic programming problem at time t consists of the utility from consumption and gifts and the discounted value function at time $t+1$.

$$V_{it}(W_{it}) = u(c_{it}) + \delta \left[\overbrace{D_{it}B(s, W_{it+1})}^{\text{Bequest Utility}} + \overbrace{(1-D_{it})E_{it}[V_{it+1}(W_{it+1})]}^{\text{Utility of Survival}} \right] \tag{1}$$

[7] In fact, there might be administrative costs of rewriting a will. The assumption of costless adjustment is equivalent to assuming that an old-age individual can write a final will just prior to death

[8] Any inter-vivos gifts above the exemption within 10 years prior to death is taxed as an inheritance and should, therefore, be inelastic to changes in the tax rate. Uncertainty over future wealth shocks makes transfers above the basic annual exemption for gifts costly for the bequest donor.

subject to the constraints described below. We assume CRRA utility function of consumption:

$$u(c) = \frac{(c)^{1-\eta} - 1}{1-\eta} \tag{2}$$

We impose a restriction that an individual can consume up to her wealth meaning that borrowing is not allowed in the model $c_t \in [0, W_t + y_t]$, where y_t denotes yearly income. As we model decisions in old age and data show fairly stable income, which mainly consists of pension income and social benefits, we assume that an individual expects to receive mean observed income in future periods. Individuals are also assumed to have beliefs about survival probabilities in line with mean death probabilities conditionally on age and gender (D).[9] The only state variable directly affected by the individuals choice is the next period wealth (W), which either remains being wealth in the next period or will be transformed to the estate if the individual dies. Wealth evolves as follows:

$$W_{it+1} = W_{it} + (y_{it} - c_{it}) + v_{it} \tag{3}$$

$$v_{it} = \mathbb{N}\left(0, \sigma^2\right) \tag{4}$$

There are two implications of this formulation. Individuals are not allowed to borrow. This constraint leaves the possibility of negative realization of wealth. We allow for a minimalistic uncertainty structure since we do not observe large wealth fluctuations in the data.

B.2 Bequest Preferences

Next, we turn to a bequest function B, which determines the interplay between wealth accumulation and bequests. We adopt the general bequest utility functional form from Lockwood (2018), which generalizes functional forms used in the literature and allows capturing a range of components of bequest preferences. It implies that bequest motives kick in after a consumption threshold c_b. Under this value, individuals do not leave bequests. $c_b > 0$ makes bequests a luxury good, for which individuals are less risk-averse than over consumption. λ_1 denotes the marginal propensity to bequest out of left-over wealth after consuming at least c_b. This functional form is combined with a disutility term from deviating from the undistorted bequest distribution $(\{s^*\}_{j=1}^{J})$, which represent the decedent's *true* preferences. As discussed above, the potential discrepancy between the chosen distribution s and the undistorted *true* s^* stems from the incentive to change bequest distributions to enter lower tax brackets.

[9] We ignore the marginal endogeneity of survival with respect to taxes, as documented in Kopczuk & Slemrod (2003); Eliason & Ohlsson (2013).

$$B\left(s, s^{*}, W\right)=\left(\frac{\lambda_1}{1-\lambda_1}\right)^{\eta} \cdot \frac{\left(\overbrace{\frac{\lambda_1}{1-\lambda_1} \cdot c_b+\sum_{j=1}^{J}(1-\tau_j) \cdot s_j \cdot W}^{\text{after-tax bequests}}\right)^{1-\eta}}{1-\eta}+\lambda_2 \cdot \overbrace{\left[U^{s}(\{s\}_{j=1}^{J}{}^{*})-U^{s}(\{s\}_{j=1}^{J})\right]}^{\text{Disutility from deviating}} \tag{5}$$

with $\sum_{j=0}^{J} s_j=1$. Parameters λ_1 and λ_2 mark the weight of this pair of bequest utilities with respect to the utility from consumption and inter-vivos gifts (weight normalized to 1).

B.3 Undistorted Bequest Distribution

The undistorted bequest distribution s^{*}, which represents *true* bequest preferences is the last missing object of the model. We assume that each donor has a utility function $U^{s}=\sum_{j=1}^{J} \exp(\phi_j) \cdot \log(s_j)$ over the distribution of bequest shares among all children $j \in 1, ..., J$. Motivated by the prevalence of exactly equal allocations in the data, which is also a default legal split in the absence of the will, we assume that individuals face fixed costs of deviating from the equal default allocation. These fixed costs reflect both a preference for equality and material costs of deviation, such as writing a will. If the difference between utilities derived from optimal unequal allocation ($\hat{U}\left(\hat{s}\right)$) and from an allocation of equal shares ($\bar{U}\left(\frac{1}{J}\right)$) is smaller than these deviation costs (ψ), the individual remains with the default of the equal share allocation.

$$U^{s}=\begin{cases}\hat{U}-\psi=\sum \exp(\phi_j) \cdot \log(\hat{s}_j)-\psi & \text{if} \quad \hat{U}-\bar{U}>\psi \\ \bar{U}=\sum \exp(\phi_j) \cdot \log\left(\frac{1}{J}\right) & \text{otherwise}\end{cases} \tag{6}$$

The preference parameter ϕ_j determines how large the bequest to child j will be relative to her/his siblings in the case of an unequal bequest distribution. Parameter ϕ_j is therefore interpreted relative to the other children of donor j, but net of any concerns for inequality, which are captured by the fixed cost of deviating from the institutional default. Such a formulation gives a rise to the following optimal choice of the estate split rules:

$$s_j^{*}=\begin{cases}\frac{\exp(\phi_j)}{\sum_{k=1}^{J}\exp(\phi_k)} & \text{if} \quad \hat{U}-\bar{U}>\psi \\ \frac{1}{J} & \text{otherwise}\end{cases} \tag{7}$$

C Solution Method

Conditionally on the parameters of interest, we solve the model using backward induction from a terminal age $T = 100$. The model has two choice variables: consumption and bequest shares. We discretize shares using steps of 5% in addition to equal split shares. For example, for a family with three children, equal split shares are 33%, which would not be covered by a 5% grid. This discretization could be avoided with continuous shares. However, it is likely that individuals think in terms of such discrete shares, which is observed in the data. Such a discretization yields a number of bequest allocation portfolios depending on the number of children. For instance, a donor with two children has the following choices: $(25\%, 75\%)$, $(30\%, 70\%)$, ... , $(50\%, 50\%)$, ... , $(70\%, 30\%)$, $(75\%, 25\%)$. Note that the distributions are limited to an individual minimum of 25% per child because of the legal restriction that each heir is eligible to a minimum of 50% of the default allocation.

Despite having a continuous consumption choice variable and a discrete estate split variable, it does not introduce the widely discussed problem associated with secondary kinks in the value function due to a mix of a continuous and a discrete choice variables (Fella, 2014; Blundell *et al.*, 2016; Iskhakov *et al.*, 2017). The reason is that the disutility from distributional deviations in bequest is time-invariant and is only a function of terminal wealth and the chosen distribution. It means that these disutilities can be pre-computed on a wealth grid. These pre-computed values are then used in the solving a dynamic model with linear interpolation in case realized value of wealth is not on the grid point. As a result, the dynamic problem involves only one continuous choice variable conditionally on precomputed utilities of bequest and optimal choices of splits for various wealth levels. As a result, the first order condition that determines consumption choices can be solved using scalar function optimization methods robust to secondary kinks (e.g. Bisection method).

In the estimation, wealth is discretized and interpolation or, if needed, extrapolation is used when the state variable value is not on the grid. To integrate over wealth shocks, we employ Hermite quadratures. The model solution approach is the same as in e.g. French (2005); Lockwood (2018). The main difference is related to the structure of bequest function that includes additional parameters and introduces a richer structure of a bequest decision required to comprehensively study the responses to bequest taxes. We discuss how these parameters are obtained in the next section.

4 Estimation

To estimate the model, we use the Simulated Method of Moments (SMM). It extends the minimum distance estimator to cases when a closed form solution of the problem cannot be obtained. The estimation of life-cycle style models is usually separated into two stages. In the first stage, all the parameters that can be identified without solving the model are estimated. In the second stage, these parameters are fed into the estimation of the remaining parameters, which requires solving the dynamic model. Such a two-stage procedure allows reducing the computational costs of repeatedly solving the dynamic model to search for a large set of parameters.

In our case, we use this two-stage approach to first estimate *true* preference parameters to inform the undistorted optimal bequest distribution of decedents. To identify these parameters in the first stage, we leverage the *ceding rule*, which is a special institutional feature of Swedish inheritance tax that provides this unique opportunity to identify true allocation preferences. This rule enables heirs to transfers part or all of the received bequest directly to her/his own descendant, i.e. grandchildren of the deceased. Ceding is therefore only available to those heirs who have children of their own. As discussed in Sections 2D and 2E we use a subset of decedents for whom all children have the possibility to cede and thus have an almost costless tax avoidance strategy at their disposal. As a result, these old-age individuals should reveal their *true* bequest preferences not distorted by the tax. Consequently, we estimate a bequest distribution model on this selected subsample and use the estimates in the second stage, i.e. the dynamic model. Here we recover the remaining parameters for the wealth de- and accumulation and the bequest utility function: $\xi = \{\lambda_1, \lambda_2 = \{\lambda_2^{2kids}, \lambda_2^{3kids}, \lambda_2^{4kids}\}, \eta, c_b, \sigma_W\}$. We use a parameter of time-discounting (δ) from the literature since it is not well-identifiable separately from other parameters of interest. The remainder of this section describes the estimation of the first stage parameters and the estimation of the main parameters of interest from the dynamic life-cycle model.

