



Wealth inequality, family background, and estate taxation



Mariacristina De Nardi^{a,b,c,d,*}, Fang Yang^e

^a University College London, United Kingdom

^b Federal Reserve Bank of Chicago, United States

^c Institute for Fiscal Studies, United Kingdom

^d National Bureau of Economic Research, United States

^e Louisiana State University, United States

ARTICLE INFO

Article history:

Received 24 July 2015

Received in revised form

19 October 2015

Accepted 21 October 2015

Available online 10 November 2015

Keywords:

Wealth inequality

Parental background

Estate taxation

Bequests

Earnings shocks

ABSTRACT

This paper generates two main contributions. First, it provides a new theory of wealth inequality that merges two empirically relevant forces generating inequality: bequest motives and inheritance of ability across generations; and an earnings process that allows for more earnings risk for the richest. Second, it uses the resulting calibrated framework to study the effects of changing estate taxation. Increasing the estate tax reduces the wealth concentration in the hands of the richest few and the economic advantage of being born to a rich and super-rich family at the cost of reduced aggregate capital and output. However, all of these effects are quite small. In contrast, increasing estate taxation can generate a significant welfare gain to a newborn under the veil of ignorance, but this comes at a large welfare cost for the super-rich.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Since its introduction in 1916, the estate tax has been one of the most controversial taxes in the United States tax code. Estate tax opponents call it the “death tax.” Among legislators supporting the abolition of the estate tax, former representative Ron Paul (14th district of Texas) stated: “The estate tax is immoral and counter-productive. ... My office has received hundreds of letters and emails from individuals. ... These people are not rich, but they have worked hard and saved to create an inheritance for their children...”¹

Estate tax supporters see the estate tax as an extremely progressive tax and a very effective way to tax the richest (and dead) few. Former representative Bob Etheridge (2nd district of North Carolina) stated “the so-called Death Tax Elimination Act should be called the Multi-millionaire Protection Act.”²

There is also much debate about wealth inequality and the importance of parental background in determining one's lot in life. Many papers measure and document the importance of parental background and initial conditions at the individual level. At the aggregate level, the large amount of wealth that is transmitted across generations, including physical wealth and human capital, has been extensively measured and debated. There is also a lot of discussion about the role of taxation and estate taxation in particular.

* Correspondence to: UCL Department of Economics, Drayton House, 30 Gordon St, London WC1H 0AX, United Kingdom. Tel.: +1 312 322 5295.

E-mail addresses: denardim@nber.org (M. De Nardi), fyang@lsu.edu (F. Yang).

¹ http://lobby.la.psu.edu/027_Estate_Tax/Congressional_Statements/House/H_Paul_090800.htm

² <https://www.congress.gov/crec/2000/06/09/CREC-2000-06-09.pdf>

This paper provides two main contributions. First, it provides a new theory of wealth inequality that merges two sources of inequality previously proposed: bequest motives and inheritance of ability across generations; and an earnings process that allows for more earnings risk for the richest. Second, it uses our calibrated framework to study the importance of parental background in our benchmark economy and the effects of changing estate taxation on aggregate capital accumulation, inequality, parental background as a source of inequality, and welfare.

We calibrate our framework to the 1990s, a period during which the estate tax was relatively stable, and we match key moments of earnings mobility and earnings inequality, aggregate savings, the fraction of wealth transmitted across generations, one moment of the observed bequest distribution, the fraction of estates that pay the estate tax, and the total estate tax revenue as a fraction of output. Our implied effective exemption level is \$756,000 (compared with the statutory level of \$675,000) and our implied effective marginal tax rate is 21% (compared with the highest statutory rate of 55%). These numbers are consistent with other estimates of the effective estate tax rate, including across the estate size distribution (see, for instance, [Gale and Slemrod, 2001](#)). Our calibrated model also generates realistically skewed distributions for wealth, earnings, and bequests, and is thus a good laboratory to use to study the effects of estate taxation; and it yields several interesting findings.

First, our benchmark model allows for four types of parental backgrounds – low-earnings, middle-earnings, high-earnings (rich), and super-high earnings (super-rich) – and implies that one's parental background is an important determinant of one's expected lifetime utility, especially for the rich and super-rich.

Second, we consider revenue-neutral reforms and study the effects of balancing the government budget constraint using either a labor income or capital income tax adjustment. We find that both taxes have very similar effects in terms of inequality, importance of parental background, and aggregate capital and inequality, but that adjusting the labor income tax when the estate tax is raised yields larger welfare gains for most of the population.

Third, changing estate taxation from their effective levels to levels of the order of the statutory ones that were common around the year 2000 (an exemption level of \$675,000 and a marginal tax rate of 55%) would lower aggregate capital and output, but would also reduce wealth inequality (and especially the concentration of wealth in the hands of the wealthiest 1%) and the advantage to being born to a rich and super-rich family. However, these effects are quite small. In terms of welfare, this reform generates a significant welfare gain from the standpoint of a newborn under the veil of ignorance, which comes at a huge welfare cost for the super-rich.

Fourth, our results about the effects of higher estate taxation on the aggregates, on inequality, and on the importance of parental background are surprisingly consistent regardless of whether bequests net or gross of estate taxes enter the utility function (more of a “wealth in the utility function formulation”), or even in the case of bequests due to completely altruistic parents, once these models are calibrated to match the same facts as closely as possible. In addition, even the ex-ante welfare measures are surprisingly similar.

To be consistent with the observed distribution of bequests, our calibrated bequest motives are of the luxury goods kind; that is, people desire to leave bequests only when they are rich enough. Hence, households that get rich because they received positive earnings shocks and/or large bequests want to share their luck with their descendants. The bequest motive thus raises the saving rate of the already rich and endogenously generates a positive correlation of saving rates across generations. In addition, more successful parents tend to have higher-earning offspring, which makes for an even more concentrated distribution of wealth and a higher correlation of savings across generations.

The paper is organized as follows. [Section 2](#) frames our contribution in the context of the previous literature. [Section 3](#) presents the model. [Section 4](#) discusses the model's calibration choices. [Section 5](#) highlights the calibrated model's implications. [Section 6](#) investigates the effects of various estate tax reforms. [Section 7](#) compares our results with those in the previous literature. [Section 8](#) concludes and discusses directions for future research.

2. Related literature

Our analysis builds on the model developed by [De Nardi \(2004\)](#) (and further refined by [Yang, 2013](#); and [De Nardi and Yang, 2014](#)) by introducing an earnings process calibration based on the one proposed by [Castañeda et al. \(2003\)](#), which helps in matching the observed wealth concentration (see [Cagetti and De Nardi, 2008](#) for a survey on wealth inequality), and by considering two different bequest motives. We use this improved framework to study the effects of parental background and estate taxation.

An extensive literature, both empirical and theoretical, shows that the transmission of physical and human capital from parents to children is a very important determinant of household wealth in the aggregate economy (see [Kotlikoff and Summers, 1981](#); [Modigliani, 1988](#), and [Gale and Scholz, 1994](#)) and of wealth and earnings ability over the household's life cycle (see [Hurd and Smith, 1999](#); [Becker and Tomes, 1986](#)). As a result, they are also prime forces to include to study the effects of parental background on inequality and the effects of estate taxation.

Another set of papers has pointed out the importance of initial conditions at labor market entry in determining lifetime inequality (and one's success in the labor market and expected lifetime utility); see [Keane and Wolpin \(1997\)](#) for an earlier contribution and [Huggett et al. \(2011\)](#) for a more recent one. We also study this dimension, as well as the effects of parental background on lifetime utility and inequality.