A Undistorted Bequest Shares - Stage One

We start by estimating the optimal undistorted bequest shares of donors, which represent *true* bequest preferences in absence of any taxation. ϕ_j is parametrized to be a linear function of observable heir characteristics $\phi_j = \alpha X_j$, where X_j contains age, marital status, gender, income, wealth and years of schooling. In line with the formulation from (7), optimal shares can be rewritten:

$$s_j^* = \begin{cases} \hat{s}_j = \frac{\exp(\alpha \cdot X_j)}{\sum_{k=1}^{J} \exp(\alpha \cdot X_k)} & \text{if} \quad \hat{U} - \bar{U} > \psi \\ \bar{s}_j = \frac{1}{J} & \text{otherwise} \end{cases} \tag{8}$$

As defined above, $\hat{U}$ is utility from optimal bequest distribution $\{\hat{s}_j\}_{j=1}^{J}$ in the case of deviation from default. Utility $\bar{U}$ is derived from the default of equal bequests. We assume that fixed costs of deviating from the equal default distribution are normally distributed: $\psi_i \sim N(\alpha Z_i, \sigma_\psi)$. Mean and variance of the distribution are to be estimated within the model. The set of donor characteristics Z_i includes a constant, years of schooling, age at death, estate value and dummies that control for the number of children of the decedent. The probability of deviating from the equal allocation is then defined as follows:

$$P_i = F\left(\frac{\hat{U}_i - \bar{U}_i - \psi_i}{\sigma_\psi}\right) \tag{9}$$

where $F(\cdot)$ denotes the normal cumulative density function. It describes the probability that individual's deviation costs are lower than utility gains of deviation. Consequently, the expected allocation of bequest shares to children $1, ..., J$ of decedent i is given by the weighted sum of unequal ($\hat{s}$) and equal ($\bar{s}$) share vectors.

$$\{s_j^*\}_{j=1}^{J} = P_i \cdot \{\hat{s}_j\}_{j=1}^{J} + (1 - P_i) \cdot \{\bar{s}\}_{j=1}^{J} \tag{10}$$

There are two important clarifications regarding donor and heir characteristics used in this part of the model. Firstly, the matrix X does not contain a constant. The reason is that the optimal allocation model represents the optimal split of the bequests, which implies that only characteristics of heirs in relation to each other matter. Consequently, a constant term is not identified and is irrelevant. Secondly, Z contains dummies for the number of children of the donor. The main reason to include those dummies is that utilities of optimal and equal allocations must differ across family structures since they are mechanically affected by the number of elements in the function. Therefore, it is important to control for these shifts in levels of deviation costs by using dummy variables.

This first stage model implies that we need to estimate a vector of heir-level coefficients α and the parameters of the distribution of deviation costs (β, σ_ψ). We use a minimum distance estimator to find parameters that match the moments of the observed bequest distribution for the *ceding* subsample.

$$\varphi^* = \arg\max(m(\varphi) - \hat{m}(\varphi))' I (m(\varphi) - \hat{m}(\varphi)) \tag{11}$$

where $m(\varphi)$ are the observed moments of the data that we match. $\hat{m}(\varphi)$ denotes the corresponding moments generated by the model and I is an identity matrix.

We match three groups of moments. Firstly, we match a percentage of non-equal splits by a number of kids and age bins $\{< 75, [75; 85), \geq 85\}$. Secondly, since the preferences over heirs are primarily informed by those who actually give unequal bequests, we match the distribution of shares for those heirs who deviated from the default[10]

B Estimation of Main Parameters - Stage Two

Upon estimating the first stage parameters, we proceed to recover the parameters of the life-cycle model in the presence of the Swedish inheritance tax scheme of 1992-2004. More precisely, we estimate the bequest preference parameters $\{\lambda_1, \lambda_2^{2kids}, \lambda_2^{3kids}, \lambda_2^{4kids}, c_b\}$, the parameter of standard deviation of the wealth process σ_W and a risk preference parameter η, which is common for the bequest and utility of consumption functions.

To identify the parameters of interest, we use a discount factor $\delta = 0.96$ in line with De Nardi (2004) and De Nardi & Yang (2014).[11] Probabilities of survival conditional on age and gender are recovered from the life tables provided by the Swedish Statistical Office (SCB). Due to the evaluation of estate by tax authority at below market prices, each individual knows with certainty that the terminal wealth is reduced by a constant percentage before bequests are distributed.[12]

To estimate second stage parameters we use the Simulated Method of Moments estimator that minimizes the distance between data and model-generated moments:

$$\xi^* = \arg\max(m(\xi) - \hat{m}(\xi))' W (m(\xi) - \hat{m}(\xi)) \tag{12}$$

where W is GMM optimal weighting matrix. To minimize the criterion function, we firstly run a global stochastic Covariance Matrix Adaptation Evolution Strategy (CMA-ES) optimizer

[10] Equal splits also inform parameters since preferences over heirs also affect how large fixed costs should be to keep a default choice.

[11] These authors use this calibration for both Swedish and US data.

[12] Actual asset evaluation (as a percentage of market value) depends on the asset type and therefore on the composition of wealth: 75% for real estate and stocks traded on main Swedish exchange lists and foreign exchanges, 100% for cash, inventories and debt, 30% for stocks on minor Swedish exchange lists and NASDAQ and 30% of book value for firms. Apartments' evaluation percentage depends on the net wealth of the housing society. For simplicity, we fix the evaluation percentage at the observed value in the data. Additionally, surviving spouses may hold some estate from the deceased spouse. While they are allowed to consume this wealth, it cannot be bequeathed and does therefore not affect any strategic behavior to avoid taxes.

from various starting values (Hansen, 2006). After convergence, we start the local derivative-free Nelder-Mead optimizer from the best parameters generated by the global optimizer to refine the solution.[13]

5 Results

A Parameter Estimates

Table 4 reports the parameter estimates for the undistorted bequest preferences of decedents (estimation stage one). Donors exhibit preferences that reinforce existing differences in education and income. This behavior is consistent with a wide range of theories, such as evolutionary bequeathing, exchange motives or even the altruistic theory. The positive coefficient towards female and married heirs partly reflects the size of the heirs family line.[14] With respect to the decedent fixed costs for deviation from the default rule of equal shares, Table 4 shows plausible coefficients, that relate to either the monetary and cognitive costs of deviating or to a preference for equality. Male and older donors are more likely to stipulate a will to deviate from the default.[15] Finally, Table 5 confirms that due to the flexible form of the utility function for bequest shares, the model fits targeted moments well.

For the main model parameter estimates (estimation stage two) Table 6 reports parameter estimates for the bequest utility and the weight of the disutility term from deviating in the bequest distribution. In line with Lockwood (2018) we find a large propensity to bequeath and a high risk aversion parameter (3.78). The threshold of minimum consumption at which bequest motives kick in is low at SEK 10.765 and partly reflects the inter-vivos gift tax exemption, which, if used, is part of the consumption. The variance of wealth shocks is small at 884. The model fit is shown in Figure 6. Overall, the model fits the moments reasonably well.

[Insert Tables 4, 5, 6 and Figure 6 here]

[13] In fact, the concept of convergence of global optimizers does not exist. Therefore, by convergence, we mean the best value obtained from a stochastic pattern-based search algorithm from a fixed number of iterations.

[14] The results differ from a family fixed effects estimation, in which the individual bequest size per family line is regressed on heir characteristics, see Appendix Table 8. While such a specification captures similar aspects than the structural estimates, differences arise from the joint estimation of bequest preferences and switching costs in the model.

[15] Table 9 in the Appendix shows consistent estimates for donor age and sex in a linear probability model that explains donors decision to bequeath in unequal splits. Again the structural estimates differ due to the non-linear structure of the model.

B Counterfactuals

To analyze behavioral responses to bequest taxation we simulate counterfactual wealth paths and bequest distributions for three alternative tax designs: **i)** the 1992-2004 Swedish inheritance tax scheme, excluding the ceding rule, **ii)** a comparable estate tax with equivalent marginal tax rates and exemption levels and tax rate kinks that depend on the number of children and **iii)** a similarly progressive estate tax with fixed exemption levels and tax rate kinks. Table 7 summarizes the tax schedules (i-iii) for the policy counterfactuals.

To create comparable results, a baseline counterfactual in the absence of any intergenerational wealth tax is computed for each decedent. It describes the wealth path and bequest distribution under the absence of taxation, and therefore behavioral responses, respectively. From this distribution, the hypothetical tax revenues in the absence of any behavioral responses can be recovered by applying each tax schedule (i-iii) on the final estate or bequest vector generated by the no tax counterfactual. We can then compare wealth and bequest distributions under each tax design to a *no-response* counterfactual. Furthermore, given that, by definition, the baseline, no-tax counterfactual does not include any distortions to the wealth path and bequest distribution from responses to taxes, we can design all tax schemes in the counterfactual analysis (i-iii) to match on the total tax revenue in the absence of responses. Constructing the alternative tax scheme to have the same tax revenue in the absence of behavioral responses, allows us to compare these taxes.

C Effect on the Bequest Distribution

Responses to bequest taxation lead to overall changes in the distribution of terminal bequests. Figure 7 shows the bequest distribution of the Swedish inheritance tax (i) and a comparable estate tax (ii) in contrast to the no-tax and no-response counterfactual. Panels A and B show that any type of bequest taxation reduces the total mass in the bequest distribution. The taxes provide an incentive to bequeath less in general, and at lower marginal tax rates in particular. The latter incentive is particularly strong in the upper tail of the bequest distribution. The tax kinks in both tax schedules at SEK 70.000, 370.000 and 670.000 create visible excess masses of bequests, that are absent in the no tax case. These bequest adjustments highlight the elasticity of bequest to taxation caused by the behavioral responses of donors. Panel C shows that the two alternative bequest taxes, on inheritances and on estates, fare similar compared to each other. Slight differences are due to the additional potential strategy of donors to avoid taxes by changing the bequest distribution.

While inheritance and estate tax with comparable schedules affect the bequest distribution very similarly, an estate tax with fixed exemption levels and tax rate kinks (iii) may generate a very different distribution. One example of this widely used design is shown in Figure 8. It suggests that policymakers need to be aware of the incentives that family-specific exemptions provide for donors to avoid paying taxes. In particular, such an estate tax design puts higher burden on large and wealthy families.

Notice that a tax on intergenerational wealth transfers can create incentives for donors to transfer more wealth via inter-vivos gifts since a SEK 10.000 annual exemption is applied to them. While the model allows for this strategic response, it is ignorant about the exact levels and recipients of such transfers. The bequest distributions in this paper only reflect transfers out of the terminal wealth.

[Insert Figures 7 and 8 here]

D Effect on the Wealth Accumulation Process in Old Age

A fundamental concern with respect to bequest taxation is whether behavioral responses to the tax lead to distortions in the wealth accumulation, as such behavior can lead to a wide range of second-order effects, e.g. change in the overall saving rate and inequality across families and generations. We find relatively large responses to both inheritance and estate taxation in the wealth accumulation of old-age individuals compared to the no-tax counterfactuals. Figure 9 plots the wealth levels per age for the 25th, 50th and 75th percentile of the wealth distribution for the comparable counterfactual policies i) and ii).[16] Due to the progressiveness of both taxes, wealthier donors are adjusting their wealth path to a larger degree. Due to the similarity of policies i) and ii) in terms of tax schedule, inheritance and estate tax affect the wealth accumulation process almost equally. These changes in the wealth path in old age translate directly into the distribution of terminal estates in Figure 11.

Again, if a more traditional estate tax with fixed progressiveness is chosen, the behavioral responses may differ significantly, as shown in Figure 10. Non-individual exemption levels and tax rate kinks reduce the incentive for many families to engage in tax avoidance via wealth accumulation and therefore reduces the wealth distortion. This is due to the fact that for many families, lower tax-brackets are out of reach. The caveat of such policy is the tax incidence is shifted particularly towards large families.

The effects of taxation on terminal wealth are in line with the literature. The elasticity of terminal estate to tax of 0.22 generated by our model compares well to the 0.1-0.2 elasticities

[16] Wealth levels per age group are subject to the cohort composition effect, as they are pooled over different calendar years.

estimated by Slemrod & Kopczuk (2000), Joulfaian (2006) and Glogowsky (2016) as well as to the 0.09-0.27 elasticity of wealth to the Swedish wealth taxation documented by Seim (2017).

[Insert Figures 9, 10 and 11 here]

E Response Decomposition and Tax Revenue

The counterfactuals allow decomposing the responses to bequest taxation. As documented below, wealth reactions to the tax are almost equal, if inheritance and estate tax have comparable schedules. In addition, we find that for the case of inheritance taxation, 1.4% of individuals change their bequest distribution among children to minimize the tax bill. Given the low incidence of unequal bequests in the Swedish context (2-5%), this represents a non-trivial fraction of the donors.

Finally, in light of high administrative costs of bequest taxation, policymakers care about the impact that responses to taxation have on the generated tax revenue. As the estate and inheritance tax in our counterfactuals are designed to have equal tax revenue in the absence of any behavioral responses, it is possible to measure the loss for the government revenues from taxpayers' reactions. We find a significant loss in revenue of 34.4% for inheritance (i) and 29.3 (27.9)% for estate taxations. While the bulk of this loss is explained by the adjustment in wealth accumulation, in particular of wealthy donors, the difference between the tax designs has two origins. First, under inheritance taxation donors can use an additional strategy to avoid taxation, i.e. changing the bequest distribution. Second, strong preferences for unequal bequests under inheritance tax may lead some donors to not fully use the individual exemptions levels, which gives additional incentive to adjust the wealth path.

6 Conclusion

The bequest taxation is often at the center of policy debates since in light of being a tool to correct distributional inefficiencies propagated over generations with bequests. In addition, this tax is often viewed as a tax that does not cause undesirable distortion. For example, the Economist writes: *"In fact, people who are against tax in general ought to be less hostile to inheritance taxes than other sorts. However disliked they are, they are some of the least distorting" (Economist, 2017)*.

Although this statement is theoretically appealing, in this paper we show that bequest taxation implies a range of behavioral responses that should be taken into account by policymakers who are aimed at minimizing tax distortions, while simultaneously collecting tax revenue. More precisely, progressiveness and exemption levels are the predominant tools to control the incidence of the tax on particular groups in the population. Using a comprehensive structural model that captures main behavioral responses of old-age individuals, we can compare the impact of various tax designs on the wealth accumulation, bequest distributions and tax revenue, which are main policy outcomes of interest. Our results show, that comparable inheritance and estate tax schedules in terms of progressiveness have similar but important effects of individual behavior. At the same time, due to the additional margins of strategic behavior under inheritance taxation, estate taxes lead to higher overall tax revenue. Therefore, this paper emphasizes that at the cost of relaxing the control over tax incidence, estate taxation can be designed to further minimize distortions.

Our model is comprehensive and flexible enough to allow for the simulation of counterfactuals for the universe of alternative bequest tax designs. Various tax structures enable policymakers to balance distortions, progressiveness, tax revenue, and tax incidence according to their social welfare functions. The context in which we apply the structural model is ideal, as it abstracts to a large degree from incentives of precautionary savings, due to the generous social welfare system in Sweden. The results are therefore likely to be applicable to other contexts, which feature additional incentives to accumulate wealth at old age. Due to the strong preferences for equal bequests within the family in our sample, differences between estate and inheritance taxation are relatively modest. They may be amplified in contexts like the US, where up to 20% (Light & McGarry, 2004), ten times the percentage of Sweden, leave unequal terminal bequests to their children and have therefore potentially higher responses through changes in the bequest distribution.

The findings in this paper also open up several paths for future research. One important question is considering inter-generational wealth taxation in a general equilibrium framework that takes into account wealth taxation and returns to capital. The large wealth effects in our model emphasize that the design of the inheritance tax might have important spillovers on the wealth taxation and capital markets more broadly. Another important area is spousal tax-planning in old ages since distortions from the tax and responses to it are often realized at the household rather than individual level. In addition, the relevance of behavioral responses to bequest taxation for inequality should be investigated. Taxes on inter-generational transfers are almost always designed to redistribute wealth from the upper to the lower tail of the distribution. If, however, strategic responses benefit specific subgroups, the effectiveness of the tax might be harmed. Finally, although we touched upon the question of within-family inequality, further works might be needed to study the aggregate implications of changes in within-family wealth allocation.

References

Adermon, Adrian, Lindahl, Mikael, & Waldenström, Daniel. 2018. Intergenerational Wealth Mobility and the Role of Inheritance: Evidence from Multiple Generations. *The Economic Journal*, **128**(612), F482–F513.

Arrondel, Luc, & Masson, André. 2006. Chapter 14 Altruism, Exchange or Indirect Reciprocity: What Do the Data on Family Transfers Show? *Pages 971 – 1053 of:* Kolm, Serge-Christophe, & Ythier, Jean Mercier (eds), *Applications*. Handbook of the Economics of Giving, Altruism and Reciprocity, vol. 2. Elsevier.

Barro, Robert J. 1974. Are Government Bonds Net Wealth? *Journal of Political Economy*, **82**(6), 1095–1117.

Becker, Gary S., & Tomes, Nigel. 1979. An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility. *Journal of Political Economy*, **87**(6), 1153–1189.

Behrman, Jere R, Pollak, Robert A, & Taubman, Paul. 1982. Parental Preferences and Provision for Progeny. *Journal of Political Economy*, **90**(1), 52–73.

Blundell, Richard, Costa Dias, Monica, Meghir, Costas, & Shaw, Jonathan. 2016. Female Labor Supply, Human Capital, and Welfare Reform. *Econometrica*, **84**(5), 1705–1753.

Boserup, Simon H., Kopczuk, Wojciech, & Kreiner, Claus T. 2016. The Role of Bequests in Shaping Wealth Inequality: Evidence from Danish Wealth Records. *American Economic Review*, **106**(5), 656–661.

Cox, Donald. 2003 (Dec.). *Private Transfers within the Family: Mothers, Fathers, Sons and Daughters*. Boston College Working Papers in Economics 605. Boston College Department of Economics.

De Nardi, Mariacristina. 2004. Wealth Inequality and Intergenerational Links. *Review of Economic Studies*, **71**(3), 743–768.

De Nardi, Mariacristina, & Yang, Fang. 2014. Bequests and Heterogeneity in Retirement Wealth. *European Economic Review*, **72**(C), 182–196.

De Nardi, Mariacristina, French, Eric, & Jones, John B. 2010. Why Do the Elderly Save? The Role of Medical Expenses. *Journal of Political Economy*, **118**(1), 39–75.

Duffie, Darrell, & Singleton, Kenneth J. 1997. An Econometric Model of the Term Structure of Interest-Rate Swap Yields. *The Journal of Finance*, **52**(4), 1287–1321.

Economist, The. 2017. A hated tax but a fair one. *www.economist.com*, Nov.

Eliason, M., & Ohlsson, H. 2013. Timing of Death and the Repeal of the Swedish Inheritance Tax. *Journal of Behavioral and Experimental Economics (formerly The Journal of Socio-Economics)*, **45**(C), 113–123.