The literature studying the effects of estate taxation in quantitatively calibrated models that match observed wealth inequality includes [Cagetti and De Nardi \(2009\)](#) and [Castañeda et al. \(2003\)](#). While Cagetti and De Nardi (and their previous paper [Cagetti and De Nardi, 2006](#)) do so in a model with entrepreneurial choice and Castañeda et al. do not, both use a simplified life cycle with stochastic aging and assume completely altruistic parents. In contrast, we model the life cycle structure and two types of intergenerational links carefully, in a framework that also matches the observed distribution of bequests and generates a realistic increase of wealth inequality over the life cycle. We compare our results with those reported in these previous papers in [Section 7](#).

Our analysis is also connected to the qualitative literature on the effects of estate taxation in the presence of different bequest motives (see, for example, [Gale and Perozek, 2001](#); [Cremer and Pestieau, 2003](#); [Pestieau and Sato, 2006](#); [Hines, 2013](#)). Our contribution is quantitative in nature, and we address the issue of the sensitivity of the results to the assumed bequest motives in two ways. First, we consider two different formulations of bequest motives: one formulation (our main one) in which parents care about bequests net of estate taxes, which is closer to an altruistic formulation; and another formulation in which parents care about the bequest left gross of taxes, a less “altruistic” formulation, which is closer to the “wealth in the utility function” formulation advocated by [Carroll \(1998\)](#). Second, we compare our findings with those of [Cagetti and De Nardi \(2009\)](#) and [Castañeda et al. \(2003\)](#) papers that assume perfectly altruistic dynasties.

There is also a literature testing the empirical implications of parental altruism or trying to infer bequest motives using rich micro-level data sets. This branch of the literature has some bearing on the choices we might want to make when modeling bequest motives. For instance, the completely altruistic model, in which children's utility enters parent's utility, has implications for intergenerational risk sharing that have been rejected by [Altonji et al. \(1997\)](#), among others. An interesting paper by [Laitner and Juster \(1996\)](#) finds heterogeneity in bequest motives for the relatively affluent retirees in his sample. A contribution by [Kopczuk and Lupton \(2007\)](#) estimates a bequest motive that might or might not be present, depending on some households' characteristics, both observable and unobservable. Our view is that, while the jury is still out on how to best model bequests, a minimum requirement that a reasonable bequest motive should satisfy is that it should generate a realistic distribution of bequests, including the observation that many households die leaving bequests of negligible value. In addition, given that the intergenerational risk-sharing implications of complete altruism have been rejected, the bequest motive should not be of the perfectly altruistic type. Given these considerations and the empirical success of our paper (and its variations in bequest motives) in matching wealth and bequest inequality, we see our exercise as a valid contribution to evaluating the effects of parental background and estate taxation.

Finally, our paper proposes a positive analysis of estate taxation, as opposed to a normative one (for a relatively recent contribution of this kind, see [Farhi and Werning, 2010](#)).

3. The model

The model is a discrete-time, incomplete-markets, overlapping-generations economy with an infinitely lived government.

3.1. The government

The government taxes capital at rate τ_a , labor income and Social Security pay-outs at rate τ_l , and estates at rate τ_b above the exemption level x_b to finance government spending G . Social Security benefits, $P(\tilde{y})$, are linked to one's realized average annual earnings \tilde{y} , up to a Social Security cap \tilde{y}_c , and are financed through a labor income tax τ_s . The two government budget constraints, one for Social Security and the other one for government spending, are balanced during each period.

3.2. Firm and technology

There is one representative firm producing goods according to the aggregate production function $F(K; L) = K^\alpha L^{1-\alpha}$, where K is the aggregate capital stock and L is the aggregate labor input. The final goods can either be consumed or invested in physical capital, which depreciates at rate δ .

3.3. Demographics and labor earnings

Each model period lasts five years. Agents start their economic life at the age of 20 ($t=1$). By age 35 ($t=4$), the agents' children are born. The agents retire at age 65 ($t=10$). From that period on, each household faces a positive probability of dying, given by $(1-p_t)$, which only depends on age.³ The maximum life span is age 90 ($T=14$), and the population grows at a constant rate n . The online appendix (on Science Direct) graphically illustrates the demographic structure of our overlapping generations model.

³ We make the assumption that people do not die before age 65 to reduce computational time. This assumption does not affect the results since in the U.S., the number of adults dying before age 65 is small.

Total labor productivity of worker i at age t is given by $y_t^i = e^{z_t^i + \epsilon_t}$, in which ϵ_t is the deterministic age-efficiency profile. The process for the stochastic earnings shock z_t^i is: $z_t^i = \rho_z z_{t-1}^i + \mu_t^i$, $\mu_t^i \sim N(0, \sigma_\mu^2)$.

To capture the intergenerational correlation of earnings, we assume that the productivity of worker i at age 55 is transmitted to children j at age 20 as follows: $z_1^j = \rho_h z_8^i + \nu^j$, $\nu^j \sim N(0, \sigma_\nu^2)$, as parents are 35 years (seven model periods) older than their children.

3.4. Preferences

Preferences are time separable, with a constant discount factor β . The period utility function from consumption is given by $U(c) = (c^{1-\gamma} - 1)/(1-\gamma)$.

People derive utility from holding onto assets because they turn into bequests upon death. This form of ‘impure’ bequest motive implies that an individual cares about total bequests left to his/her children, but not about the consumption of his/her children.

The utility from bequests b is denoted by

$$\phi(b) = \phi_1 \left[(b + \phi_2)^{1-\gamma} - 1 \right].$$

The term ϕ_1 measures the strength of bequest motives, while ϕ_2 reflects the extent to which bequests are luxury goods. If $\phi_2 > 0$, the marginal utility of small bequests is bounded, while the marginal utility of large bequests declines more slowly than the marginal utility of consumption. In the benchmark model, we set b as bequest net of estate tax, b_n . We also consider the case in which gross bequests, b_g , enter the utility function. In that case, we set $b = b_g$. Our formulation is thus more flexible than in De Nardi (2004), Yang (2013), and De Nardi and Yang (2014) because we allow for two kinds of bequest motives. In the first one, parents care about bequests net of taxes. In the second one, parents care about bequests gross of taxes. A more altruistic parent would take into account that some of the estate is taxed away, but parents might just care about what assets they leave, rather than how much their offspring receive.

3.5. The household's recursive problem

We assume that children have full information about their parents' state variables and infer the size of the bequests that they are likely to receive based on this information. The potential set of a household's state variables is given by $x = (t, a, z, \tilde{y}, S_p)$, where t is household age (notice that in the presence of a fixed age gap, one's age is also informative about one's parents' age), a denotes the agent's financial assets carried from the previous period, z is the current earnings shock, and \tilde{y} stands for annual accumulated earnings, up to a Social Security cap \tilde{y}_c , which are used to compute Social Security payments. The term S_p stands for parental state variables other than age and, more precisely, is given by $S_p = (a_p, z_p, \tilde{y}_p)$. It thus includes parental assets, current earnings, and accumulated earnings. When one's parent retires, z_p , or current parental earnings, becomes irrelevant and we set it to zero with no loss of generality.