Elinder, Mikael, Erixson, Oscar, Escobar, Sebastian, & Ohlsson, Henry. 2014 (Nov.). *Estates, Bequests, and Inheritances in Sweden - A Look into the Belinda Databases.* Working Paper Series, Center for Fiscal Studies 2014:14. Uppsala University, Department of Economics.

Elinder, Mikael, Erixson, Oscar, & Waldenström, Daniel. 2016 (Mar.). *Inheritance and Wealth Inequality: Evidence from Population Registers.* IZA Discussion Papers 9839. Institute for the Study of Labor (IZA).

Erixson, Oscar, & Ohlsson, Henry. 2014 (Feb.). *Estate Division: Equal Sharing as Choice, Social Norm, and Legal Requirement.* Working Paper Series, Center for Fiscal Studies 2014:2. Uppsala University, Department of Economics.

Fella, Giulio. 2014. A Generalized Endogenous Grid Method for Non-Smooth and Non-Concave Problems. *Review of Economic Dynamics*, **17**(2), 329–344.

French, Eric. 2005. The Effects of Health, Wealth, and Wages on Labour Supply and Retirement Behaviour. *Review of Economic Studies*, **72**(2), 395–427.

Glogowsky, Ulrich. 2016. Behavioral Responses to Wealth Transfer Taxation: Bunching Evidence from Germany. *Working Paper.*

Hansen, Nikolaus. 2006. The CMA Evolution Strategy: A Comparing Review. *Pages 75–102 of: Towards a new evolutionary computation.* Springer.

Henrekson, Magnus, Du Rietz, Gunnar, & Waldenström, Daniel. 2014. *Swedish Inheritance and Gift Taxation (1885–2004).* Working Paper Series 936. Research Institute of Industrial Economics.

Holmlund, Helena, Lindahl, Mikael, & Plug, Erik. 2011. The Causal Effect of Parents' Schooling on Children's Schooling: A Comparison of Estimation Methods. *Journal of Economic Literature*, **49**(3), 615–51.

Iskhakov, Fedor, Jørgensen, Thomas H, Rust, John, & Schjerning, Bertel. 2017. The Endogenous Grid Method for Discrete-Continuous Dynamic Choice Models with (or without) Taste Shocks. *Quantitative Economics*, **8**(2), 317–365.

Joulfaian, David. 2005. Choosing Between Gifts and Bequests: How Taxes Affect the Timing of Wealth Transfers. *Journal of Public Economics*, **89**(11-12), 2069–2091.

Joulfaian, David. 2006. The Behavioral Response of Wealth Accumulation to Estate Taxation: Time Series Evidence. *National Tax Journal*, **59**(2), 253–68.

Kendrick, M. Slade. 1939. The Ability-to-Pay Theory of Taxation. *The American Economic Review*, **29**(1), 92–101.

Kopczuk, Wojciech, & Lupton, Joseph P. 2007. To Leave or Not to Leave: The Distribution of Bequest Motives. *The Review of Economic Studies*, **74**(1), 207–235.

Kopczuk, Wojciech, & Slemrod, Joel. 2003. Dying to Save Taxes: Evidence from Estate-Tax Returns on the Death Elasticity. *The Review of Economics and Statistics*, **85**(2), 256–265.

Laitner, John, Silverman, Dan, & Stolyarov, Dmitriy. 2018. The Role of Annuitized Wealth in Post-Retirement Behavior. *American Economic Journal: Macroeconomics*, **10**(3), 71–117.

Light, Audrey, & McGarry, Kathleen. 2004. Why Parents Play Favorites: Explanations for Unequal Bequests. *American Economic Review*, **94**(5), 1669–1681.

Lockwood, Lee, *et al.* 2012. Bequest Motives and the Annuity Puzzle. *Review of Economic Dynamics*, **15**(2), 226–243.

Lockwood, Lee M. 2018. Incidental Bequests and the Choice to Self-Insure Late-Life Risks. *American Economic Review*.

Ohlsson, Henry. 2007 (Feb.). *Tax Avoidance, a Natural Experiment*. Working Paper Series 2007:13. Uppsala University, Department of Economics.

Ohlsson, Henry. 2011. The Legacy of the Swedish Gift and Inheritance Tax, 1884–2004. *European Review of Economic History*, **15**(03), 539–569.

Pakes, Ariel, & Pollard, David. 1989. Simulation and the Asymptotics of Optimization Estimators. *Econometrica: Journal of the Econometric Society*, 1027–1057.

Piketty, Thomas, & Saez, Emmanuel. 2013. A Theory of Optimal Inheritance Taxation. *Econometrica*, **81**(5), 1851–1886.

Saez, Emmanuel. 2010. Do Taxpayers Bunch at Kink Points? *American Economic Journal: Economic Policy*, **2**(3), 180–212.

Seim, David. 2017. Behavioral Responses to Wealth Taxes: Evidence from Sweden. *American Economic Journal: Economic Policy*, **9**(4), 395–421.

Slemrod, Joel, & Kopczuk, Wojciech. 2000 (Oct.). *The Impact of the Estate Tax on the Wealth Accumulation and Avoidance Behavior of Donors*. NBER Working Papers 7960. National Bureau of Economic Research, Inc.

7 Tables

Table 1: Summary statistics

	Full Sample		**Full Ceding Sample** (share-to-children estimation)	
Heir Characteristics	Mean	Sd	Mean	Sd
Bequest	121087.8	(298984.7)	59822.0	(73320.8)
Share	0.506	(0.260)	0.561	(0.284)
Heir female (0/1)	1.495	(0.500)	1.517	(0.500)
Education of heirs	11.52	(2.162)	11.35	(2.096)
Married heir (0/1)	0.586	(0.493)	0.692	(0.462)
Age of heir	54.11	(9.577)	56.46	(7.936)
Income of heir	2024.9	(2746.6)	1922.0	(2585.1)
Observations	123659		58460	
Donor Characteristics	Mean	Sd	Mean	Sd
Estate size	241106.6	(497310.1)	107260.2	(93262.0)
Will (0/1)	0.195	(0.396)	0.167	(0.373)
Inter-vivos transfers (0/1)	0.0942	(0.292)	0.0846	(0.278)
Donor female (0/1)	1.664	(0.472)	1.716	(0.451)
Education of donor	11.57	(3.826)	11.72	(4.051)
Age at death	84.10	(9.065)	85.91	(7.430)
Wealth at death	597325.9	(2076097.2)	296266.6	(362468.1)
Number of children	2.677	(0.747)	2.610	(0.725)
Unequal split of bequest	0.0315	(0.175)	0.0185	(0.135)
Observations	64707		33970	

Education denotes years of schooling, coded consistently with Holmlund *et al.* (2011): 9 years for primary school, 9,5 for post-primary school, 11 for short high school, 12 for long high school, 14 for short university, 15.5 for long university and 19 for PhD university education.

Table 2: Children, Spouses, Grandchildren: 1992-2004

Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 300.000	0 + 10%
300.000 - 600.000	30.000 + 20%
> 600.000	90.000 + 30%
Basic Exemptions, SEK:	Amount
Children:	70.000
Gifts:	10.000

This tax scheme represents the marginal tax rates and exemption levels for the first parentelic group, including an annual inter-vivos gift exemption of SEK 10.000.

Table 3: Bequest taxation: Strategic responses and (legal) incentives for avoidance

	Estate Taxation	Inheritance Taxation
Wealth accumulation	✓	✓
Within family distribution	—	✓
Gifts	✓	✓
Cedes	—	(✓)

The availability of strategic responses of donors to the two main alternatives for bequest taxation, inheritance and estate taxes, depends on the definition of the tax-base. Taxation at the heir level allows for additional reactions by adjusting the distribution of bequests among heirs or, if the legislation provides this possibility, by ceding.

Table 4: First Stage Model Parameter Estimates

	Coefficient
Heir Characteristics (ϕ)	
Gender (0/1)	0.12
Married (0/1)	1.78
Education	1.84
Age	0.85
Income	1.8
Distribution of Donors' Deviation Costs	
Constant	0.83
Education	0.06
Gender (0/1)	0.18
Age at Death $[75; 85)$	-0.15
Age at Death ≥ 85	-0.16
# Children = 3 (0/1)	0.19
# Children = 4 (0/1)	0.42
σ	0.06

Parameters indicate the preferences of donors to bequeath heirs with particular observable characteristics. Donor characteristics determine the distribution of the cost of deviating from the default split of equal bequest shares to all children. Taken together, these two sets of parameters determines the preferred *true* bequest split of donors to their offsprings. The standard errors are not reported since full population is used in the estimation. Another reason why parameters are assumed to be constants is because bootstrap is employed to obtain standard errors of the first stage model.

Table 5: First Stage Model Fit

	Actual	Predicted
Share of Unequal Bequest Splits by Subgroup		
Children = 2	0.021	0.018
Children = 3	0.023	0.022
Children = 4	0.014	0.022
Age < 75	0.02	0.015
Age $[75; 85)$	0.024	0.026
Age ≥ 85	0.018	0.017
Distribution of Shares Conditional on Deviating		
10%	0.165	0.153
20%	0.183	0.19
30%	0.25	0.234
40%	0.256	0.302
50%	0.384	0.381
60%	0.417	0.418
70%	0.585	0.536
80%	0.683	0.625
90%	0.75	0.738

The two columns compare actual and predicted moments of the bequest and deviation distributions. The first panel regards the percentage of unequal share by subgroups of donors. The moments below measure the distribution of shares to children conditional on a deviation from the equal default split.

Table 6: Main Model (Second Stage): Parameter Estimates

		Coef.	Std. Err
Propensity to bequeath	λ_1	0.99	(0.001)
	λ_2^{2kids}	< 0.001	(< 0.001)
Weight of the disutility term from deviation	λ_2^{3kids}	< 0.001	(< 0.001)
	λ_2^{4kids}	< 0.001	(< 0.001)
Std. Dev. of wealth shocks	σ	947.96	(14.43)
Consumption threshold for bequest motives	c_b	10765.49	(60.83)
CRRA risk aversion parameter	η	3.78	(0.27)

Parameter estimates for the wealth accumulation model in old age, including utility from bequeathing in case of death.Standard errors presented in brackets are obtained using bootstrap with 100 draws with replacement.

Table 7: Tax Schedules of the Policy Counterfactuals

i) Inheritance Tax	
Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 300.000	0 + 10%
300.000 - 600.000	30.000 + 20%
> 600.000	90.000 + 30%
Basic Exemptions, SEK:	Amount
Children:	70.000

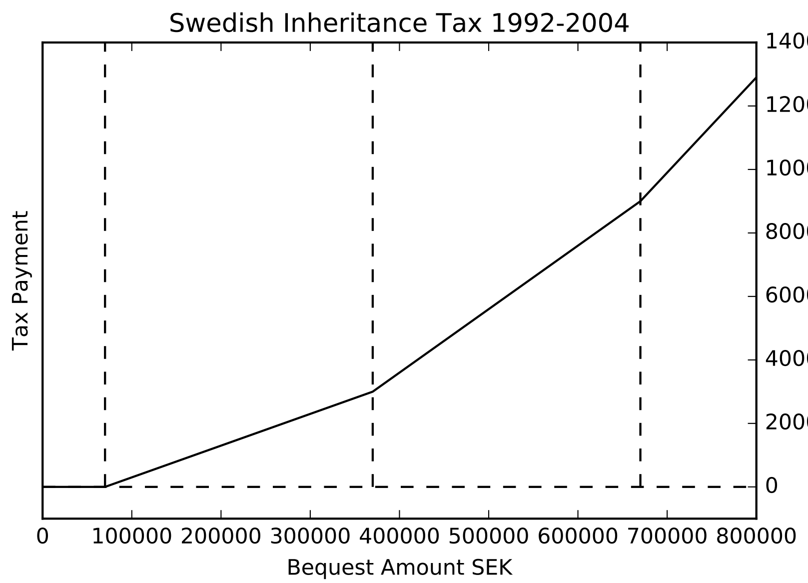
ii) Estate Tax with Flexible Kinks	
Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 300.000*# children	0 + 10%
300.000*# children - 600.000*# children	30.000*# children + 20%
> 600.000*# children	90.000*# children + 30%
Basic Exemptions, SEK:	Amount
70.000 per child	

iii) Estate Tax with Fixed Kinks	
Tax bracket, SEK	Tax (lump sum + tax rate)
0 - 600.000	0 + 9,76%
600.000 - 1.200.000	58.560 + 19,52%
> 1.200.000	175.680 + 29,28%
Basic Exemptions, SEK:	Amount
140.000	

Counterfactual tax policy i) corresponds to the 1992-2004 Swedish inheritance tax scheme, excluding the ceding rule. Policy ii) is an estate tax that mimics the properties of the inheritance tax by applying per-child exemption levels and tax rate kinks. It differs through the definition of the tax base at the donor's terminal estate. Tax scheme iii) fixes the exemptions and kinks at the median number of children (2) and represents a widely used design of non-individual progressiveness. All three taxes generate approximately equal tax revenues in the absence of behavioral responses, i.e. when applied to the no-tax counterfactual and are therefore comparable.

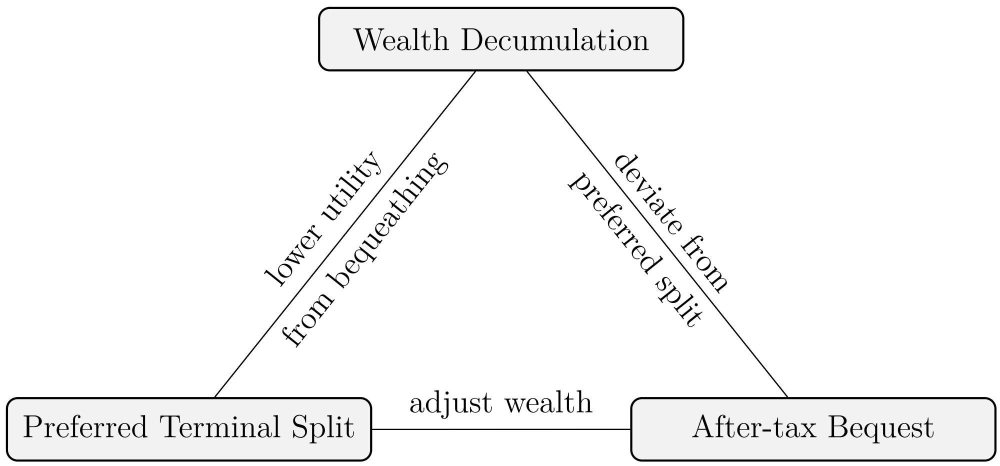
8 Figures

Figure 1: Kinks in the Swedish inheritance taxation for parentelic group 1



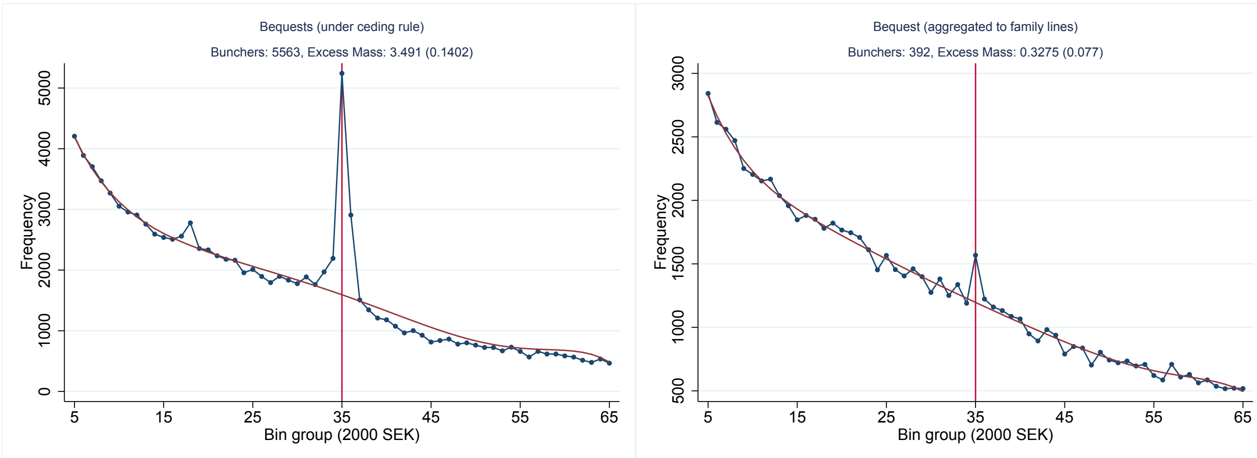
Tax scheme for the first parentelic group (spouses, children, grandchildren) with an exemption level of 70.000 per heir. Kinks of the marginal tax rate at SEK 370.000 and 670.000.

Figure 2: The "Bequest Trilemma" under bequest taxation



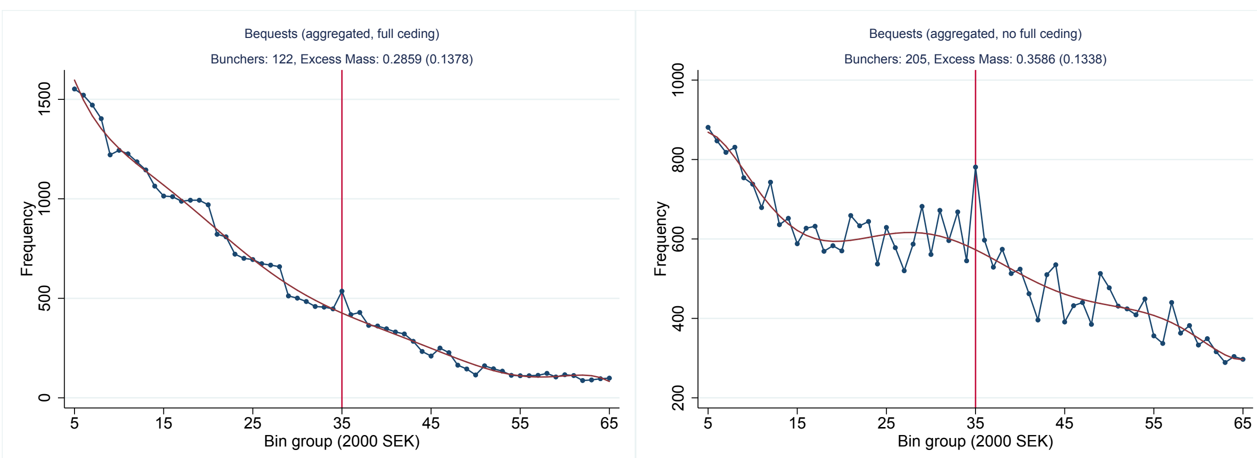
The nodes define the three objectives of the donor, when making decisions in old-age on wealth accumulation and bequeathing. The edges show the individual's reaction in order to keep the objectives in the two connected nodes constant when a bequest tax is levied on inter-generational transfers. As the preferred terminal split does not play a role under estate taxation, the trilemma is transformed into a dilemma under such a tax scheme.