From 20 to 60 years of age ($t=1$ to $t=9$), the agent works and survives for sure to next period. Let $V_w(t, a, z, \tilde{y}, S_p)$ and $V_w^l(t, a, z, \tilde{y})$ denote the value functions of a working-age person whose parent is alive and dead, respectively, where l stands for “inherited.” In the former case, the household's parent is still alive and might die with probability p_{t+7} , in which case the value function for the orphan household applies, and assets are augmented by inheritances in per-capita terms. That is,

$$V_w(t, a, z, \tilde{y}, S_p) = \max_{c, a'} \left\{ U(c) + \beta p_{t+7} E \left[V_w(t+1, a', z', \tilde{y}', S_p') \right] + \beta (1-p_{t+7}) E \left[V_w^l(t+1, a' + b_n/N, z', \tilde{y}') \right] \right\}, \quad (1)$$

subject to

$$c + a' = (1 - \tau_l)wy - \tau_s \min(wy, 5\tilde{y}_c) + [1 + r(1 - \tau_a)]a, \quad (2)$$

$$a' \geq 0, \quad (3)$$

$$\tilde{y}' = [(t-1)\tilde{y} + \min(wy/5, \tilde{y}_c)]/t, \quad (4)$$

$$\tilde{y}_p' = \begin{cases} [(t+6)\tilde{y}_p + \min((wy_p/5, \tilde{y}_c)]/(t+7) & \text{if } t < 3 \\ \tilde{y}_p & \text{otherwise} \end{cases} \quad (5)$$

$$b_n = b_n(S_p), \quad (6)$$

where N is the average number of children determined by the growth rate of the population. The expected values of the value functions are taken with respect to (z', z_p') , conditional on (z, z_p) . The agent's resources depend on labor endowment y and asset holdings a .

Average yearly earnings for children and parents evolve according to Eqs. (4) and (5), respectively. Since current income y refers to a five-year period, current income is divided by five when the yearly lifetime average labor income (\tilde{y}) is updated. Eq. (6) is the law of motion of bequest for the parents, which uses their optimal decision rule.

The value function of an agent who is still working but whose parent is dead is

$$V_w^l(t, a, z, \tilde{y}) = \max_{c, a'} \left\{ U(c) + \beta E \left[V_w^l(t+1, a', z', \tilde{y}') \right] \right\}, \quad (7)$$

subject to (2), (3), and (4).

From 65 to 85 years of age ($t=10$ to $t=14$), the agent is retired and receives Social Security benefits and his parent is already deceased. He faces a positive probability of dying, in which case he derives utility from bequeathing the remaining assets

$$V_r(t, a, \tilde{y}) = \max_{c, a'} \left\{ U(c) + \beta p_t V_r(t+1, a', \tilde{y}) + (1-p_t)\phi(b) \right\}, \quad (8)$$

subject to (3),

$$c + a' = [1 + r(1 - \tau_a)]a + (1 - \tau_l)P(\tilde{y}), \quad (9)$$

$$b_n = \begin{cases} a' & \text{if } a' < x_b, \\ (1 - \tau_b)(a' - x_b) + x_b & \text{otherwise,} \end{cases} \quad (10)$$

and, in the case of net bequest motives,

$$b = b_n, \quad (11)$$

while in the case of gross bequest motives,

$$b = b_g = a', \quad (12)$$

regardless of the structure of the estate tax.

We focus on a stationary equilibrium concept in which factor prices and age-wealth distribution are constant over time. Due to space constraints, the definition of a stationary equilibrium for our economy is in the online appendix.

4. Calibration

Unless stated otherwise, we report parameters at an annual frequency. The calibration table in the online appendix summarizes the parameters that are either taken from other studies or can be solved independently of the endogenous outcomes of the model. Regarding the latter, due to the assumption of exogenous labor supply and retirement decisions, the tax rate on Social Security only depends on the earnings shocks and the population demographics, which are exogenous to the model.

We set the population growth rate, n , to be 1.2%, the average value of population growth from 1950 to 1997 from the Council of Economic Advisors (1998). The p_t 's are the vectors of conditional survival probabilities for people older than 65 and are set to the survival probabilities for people born in 1965 (Bell et al., 1992). We take the risk aversion coefficient, γ , to be 1.5.

The deterministic age-profile of labor earnings e_t has been estimated by Hansen (1993). Since we impose mandatory retirement at the age of 65, we set $e_t = 0$ after that age ($t > 9$). Our calibration of labor earnings process is based on the observation that the Panel Study of Income Dynamics (PSID) provides excellent data on the earnings dynamics of much of the population but not of the richest households (see, for instance, Bosworth and Anders, 2011). To match the earnings dynamics of all the population, we model our earnings process as follows.

First, it assumes four possible earnings states: low, middle, high, and super-high. The support of the earnings shocks comes from Castañeda et al. (2003) and the resulting grid points for ψ are [1, 3.15, 9.78, 1,061]. Second, it takes the persistence ρ_h of the earnings inheritance process from Zimmerman (1992) and Solon (1992) and the variance σ_h^2 from De Nardi (2004). The earnings inheritance process is then discretized as proposed by Tauchen (1986).

Third, it takes PSID estimates on the persistence (0.92) and variance (0.38) over five-year periods from Table A1 in Appendix A in De Nardi (2004); and discretizes this process for the lowest three grid points using Tauchen (1986) to make sure that our process accurately represents the estimated earnings dynamics for much of the population. This gives a three by three transition matrix.

Fourth, the remaining six elements of the four by four transition matrix are picked to match the following aspects of the earnings distribution: the Gini coefficient and the share of total earnings earned, respectively, by the top 1%, 5%, 20%, 40%, 60%, and an earnings persistence at the top of 80%. The latter is consistent with work by De Backer et al. (2012), which reports that the persistence of both labor and business income at the top of labor and business income distributions is high and that, in particular, the probability of staying there, both after one year and five years (the latter results are available from the authors on request), is around 80%. We also impose adding-up restrictions.

The online appendix (on Science Direct) shows that our calibration generates a cross-sectional earnings distribution that is very close to that computed from the Survey of Consumer Finances (SCF) data. It also reports the transition matrices for the earnings process over time and across generations and the invariant distribution over earnings states upon entering the

Table 1

Parameters calibration for the benchmark model and the model with no voluntary bequests.

Moment	Data	Benchmark	Gross bequests	No bequest motives
Wealth–output ratio	3.10	3.10	3.10	3.11
Bequest–wealth ratio	0.88–1.18%	0.88%	0.88%	0.58%
90th perc. bequest distribution	4.34	4.51	4.29	4.71
Fraction of estates paying taxes	2.0%	1.92%	1.92%	2.04%
Revenue from estate tax/output	0.33%	0.33%	0.33%	0.32%
Government spending/output	18%	18.00%	18.00%	18.00%
Parameters				
β	discount factor	0.9454	0.9455	0.9525
ϕ_1	bequest utility	–5.4473	–6.1561	0.0000
ϕ_2	bequest utility shifter (in \$2000)	1095 K	1376 K	0.0000
τ_b	tax on estates	21.43%	21.30%	62.94%
x_b	estate exemption level (in \$2000)	756 K	786 K	745 K
τ_l	tax on labor income	19.20%	19.20%	19.20%

economy. The share of income that goes to capital, α , is set at 0.36 (Cooley and Prescott, 1995), and depreciation is 6% (Stokey and Rebelo, 1995).

The capital income tax rate τ_q is set at 20% as in Kotlikoff et al. (1999). The Social Security benefit $P(\tilde{y})$ mimics the Old Age and Survivor Insurance component (see online appendix for details). The tax rate on labor income τ_s is set at 12.0% to balance the Social Security budget.

Table 1 lists the parameters we use to calibrate the model. We choose β , to match the capital output ratio; and in the cases in which a bequest motive is present, we choose ϕ_1 , and ϕ_2 to match the bequest–wealth ratio (Gale and Scholz, 1994) and the 90th percentile of the bequest distribution normalized by income (Hurd and Smith, 1999). In the data, the bequest–wealth ratio is 0.88% when only bequests are included, but rises to 1.18% if inter-vivos transfers and college expenses are included in the measure of bequests. Although one might argue that we should calibrate to the total of such transfers because we do not model the last two components explicitly, we calibrate to the lower bound of the range to be conservative. Regarding the bequest distribution, we use the one for single descendants instead of the one for all descendants. As argued in De Nardi (2004), typically a surviving spouse inherits a large share of the estate, consumes part of it, and only leaves the remainder to the couple's children.