Figure 3: Bequest distributions: Raw data vs. aggregated over family lines



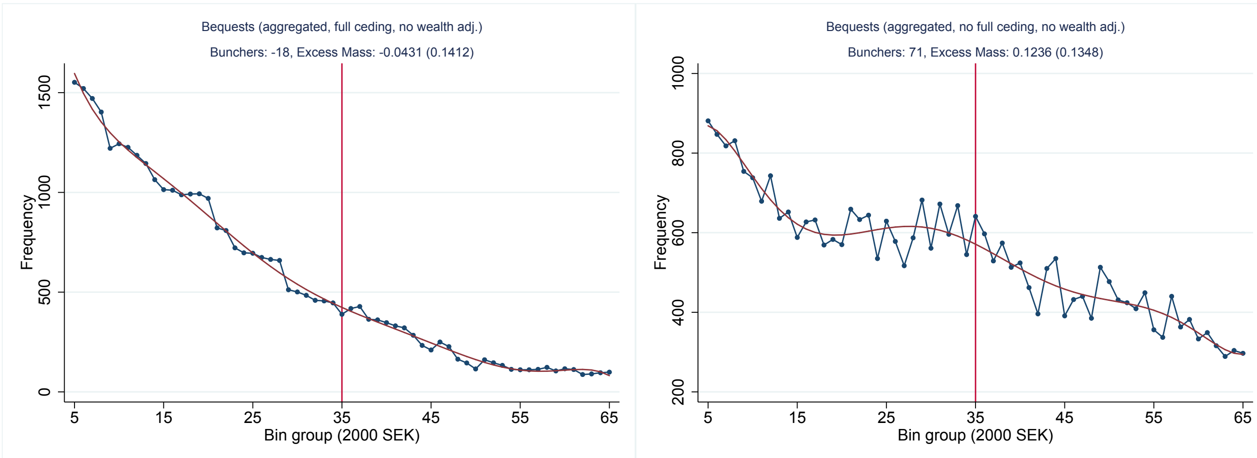
The graph on the left hand side plots the raw bequest distribution under Swedish inheritance taxation for 2001-2004. Bunching at the first kink of the marginal tax rates is mostly attributable to the ceding rule. When aggregated over family lines (to reverse the ceding rule) a much smaller, yet significant excess mass at the kinks remains.

Figure 4: Bequest distributions: Aggregated over Family Lines and Full Ceding Possibility



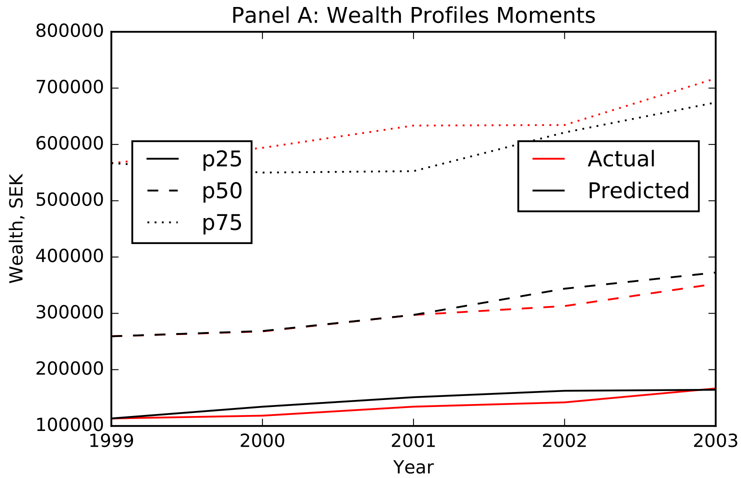
The graph on the left hand side plots bequests aggregated over family lines for donors, whose children can fully eliminate the tax bill through the ceding rule. When receiving the maximum possible bequest, these children have enough offspring of their own to cede and use individual exemption levels, such that no tax payments result. The complementary subgroup of donors, whose children cannot fully eliminate the tax bill through ceding is shown on the right-hand side.

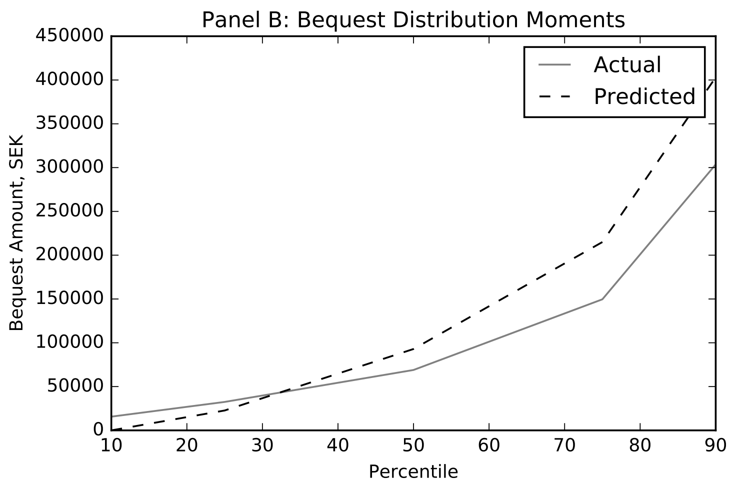
Figure 5: Bequest distributions: Aggregated over Family Lines, Full Ceding Possibility and Estate Adjustment



The graph on the left hand side plots bequests aggregated over family lines for donors, whose children can fully eliminate the tax bill through the ceding rule. It further excludes donors whose terminal wealth divided by the number of children results in bequests precisely on the tax kink ($\gtrless$ SEK 500) in case of equal splitting. The complementary subgroup of donors, whose children cannot fully eliminate the tax bill through ceding and do not adjust wealth is shown on the right-hand side.