The discount factor affects savings and average wealth in the economy. The term ϕ_1 measures the strength of bequest motives, thus we choose the aggregate bequest as a moment. The term ϕ_2 reflects the extent to which bequests are luxury goods, thus affecting the upper tail of the bequest distribution. Our calibration for the model with net bequests in the utility function implies that, during the last period of life, when the individual knows that he/she will die for sure next period, the marginal propensity to bequeath out of an additional dollar above the estate tax threshold is 56%, while the threshold above which the person wants to start bequeathing is \$1.095 million (normalized using \$57,135 as average income in 2000). The corresponding numbers for the gross bequests model are, respectively, 53% and \$1.376 million. We discuss the interpretation of the bequest parameters in the online appendix.

Although many experts agree that effective estate taxation can be reduced substantially by appropriate estate management and valuation, there is considerable uncertainty about how much people can and do reduce the estate tax burden through both legal and illegal means. There is, in contrast, no dispute about the observed revenues from the estate and gift tax and the fraction of estates that do pay estate taxes. We choose the tax parameters τ_b and x_b to match the fraction of estate tax revenue to output (0.33%, Gale et al., 2001 and Gale and Slemrod, 2001) and the fraction of estates that pay estate taxes (2.0%, Gale et al., 2001 and Gale and Slemrod, 2001). The implied exemption level expressed in terms of year 2000 dollars turns out to be \$756,000, which is only modestly higher than the \$675,000 exemption that was in place at that time. Our calibrated numbers fall well within the bounds proposed by the previous literature. Given that our model matches asset holdings so well, and given the considerable uncertainty about effective estate tax avoidance and evasion, we see this as a useful way to proceed.

We choose τ_l to balance the government budget constraint, given a ratio of government spending to output of 18% (Council of Economic Advisors, 1998).

In the model without bequest motives, we choose the parameters β , τ_b , x_b , and τ_l to match the capital output ratio, the fraction of estate tax revenue to output, the fraction of estates that pay estate taxes, and the ratio of government spending to output.

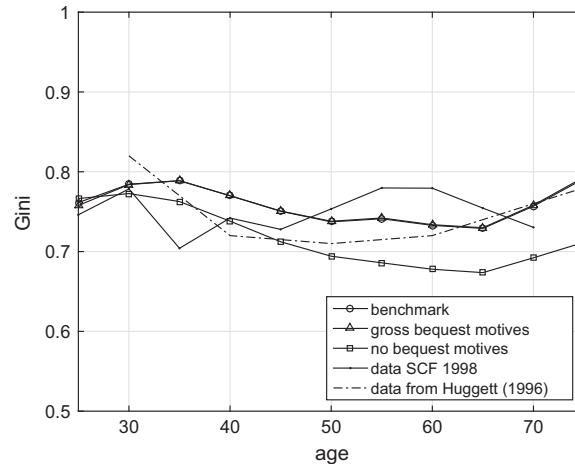
An inspection of Table 1 reveals that, unlike our calibrated model with voluntary bequest motives, the model without bequest motives cannot match the flow of aggregate bequests to aggregate wealth. In fact, it only captures 66% of it, and thus overstates the estate tax rate (63%), setting it even higher than the statutory tax rate (55%), which applies only to the largest bequests. The higher tax rate mechanically comes from the fact that the flow of bequests is too small and yet the estate tax revenue has to match the observed revenue in the data.

We present our numerical results as follows. In Section 5, we discuss three versions of the model and their implications, how they compare with the actual data, and how they differ across models. We also discuss the importance of parental

Table 2

Percentage of total wealth held by households in the top percentiles. First line: 1998 SCF data. Second line: benchmark model with voluntary bequests in which net bequests are in the utility function. Third line: model with voluntary bequests in which gross bequests are in the utility function. Fourth line: model without voluntary bequests.

Data and models	Gini	Percentile (%)					
		1	5	20	40	60	80
1998 SCF	0.80	34.7	57.8	69.1	81.7	93.9	98.9
Benchmark model	0.80	35.2	51.9	66.1	82.9	95.3	99.6
Gross bequests model	0.80	35.3	52.1	66.3	83.0	95.3	99.6
No bequest motives	0.76	25.8	44.1	59.7	78.5	93.5	99.1

**Fig. 1.** Gini coefficient of wealth by age.

background in affecting lifetime expected utility, and we evaluate the intergenerational persistence of earnings and wealth in our benchmark economy. The online appendix also discusses the distribution of the tax burden and how it changes with estate taxation reform. In Section 6, we study the long-run effects of various estate taxation reforms, in which we use either the tax on capital or the tax on labor income to re-establish budget balance. In each run, unless otherwise indicated, we solve for the dynamic programming problem, impose budget balance for the government, and adjust prices to re-establish market clearing.

5. Numerical results

This section highlights the implications of the calibrated model.

5.1. The wealth distribution in the cross section and over the life cycle

Table 2 reports values of the wealth distribution. The first line refers to data from the 1998 SCF taken from Budría et al. (2002) and shows that, in the data, wealth is highly unevenly distributed. The wealthiest 1% of people hold 35% of net worth, while the wealthiest 5% hold 58% of total net worth. The second line of data reports the corresponding numbers for the benchmark model with intergenerational links and bequest motives and bequests net of taxes entering the utility function. The third line of data reports the corresponding numbers for the model with intergenerational links and bequest motives and bequests gross of taxes entering the utility function.⁴ Both versions of the model with voluntary bequests, whether the utility from bequests is net or gross of taxes, when appropriately calibrated to match our target moments, succeed in generating the observed wealth concentration.

The fourth line of data reports values for the wealth distribution generated by a model without voluntary bequests that is calibrated as discussed previously. This version of the model succeeds in generating wealth holdings in the hands of the richest 1% that are larger than the share of earnings of the richest 1%. The key mechanism generating this is that the earnings super-rich have a 20% probability of sliding into a much lower earnings state each period and thus save at very high

⁴ Since all of our 20 year olds are born with zero net worth, we exclude them from our calculations of wealth inequality.

rates to smooth consumption over time. Despite this additional saving motive for the high earners, however, the model falls short of matching the observed fractions of wealth held by the richest. The comparison between the model with voluntary bequest motives and the one without voluntary bequest motives highlights the role of the voluntary bequest motive, calibrated as a luxury good, in generating a higher concentration of wealth in the hands of the richest few and raising overall wealth inequality as measured by the Gini coefficient. The intuition is that this kind of bequest motive raises the saving rate of the rich, who thus leave larger estates to their children; they in turn also save more, thus increasing wealth concentration.

Fig. 1 displays the evolution of a summary measure of wealth concentration, the Gini coefficient, by age. The figure reports two different series for the data. The first one, from Huggett (1996), displays a U-Shaped form by age (dash-dot line); while the second one, from Kuhn (2014), is flatter (solid line). Both lines imply a high concentration of wealth at all ages. The Gini coefficient of wealth by age produced by our benchmark model with net bequests in the utility function (line with circles) coincides with the one in the model with gross bequests in the utility function (line with triangles), as the two models, appropriately re-calibrated, fit the data very similarly. All of our models produce Gini coefficients by age in the ballpark of the data, but the models with voluntary bequests better match the observed Gini coefficient for wealth at all ages compared with the implications of the model without voluntary bequests (line with squares). This indicates that the model with voluntary bequests not only better matches the cross-sectional wealth inequality at all ages, but also better reproduces some of its evolution over the life cycle. The evolution of the Gini coefficient, and more generally wealth inequality, as people age, is a promising avenue to help identify bequest motives.

5.2. The importance of parental background

Parental background affects one's prospects in life through two channels. First, since richer parents leave larger bequests, it influences the amount of expected bequests that one will receive. Second, since one's initial earnings draw is correlated to one's parental earnings and is then persistent over time, it also influences one's lifetime earnings.

In this subsection, we discuss the value of being born to a family with different parental backgrounds (or earnings). Later, when evaluating various policy reforms, we assess to what extent estate, capital income, and labor income taxes can affect the luck (or lack thereof) of being born with a certain parental background rather than another one in our framework.

In our calibration, the earnings of both parents and children can assume four values: low-earnings, middle-earnings, high-earnings, and super-high earnings. We perform our calculations of the value of being born in a certain parental socio-economic class as follows. Take a new worker with parental background i . Find the median of the other parental state variables (assets and associated lifetime earnings) with current parental earnings or background at the time when the child enters the labor market. Also find the median of the new workers' state variables (initial earnings) conditional on their parental earnings or background. Take the corresponding value function for all of these state variables. Repeat this process for a new worker with parental background j . Compare the two value functions, and compute the one-time asset compensation requested to make the newborn worker born to a given family background indifferent to being born to a family with another level of parental earnings or background and divide by average income to normalize. One way of interpreting this comparison is that it calculates the value of being born to a typical background, conditional on parental socio-economic status, and all of the median associated state variables that go along with it, with a different parental socio-economic status and all associated other median state variables.

In Table 3, we first switch both initial human capital and expected bequests among the offspring of families from different parental backgrounds, thus evaluating the importance of bequests and initial productivity, or human capital, together (top panel). In the bottom panel, we only switch expected bequests, thus evaluating only the importance of wealth transmission across generations, for a given level of initial productivity or human capital. The top panel of Table 3 shows that newborn workers whose parents are at the highest earnings at age 55 need to be compensated, respectively, by 35.7, 35.5, and 28.4 times average income to be moved to the state of being born to a family with the low (1st), middle (2nd), or high

Table 3

Asset compensation required for moving from a parental background level to another, normalized as a fraction of average income. Top panel, background advantage due to both bequests and inheritance of human capital. Bottom panel, background advantage due to bequests only.

Parent's earnings	Moving to parent's earnings		
	1st	2nd	3rd
Bequests + human capital inheritance			
2nd	0.06	–	–
3rd	5.59	5.43	–
4th	35.71	35.50	28.41
Bequests only			
2nd	0.06	–	–
3rd	0.57	0.42	–
4th	14.87	14.71	13.98

level (3rd) of parental earnings. A newborn worker with parents in the 3rd (high) earnings background has to be compensated by over five times average income to be born to a family with middle- or low-earning parents. Finally, low (1st) and middle (2nd) earning families are quite similar in terms of the lifetime utility that they provide to their children, compared with the high or super-high earners. The bottom panel shows that, for those born to a super-rich family, 40% of the compensation is related to expected bequests, while 60% is related to a higher initial level of productivity, or human capital inheritance. Comparing the second line of both panels shows that the importance of bequests shrinks very quickly as we move from a super-rich family background to a merely rich family background.

These calculations thus suggest that the value of being born into a family with a high or super-high socio-economic background is very large, and that parental background (and especially expected bequests) is an important determinant of the lifetime utility of the richer households in our calibrated model. In contrast, the effects of parental background are much smaller for the households born to the low- and middle-income parental level, with the importance of bequests becoming much smaller as the level of parental background decreases. Since in our economy the fraction of people born with a high- and super-high parental earnings background is very small (about 2%), for the majority of people in our economy the effect of parental background on lifetime expected utility is small.

5.3. Intergenerational wealth and earnings mobility

Next, we assess the model's implications for intergenerational mobility of earnings and wealth. [Chetty et al. \(2014\)](#) use data from federal income tax records for children born in the 1980–1982 birth cohorts and regress the log of child income (mean family income in 2011–2012) on the log of parent income (mean family income for parents, over the five years from 1996 to 2000) and find an estimated coefficient of 0.344. We generate a simulated panel of parents and children from the model and run the following regression: $y_{k,i} = \beta_0 + \beta_1 y_{p,i} + \epsilon_{i}^y$, where $y_{k,i}$ is the earnings of the child in family i at age 20–24, $y_{p,i}$ is the earnings of the parent at age 55–59. The resulting coefficient β_1 is 0.306, which is lightly lower than the value of 0.344 reported in [Chetty et al. \(2014\)](#). For other work discussing important issues with the estimation of intergenerational mobility, see [Mazumder \(2015\)](#).

[Charles and Hurst \(2003\)](#) compute an intergenerational mobility of wealth of 0.263 from the PSID after controlling for education. In their sample, children's wealth is measured in 1999 and parental wealth is average wealth between 1984 and 1989. We select parents who are age 45–65 in the first period and are alive four periods later. We then run the following regression: $a_{k,j} = \beta_0 + \beta_1 a_{p,i} + \alpha_1 \text{age}_{k,i} + \alpha_2 \text{age}_{k,i}^2 + \epsilon_i^a$, where $a_{p,i}$ is the average wealth of the parent in the first and second period, $a_{k,j}$ is the wealth of the children four periods later, and age is children's age four periods later. The resulting coefficient β_1 is 0.174. There are two reasons why our model slightly underestimates intergenerational persistence of wealth over those age groups. First, for tractability, every household starts at age 20 with zero wealth in our model, hence there is no correlation of wealth between parents and children at the beginning of the life cycle, and it takes time for the households to accumulate wealth. Given this, we see our results on the importance of parental background as lower bounds. Second, our model generates a slightly lower intergenerational persistence of earnings than in the data. As a robustness check, we increase the correlation of the child's initial productivity draw to match an intergenerational persistence of earnings to 0.4. In that case, the resulting intergenerational persistence of wealth goes up to 0.207. We also re-run some of our experiments for that case and obtain very similar results (results available upon request).

6. Reforming estate taxation

We study two key margins of estate taxation: the threshold above which estates start being taxed, and the marginal tax rate above which estates are taxed above the exemption threshold. Modifying the estate taxation exemption levels affects both the size of the estates that are hit by estate taxes and the burden of estate taxation. For example, reducing the exemption level implies that smaller estates start being taxed, but also that the previously taxed estates pay more taxes, because their exemption level is smaller. In contrast, changing the estate tax rate for a given exemption level just increases or decreases the burden of estate taxes on estates of the same size.

Changing estate taxation also has an effect on the estate distribution. This can happen for two reasons. First, if the people leaving estates care about the estate net of bequest taxes (a more altruistic form of bequest motive), they will change their saving behavior and desired bequest when estate taxation changes. This effect will be missing in the case of gross bequests in the utility function. Second, people might receive different amounts of bequests net of taxes, which will affect their saving behavior and desired bequests in turn, because the model with realistically calibrated bequest motives generates a non-homotheticity of savings in income and wealth.

We now turn to presenting the effects of various estate taxation policy reforms on the aggregates, on inequality, on the importance of parental background, and on welfare, in the cases of adjusting either the capital income ([Table 4](#)) or the labor income tax (some of the results for this case are in the online appendix) to re-establish government budget balance. In some instances, to better discuss the various effects, we also report results for fixed prices and thus partial equilibrium.