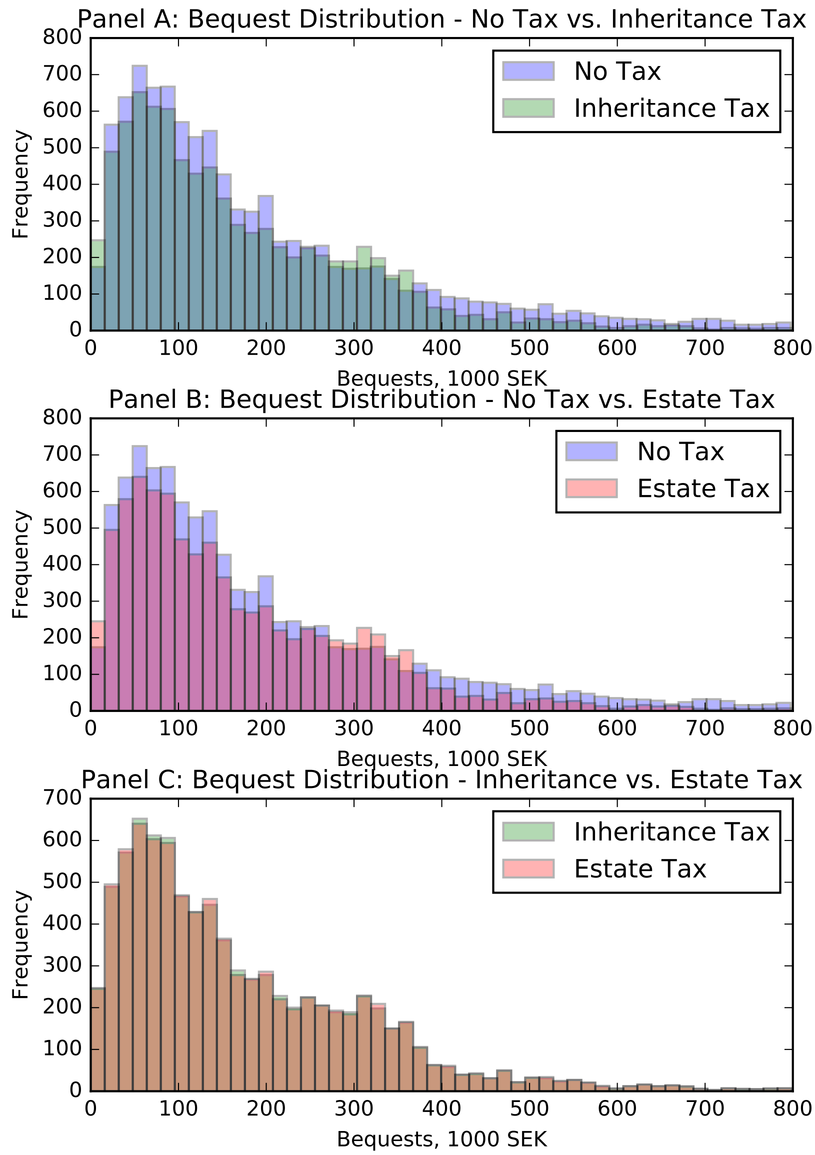
Figure 6: Model Fit





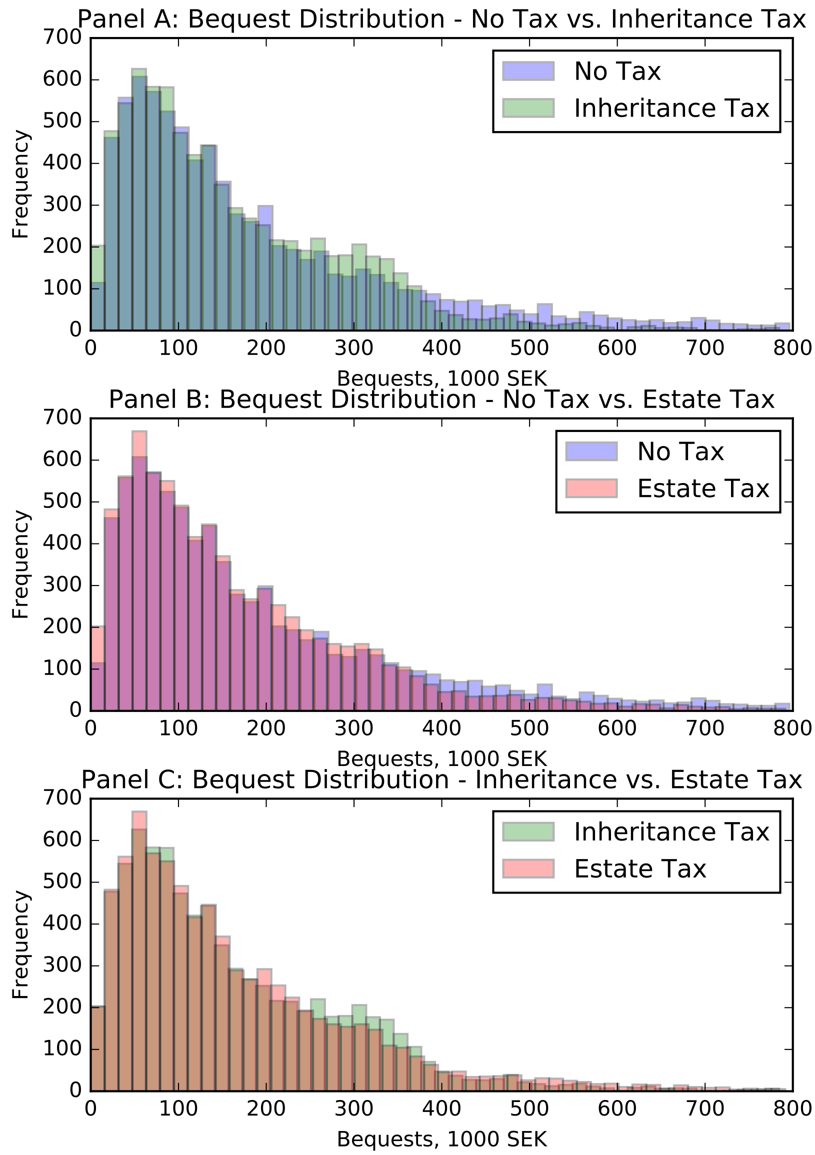
Actual and predicted moments of the wealth and bequest distributions. Predict values result from simulating the wealth accumulation model with bequest utilities using the estimated parameters.

Figure 7: Effect of Bequest Taxation on Bequest Distributions: Counterfactual policies i and ii



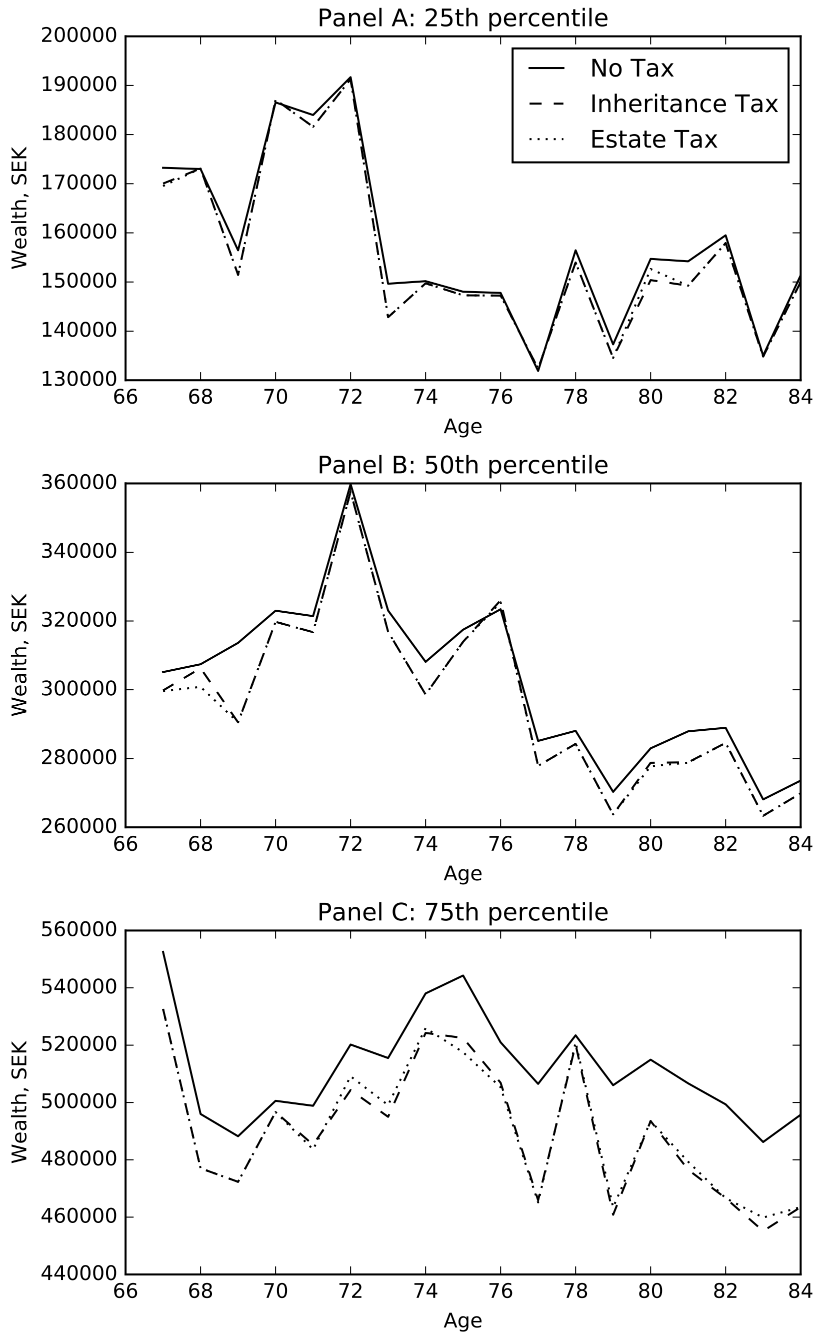
Bins of the bequest distribution for the inheritance and estate tax counterfactuals (i and ii) in comparison to the no-tax counterfactual.

Figure 8: Effect of Bequest Taxation on Bequest Distributions: Counterfactual policies i and iii



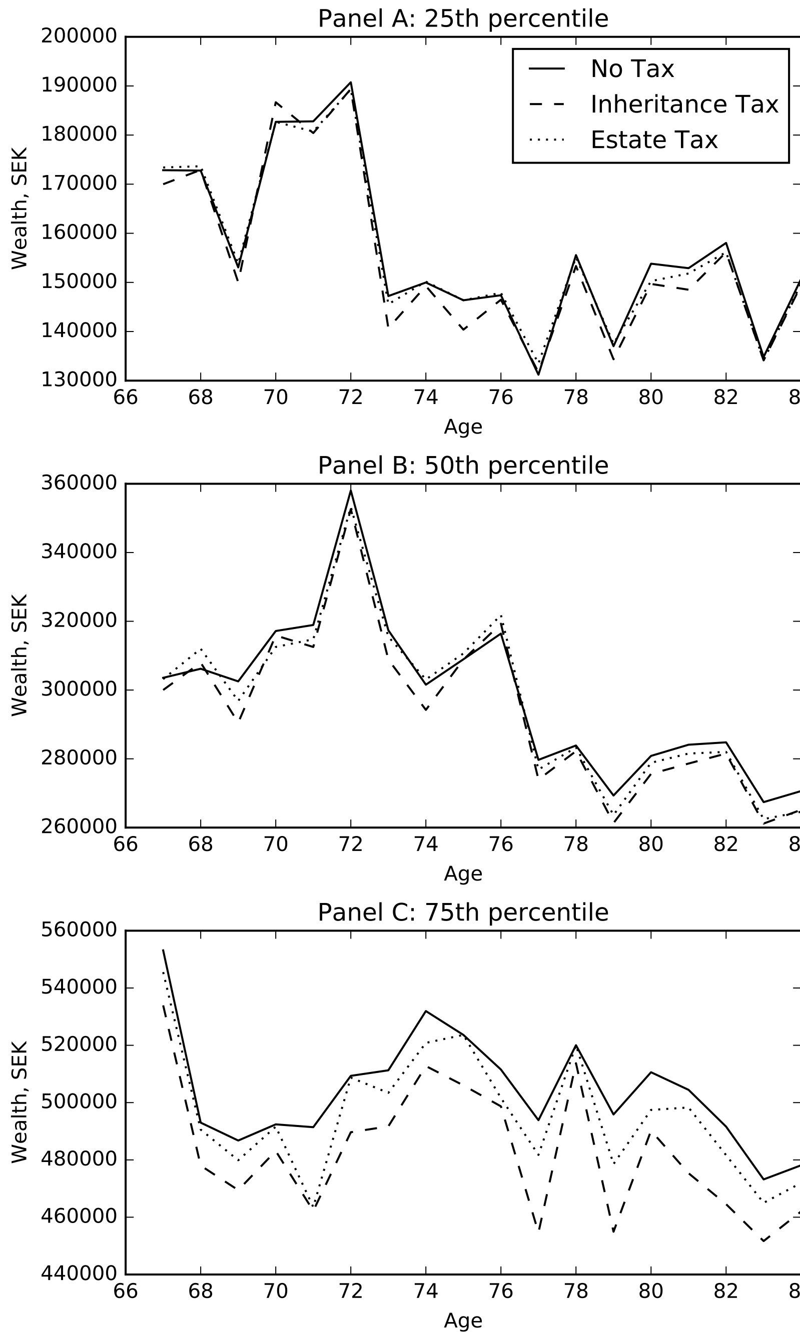
Bins of the bequest distribution for the inheritance and estate tax counterfactuals (i and iii) in comparison to the no-tax counterfactual (Panel A and B). Panel C compares the distributions under the two taxes to each other.