6.1. Aggregate effects

Table 4 reports the results for the estate tax reforms in which the capital income tax is used to re-establish budget balance. Due to space constraints, we report the aggregate and distributional results for the estate tax reforms in the case in which the labor income tax is used to re-establish government budget balance in the online appendix. Changing the tax on capital income changes the incentives to save by affecting the net rate of return on capital. Changing labor income taxation does not distort labor supply decisions because, for tractability, we assume exogenous labor supply; it does affect net lifetime income, and hence the importance of human capital inheritance across generations. In fact, raising the tax on labor earnings reduces the advantage of being born to more able parents and having a higher expected lifetime income.

The top panel of the table shows the aggregate effects of changing the estate tax rate, while the second panel reports the results for changes in the estate tax exemption level. The third panel changes both the estate tax rate and its exemption level at the same time. The line in bold refers to our benchmark economy. The bottom panel reproduces some of the analysis for the case of utility from bequests gross of taxes.

Lowering the estate tax rate (τ_b) below our calibrated level of 21% increases the return to leaving a bequest for people who are rich enough to have an active bequest motive but requires an increase in another tax instrument to re-establish budget balance. Increasing the tax rate on capital income decreases the incentive to save for everyone and especially for those who are not actively saving to leave a bequest. The net effect for the richest in our framework is that the increased return from leaving a bequest is larger than the disincentive coming from the lower interest rate. In addition, in the aggregate, the increased savings of the richest are large enough to counterbalance the decreased savings of everyone else and, on net, aggregate capital and income go up as the estate tax is lowered. When the labor income tax is used to balance the government budget constraints, for given prices, reducing estate taxation does not reduce the rate of return to savings for anyone in the population and still increases the return to leaving a bequest for the rich. As a result, aggregate capital goes up a bit more (which tends to reduce the interest rate by more in general equilibrium) and so does aggregate output. This is not very surprising because not only does taxing labor not discourage savings as taxing capital income does, but in our economy labor supply is fixed, and therefore there is no disincentive of labor supply coming from increasing the labor tax.

Increasing the tax rate on estates: Up to a tax rate on estates of about 50%, raising the estate tax rate and lowering the capital income tax reduce both aggregate capital and output due to the fact that the return to leaving a bequest goes down when the estate tax goes up, and the saving rate of the rich goes down by more than the increased savings of everyone else (now facing higher returns due to a lower tax rate on capital and higher equilibrium interest rates and thus saving more). However, around a tax rate on estates of about 60%, bequests net of the estate tax become smaller and smaller and the richest keep up their saving to avoid a large reduction in net bequests. The rest of the population faces a lower capital income tax and desire to save more, and aggregate capital and income go up. In the model with gross bequest motives, the rich do not adjust savings up to avoid a large reduction in net estates, as the tax rate on estates keeps going up and this nonlinearity is absent. This nonlinearity is also absent when we increase the estate tax while lowering the tax rate on labor. In this case, the rich keep getting less rich due to smaller net bequests as we increase the estate tax, but the effect of increasing the returns to savings due to lower capital income taxes is no longer present across the whole population. However, most of the population experiences a positive wealth effect due to lower labor income taxes, and thus saves a little more as a result.

Lowering the exemption level has two effects. First, it introduces estate taxes for smaller estates that were not taxed previously; and second, it taxes more heavily the estates that were already taxed previously. When the exemption level is lowered, aggregate capital and income decrease. When it is increased, the effects go in the opposite direction but are very small. This holds regardless of whether the capital income or the labor income tax is adjusted.

Table 4

Aggregate effects of changing the estate tax rate or exemption level, adjusting the capital income tax. The lines in bold refer to our benchmark economy.

τ_b	ex_b	τ_a	K	Y	B	K/Y	B/Y	r	Wage
Net bequest model, changing the estate tax rate									
0.00	–	0.216	3.122	1.003	0.00876	3.114	0.873	5.580	0.490
0.21	756 K	0.200	3.100	1.000	0.00880	3.102	0.880	5.622	0.489
0.40	756 K	0.187	3.082	0.998	0.00896	3.088	0.898	5.658	0.488
0.60	756 K	0.170	3.084	0.998	0.00909	3.090	0.911	5.654	0.488
Net bequest model, changing the estate tax exemption level									
0.21	219 K	0.195	3.092	0.999	0.00891	3.095	0.892	5.638	0.489
0.21	756 K	0.200	3.100	1.000	0.00880	3.102	0.880	5.622	0.489
0.21	1095 K	0.201	3.101	1.000	0.00879	3.101	0.879	5.619	0.489
Net bequest model, changing both the estate tax rate and the exemption level									
0.55	675 K	0.174	3.077	0.997	0.00905	3.085	0.907	5.667	0.488
Gross bequest model, changing the estate tax rate and exemption level									
0.55	675 K	0.179	3.051	0.994	0.00872	3.069	0.877	5.717	0.486

Finally, we change the structure of estate taxation to the statutory one in place in the year 2000, when the exemption level was \$675,000 and the marginal tax rate was 55%. This change in the exemption levels implies that 2.44% of estates are now taxed, compared with 1.92% in our benchmark. This tax policy minimizes aggregate capital and income among all of the tax configurations that we consider and thus does not seem particularly desirable. Under this taxation scheme, gross bequests go up because people care about the utility of leaving bequests net of taxes and thus keep more assets to transfer to their descendants, but this increase is not enough to compensate for the increased estate tax burden.

In the model in which people derive utility from bequests gross of taxes rather than net of taxes, when the estate tax rate goes down, people do not decrease their desired gross bequests and capital and, as a result, output goes up by a little more than the case of net bequests in the utility function (more results than those reported are available on request). In contrast, when the estate tax rate goes up, people do not save more to leave larger bequests net of taxes to their children. As a result, aggregate capital and income drop slightly more than in the model with utility from bequests net of taxes. Interestingly however, both the calibrated models with net and gross bequests in the utility function imply a drop in aggregate capital and income when estate taxation is raised; and the differences in the effects generated by these two models are quite small, once the two models are calibrated to match the same facts in their respective benchmark calibrations.

We also computed the elasticity of the estate tax base to changes in the estate tax in both the net bequest model and gross bequest model, adjusting either the capital income or the labor income tax, in either a general equilibrium or a partial equilibrium setting. For changes of the estate tax rate between 10% and 60%, the elasticity of the tax base ranges between -0.158 and 0.082 and it is thus very small.

Overall, the results of changing the estate tax are thus remarkably similar whether or not the tax on capital or labor income is adjusted and whether households derive utility from leaving bequests gross or net of estate taxes.

6.2. Distributional effects

Table 5 reports the effects of various reforms on measures of wealth inequality when the capital income tax is adjusted. The corresponding table for when the labor income tax is adjusted is in the online appendix. The main conclusions to be drawn from these experiments are the following. First, the share of wealth held by the richest is monotonically decreasing in the estate tax rate. For instance, eliminating estate taxation would increase the share of total net worth held by the richest 1% of people from 35% to 37%, while increasing it to 50% would reduce their share of net worth to 33%. Second, the effects of changing estate taxation on inequality are similar when we use the labor or the capital income tax to balance the budget. Third, the decrease in wealth inequality as the tax rate on estates is increased is slightly larger when the capital income tax is used to balance the budget than when the labor income tax is used. Fourth, changing the exemption level of estate taxation in the range of \$200,000–\$1,000,000 has little effect on wealth inequality for an estate tax rate of 21%, while the effects are a bit larger with a higher estate tax rate of the order of 55% (results available from the authors).

Hence, putting together the aggregate and distributional effects of these reforms, we find that reducing estate taxation increases aggregate output and capital but also increases wealth inequality, while increasing the estate tax rate has the opposite effect; and the results are remarkably similar when the capital or labor income tax is adjusted and for gross and net bequests in the utility function.

Table 5

Distribution effects of changing the estate tax rate or exemption level, adjusting the capital income tax. The lines in bold refer to our benchmark economy.

τ_b	ex_b	τ_a	Gini	Percentile (%)			
				1	5	20	40
Net bequest model, change the estate tax rate							
0.00	–	0.216	0.811	36.91	53.34	67.28	83.61
0.21	756 K	0.200	0.804	35.15	51.90	66.09	82.89
0.40	756 K	0.187	0.798	33.78	50.71	65.10	82.27
0.60	756 K	0.170	0.793	32.83	49.82	64.27	81.67
Net bequest model, change the estate tax exemption level							
0.21	219 K	0.195	0.805	35.52	52.23	66.37	82.90
0.21	756 K	0.200	0.804	35.15	51.90	66.09	82.89
0.21	1095 K	0.201	0.804	35.11	51.87	66.10	82.92
Net bequest model, change estate tax rate and exemption level							
0.55	675 K	0.174	0.794	32.99	49.98	64.43	81.74
Gross bequest model, change estate tax rate and exemption level							
0.55	675 K	0.179	0.792	32.39	49.57	64.15	81.59

6.3. Importance of parental background effects

In order to assess to what extent estate tax reforms can affect the lifetime value of being born to a family with a different parental earnings level, or parental background, we show in Table 6 the one-time asset compensation corresponding to moving a child being born to a family with a given household's earnings to another one, expressed as a fraction of average yearly income. We report these compensations for our benchmark economy and for an economy with a 55% tax rate on estates, an estate exemption level of \$675,000, and either a lower capital income or labor income tax. We also report results for the model with gross bequests in the utility function. Table 7 keeps child productivity unchanged and only switches expected bequests due to family background.

These tables yield several findings. First, the value of being born to a family with the highest parental earnings background is significantly reduced when estate taxes are increased. For instance, the compensation requested for moving from the top to the bottom of parental earnings is 35.7 times average income in the benchmark economy, while it goes down to 33.7 times when estate taxation is increased. Second, these compensations are very similar regardless of which tax is used to balance the government budget (the results for the labor income tax are in the online appendix), and this indicates that it

Table 6

Importance of parental background effects (both bequests and human capital) of changing the estate tax rate and exemption level to the year 2000 statutory levels (the estate tax rate is raised to 55% and its exemption level is lowered to \$675K). Asset compensation required for moving from a parental background level to another, normalized as a fraction of average income.

Parent's earnings	Moving to parent's earnings		
	1st	2nd	3rd
Benchmark			
2nd	0.06	–	–
3rd	5.59	5.43	–
4th	35.71	35.50	28.41
Net bequest model, changing capital tax			
2nd	0.07	–	–
3rd	5.46	5.29	–
4th	33.70	33.52	26.73
Gross bequest model			
2nd	0.06	–	–
3rd	5.58	5.43	–
4th	35.83	35.62	28.53
Gross bequest model, changing capital tax			
2nd	0.07	–	–
3rd	5.43	5.27	–
4th	33.65	33.47	26.71

Table 7

Importance of parental background effects (bequests only) of changing the estate tax rate and exemption level to the year 2000 statutory levels (the estate tax rate is raised to 55% and its exemption level is lowered to \$675K). Asset compensation required for moving from a parental background level to another, normalized as a fraction of average income.

Parent's earnings	Moving to parent's earnings		
	1st	2nd	3rd
Benchmark			
2nd	0.06	–	–
3rd	0.57	0.42	–
4th	14.87	14.71	13.98
Net bequest model, changing capital tax			
2nd	0.07	–	–
3rd	0.55	0.39	–
4th	13.40	13.22	12.58
Gross bequest model			
2nd	0.06	–	–
3rd	0.56	0.42	–
4th	14.97	14.81	14.10
Gross bequest model, changing capital tax			
2nd	0.07	–	–
3rd	0.55	0.39	–
4th	13.44	13.26	12.62

Table 8

Welfare effects of changing the estate tax rate or exemption level to the year 2000 statutory levels (the estate tax rate is raised to 55% and its exemption level is lowered to \$675K) when using the either the capital or labor income tax to balance the budget. In the first five columns, a positive number means a welfare gain of switching from the benchmark economy to the economy with statutory levels. Welfare effects are amount of assets as a fraction of average income.

All	Initial earnings				Fraction gaining	Winner's avg gain	Loser's avg loss	
	1st	2nd	3rd	4th				
<i>Partial equilibrium</i>								
Net bequest motive, capital income tax	0.015	0.004	0.027	0.134	-77.277	0.961	0.016	0.0261
Net bequest motive, labor income tax	0.045	0.027	0.073	0.162	-89.250	0.990	0.046	0.0637
Gross bequest model, capital income tax	0.012	0.003	0.022	0.109	-65.186	0.957	0.014	0.0235
Gross bequest model, labor income tax	0.037	0.022	0.060	0.131	-78.028	0.997	0.038	0.1733
<i>General equilibrium</i>								
Net bequest motive, capital income tax	0.005	-0.003	0.013	0.116	-75.102	0.386	0.022	0.0054
Net bequest motive, labor income tax	0.020	0.009	0.035	0.111	-83.343	0.981	0.021	0.0462
Gross bequest model, capital income tax	-0.008	-0.011	-0.007	0.070	-60.027	0.097	0.028	0.0121
Gross bequest model, labor income tax	0.005	-0.001	0.012	0.070	-67.214	0.457	0.016	0.0038

is the reduction in the net bequests received that dominates the effects of this reform, rather than the tax used to balance the government budget constraint. Third, the effects of the importance of parental background and its changes are very similar both for net and gross bequests in the utility function, with only a slightly bigger reduction for the case of gross bequests in the utility function. Fourth, the importance of parental background to determine one's lot in life is basically unchanged for all other people who are not born in a super-rich family, first reflecting the very high progressivity of estate taxation both before and after the reform; second, reflecting the fact that this tax raises little revenue that can be used to rebate other taxes; and third, reflecting the fact that only a small fraction of the population receive a very large bequest.

6.4. Welfare effects

Our incomplete market framework generates, absent any policy or exogenous changes, a stationary distribution of wealth. As done by [Conesa et al. \(2009\)](#), we employ an ex-ante welfare criterion (before ability is realized) that measures expected (with respect to idiosyncratic shocks and parental background) lifetime utility of a newborn worker in a stationary equilibrium. To better understand the welfare costs and benefits of this reform, we also report the ex-ante expected lifetime utility of a newborn worker, conditional on their initial productivity.

[Table 8](#) reports one-time welfare compensations and the fraction of people gaining from a reform. The welfare compensation computes the amount of assets that we need to give agents in the economy before a reform, as a fraction of average income, so that each agent is indifferent between living in the economy before and after a reform. For simplicity, we then switch the signs so that a positive number means a welfare gain of switching from the benchmark economy to the economy with higher estate taxation. To isolate the general equilibrium effects, we present the partial equilibrium results in which we fix the prices at their level in the initial steady state (top panel).

The column "All" refers to the ex-ante welfare measure computed under the veil of ignorance. The columns labeled "Initial Earnings" condition on the newborn workers' initial earnings draw, while the last three columns report, respectively, the fraction of households benefiting from the reform, the average gains of those who gain, and the losses of those who lose.