Figure 9: Effect of Bequest Taxation on Wealth Accumulation: Counterfactual policies i and ii



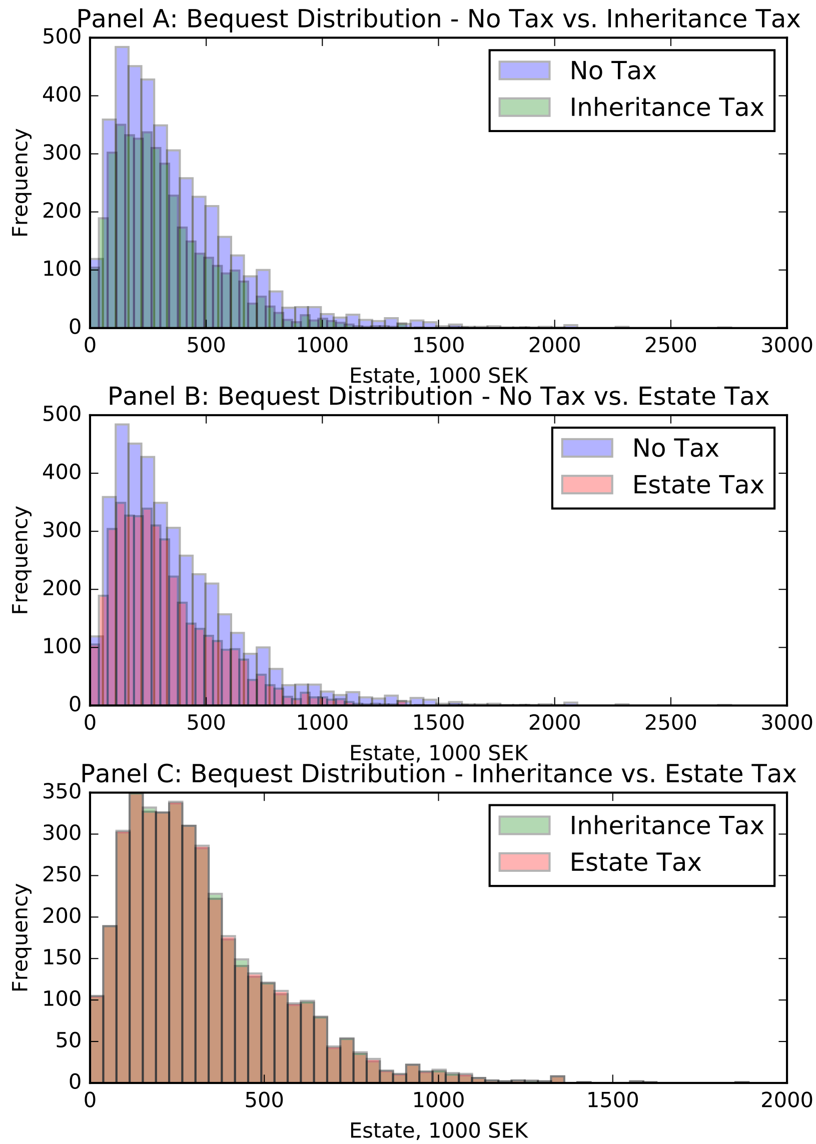
Wealth distribution for the 25th, 50th and 75th percentiles by age group for the inheritance and estate tax counterfactuals (i and ii) in comparison to the no-tax counterfactual (Panel A and B). Panel C compares the distributions under the two taxes to each other.

Figure 10: Effect of Bequest Taxation on Wealth Accumulation: Counterfactual policies i and iii



Wealth distribution for the 25th, 50th and 75th percentiles by age group for the inheritance and estate tax counterfactuals (i and iii) in comparison to the no-tax counterfactual.

Figure 11: Effect of Bequest Taxation on Terminal Wealth: Counterfactual policies i and ii



Distribution of terminal estates for the inheritance and estate tax counterfactuals (i and ii) in comparison to the no-tax counterfactual (Panel A and B). Panel C compares the distributions under the two taxes to each other.

Appendices

A Dynamic Model - Euler Equations

The Euler equations for the two choice variables in the dynamic problem show the fundamental trade-off that the donor faces when deciding on c and s. First, a change in the expected marginal utility of consumption and gift transfers must correspond to a change in the expected marginal utility from bequeathing at death.

$$u_{ct} - (1 - D_{t+1})\delta E_t \left[u_{ct+1}\right] = \delta E_t D_{t+1} \left[B_{Wt+1}\right] \tag{13}$$

Secondly, the Euler equation for each element j of the bequest share vector s requires optimality for the current wealth level of each period.

$$B_{s_{jt}} = 0 \tag{14}$$

Incorporating the functional form of the bequest function yields the following Euler equation for c_t and first order condition for the optimal bequest share s to child l:

$$\overbrace{c_t^{-\eta_1} - (1 - D_{t+1})\delta E_t \left[c_{t+1}^{-\eta_1}\right]}^{\Delta u_c} = \overbrace{\delta D_{t+1} E_t \left[\lambda_1 \left(\sum_{j=1}^{J}(1 - \tau_j)s_j W\right)^{-\eta_2} \sum_{j=1}^{J} s_j \left(1 - \tau_J - W\tau_W\right)\right]}^{\text{marginal utility from bequeathing}} \tag{15}$$

$$\begin{aligned} &\overbrace{\lambda_1 \left[\sum_{j=1}^{J}(1 - \tau_j)s_j E_t(W_{t+1})\right]^{-\eta_2} E_t(W_{t+1}) \left[1 - \tau_l - s_l \tau_{s_l}\right]}^{\text{marginal utility from sum of after-tax bequests}} \\ &= \overbrace{2\lambda_2 \left[U^s(s_1 ... s_J) - U^s({s_1}^* ... s_J^*)\right]}^{\text{marginal disutility through share deviation}} \frac{\exp(\phi_l)}{s_l} \end{aligned} \tag{16}$$

with $\sum_{j=1}^{J} s_j = 1$. These two equations guide the optimal behavior of donors and illustrate the identification of λ_1 and λ_2.

B Estimation Details

As described in the main text, the estimation of the model consists of two steps. Firstly, we estimate true allocation preferences depending on heir and donor characteristics. These parameters obtained on the first stage are used to estimate the main parameters from the dynamic model. Overall, the model contains 7 second-stage parameters and 13 first stage parameters. More parameters required to be estimated leads to more iteration of the optimization algorithm. Therefore, reducing the number of parameters estimated on the second stage while solving computationally intensive dynamic model provides large computational gains.

Estimation of the first stage parameters is fairly computationally light and is conducted on the full sample of individuals from bequest dataset. To estimate the second stage mode, we draw a random 20% sample. We use 10 cores to solve the model at each iteration of the optimization algorithm. Both estimation procedures match chosen moments that describe features of individuals behavior of interest. Both models have more moments than parameters. In the first model, we use the identity weighting matrix, while in the second stage model, we use a two-stage optimal GMM matrix.

Theoretically, our estimator is consistent and asymptotically normally distributed (Pakes & Pollard, 1989; Duffie & Singleton, 1997).

$$\xi \sim N\left(0, (G_\xi' W G_\xi)^{-1} G_\xi' W \left[(1 + \frac{N_d}{N_s})\Omega_\xi + G_\varphi \Omega_\varphi G_\varphi'\right] W G_\xi (G_\xi' W G_\xi)^{-1}\right) \tag{17}$$

where G_φ, G_ξ are the gradient matrices of moments with respect to first stage and second stage parameters, correspondingly. $\Omega_\varphi, \Omega_\xi$ denote moment variance-covariance matrices of the first and second stage, correspondingly, and N_d, N_s are sample and simulation sample size.

In practice, some of the second stage parameters, namely $\lambda_1, \lambda_2^{2kids}, \lambda_2^{3kids}, \lambda_2^{4kids}$ are close to bounds of the corresponding supports. It yields some not well-behaved elements required to obtain asymptotic standard errors, which makes the whole procedure of obtaining asymptotic standard errors less reliable. Therefore, we opt for bootstrap. Since we use a full population of donors, we assume for simplicity of a bootstrap procedure that the first stage estimates are constant. It allows applying bootstrap to only second stage parameters to obtain standard errors. We use 100 draws with the replacement because of computational costs to obtain the parameters of the model.

To estimate the parameters of the model we use a stochastic global optimizer to explore the parameter space. More precisely, we use the CMA-ES algorithm from different starting values. Then we use the Nelder-Mead simplex algorithm starting from the best parameters obtained from the global optimizer to refine the solution. While doing bootstrap, we always use the

Nelder-Mead algorithm from the same starting value used to obtain the parameters.

C Reduced Form Results

Table 8: Bequest preferences: Family fixed effect specification

	Bequest Size
Heir is female (0/1)	181.9*
	(2.49)
Heir is married (0/1)	-9.083
	(-0.10)
Income of heir	-0.00858
	(-0.60)
Age of heir	-19.42**
	(-2.78)
Years of schooling	20.11
	(0.96)
Constant	60437.2***
	(114.90)
N	58460

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Preferences for unequal bequest split: Linear probability model

	Unequal Bequest (0/1)
3 children	0.00603*
	(2.34)
4 children	0.00250
	(0.65)
Donor is female (0/1)	-0.00947***
	(-3.74)
Donor age at death	-0.000209
	(-1.27)
Donor years of schooling	0.000146
	(0.48)
Constant	0.0494***
	(3.77)
N	17417

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$