A few things are worth noticing. *For fixed prices*, first the vast majority of people gain from switching to the year 2000 statutory estate taxation. The fraction is highest when the labor income tax is lowered to balance the government budget, because many people save little and thus do not benefit from a tax break on capital income. Second, the fraction of people gaining from increasing estate taxation is very similar regardless of whether net or gross bequests enter one's utility function. Third, the first three columns of the table report the average gain or loss conditional on one's initial earnings upon entering the labor market. Conditioning on this reveals that the average gains conditional of being born in a given productivity level are positive, with the exception of the largest earnings realization. Conditional on being in that state, the utility loss from increased estate taxation as a fraction of average income is large, especially in the case in which net bequests enter the utility functions, because households in that case lose utility both because they get lower net estates (which happens with both utility functions) and because they receive smaller utility from gross bequests due to increased

estate taxation (an effect present only with net bequests in the utility function). Interestingly, however, the results are surprisingly close with gross and net bequests in the utility function.

For endogenous prices, things change. First, the interest rate goes up, but the wage rate goes down, regardless of whether capital or labor income tax is lowered. A higher interest rate increases the rate of return to savings and thus tends to improve the welfare of the savers. A reduction in the wage rate, in contrast, decreases the earnings of all workers, thus generating a welfare loss. The negative wage effect dominates, thus resulting in a much smaller fraction of people benefiting from an increase in estate taxes than for fixed prices. Second, in the case the labor income tax is lowered due to the increased revenue from estate taxation, the welfare loss from lower wages is partly offset in wages net of taxes, thus generating a larger fraction of people gaining from the reform. Third, the welfare gains can be nonlinear as a function of one's initial earnings because wages go down but the interest rate goes up. As a result, low earners who do not save much lose due to lower wages. As we move up the earnings distribution, savings increase and people start to gain due to the higher return to saving. This holds true until we get to the highest earnings level at which leaving and receiving bequests become very important; hence, the welfare of people in this state is hurt by higher estate taxes.

Lastly, for almost all reforms, with the exception of the one with gross bequests in the utility function, in which the capital income tax is adjusted and prices adjust (which implies an even larger drop in wages), increasing estate taxation results in an ex-ante welfare gain from the standpoint of the unborn person who is under the veil of ignorance.

7. Comparing our results with those in the previous literature

The literature studying the effects of estate taxation in quantitatively calibrated models that match the observed wealth inequality includes [Cagetti and De Nardi \(2009\)](#) and [Castañeda et al. \(2003\)](#).

Both papers use a simplified life cycle structure and altruistic households, but Cagetti and De Nardi do so in a model with entrepreneurial choice in which entrepreneurs are potentially very productive and credit constrained, while in Castañeda et al. the households face high earnings risk once they become super-rich (a mechanism that we also include in our analysis). Compared with these two papers, we model the life cycle structure and two types of intergenerational links carefully.

Both Cagetti and De Nardi and Castañeda et al. only study the case of abolishing estate taxation. Interestingly, both papers find, as we do, that abolishing estate taxation would generate small increases in aggregate capital and output. More specifically, for instance, all three papers, including ours, generate increases in the range of 0.7–1.5% for aggregate capital, 0.1–0.6% of aggregate output, and 1.0–1.7 percentage point increases in the share of wealth held by the richest 1%. Cagetti and De Nardi also compute welfare gains and losses and find that abolishing estate taxation would generate large welfare losses for a large fraction of the population, a finding that is also broadly consistent with ours.

While it is reassuring that the results are quite similar for the specific case of abolishing estate taxation, we study a much broader range of estate tax reforms and we flesh out the effects of these reforms on many important outcomes, including the importance of parental background. In addition, we also study the robustness of our results to two different types of voluntary bequest motives that match important aspects of the observed estate distribution.

8. Conclusions and directions for future research

The framework we use includes both voluntary and accidental bequests and the transmission of ability (or human capital) across generations and earnings risks which allows us to study wealth inequality, the importance of parental background, and the effects of reforming estate taxation. Our model fits key aspects of the data very well and is quite rich, but it makes some important assumptions.

First, we limit ourselves to steady state analysis. This is due to both computational costs and to the fact that we see understanding steady state inequality as a necessary step that comes before studying the transitions and evolution of inequality over time.

Second, for tractability, we assume exogenous labor supply, and we thus abstract from labor supply distortions coming from taxation. It would be interesting to study this channel, both in stationary environments with different taxation structures (see, for example, [De Nardi et al., 2000](#), for a discussion of the effects of government policies on income across countries) and in the context of the observed rise in wage inequality in the United States (see [Heathcote et al., 2010](#), for a discussion of the macroeconomic effects of these changes).

Third, we assume an exogenous transmission of human capital across generations, thus not modeling this interesting channel, its formation, and its reaction to policy reforms. While it would be interesting to endogenize human capital formation, this is a major undertaking in this framework. In addition, because the richest 1% of households pay 99% of the estate tax, and because they are more than rich enough to invest optimally in their children's human capital, it is unlikely that they would change their human capital investment in children when faced with realistic changes in the estate tax rates and exemption levels; and because the revenue generated by the estate tax is very small, so are the adjustments implied in the labor or capital income tax. However, there are many other reforms that are likely to impact human capital formation, including, for instance, reforms that drastically both lower the estate tax exemption level and raise its tax rate, thus heavily taxing also the estates of the upper and middle-income families, and reforms that change the level and the progressivity of

the labor income tax. For examples of frameworks modeling parental investment and the effects of family structure on income, see Aiyagari et al. (2002), Greenwood et al. (2003), Scholz and Seshadri (2012), Lee et al. (2015), and Lee and Seshadri (2014).

Fourth, we abstract from complementary important reasons to save, such as medical expense risks after retirement, heterogeneity in life expectancy, and health investments across generations. De Nardi et al. (2009, 2010, 2013) and French et al. (2006) point to the importance of heterogeneity in longevity and out-of-pocket medical expenses risk that rise with age and income, and show that these factors go a long way toward explaining the lack of assets decumulation by the high-income elderly in old age. Eriksson et al. (2005) find that in the Danish data there is strong correlation in health across generations and that accounting for health reduces the intergenerational correlation of earnings by 25–28%. However, while it is important to explicitly model health and health investment, medical risk, and heterogeneity in longevity, the fact remains that substantial physical wealth is transmitted across generations. More generally, the important related question concerning the ability of estate taxation to reduce intergenerational transmission of wealth has to do with the identification of the strength of bequest motives as opposed to precautionary savings. While more work along these lines is a promising avenue for future research, it is reassuring that our results on the effects of estate taxation in the context of realistic models of wealth inequality are robust to a variety of bequest motives and reasons to save (from warm glow bequests and high earnings risk for the richest, to completely altruistic households and entrepreneurial savings).

Lastly, our effective estate taxation is lower than the statutory one, and it would be interesting to explicitly model the costs of estate tax avoidance and to properly account for their endogenous changes in the presence of estate tax reforms.

Acknowledgments

De Nardi acknowledges support from the ERC, Grant 614328 “Savings and Risks,” and from the ESRC through the Centre for Macroeconomics. We thank Francesco Caselli, Helen Koshy, Ananth Seshadri, Gianluca Violante, Sevin Yeltekin, and several participants at many conferences and seminars for comments. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research, any agency of the Federal Government, or the Federal Reserve Bank of Chicago.

Appendix A. Supplementary data

Supplementary data associated with this paper can be found in the online version at <http://dx.doi.org/10.1016/j.jmoneco.2015.10.005>.

References

- Aiyagari, R.S., Greenwood, J., Seshadri, A., 2002. Efficient investment in children. *J. Econ. Theory* 102, 290–321.
- Altonji, J.G., Hayashi, F., Kotlikoff, L., 1997. Parental altruism and inter vivos transfers: theory and evidence. *J. Polit. Econ.* 6 (105), 1121–1166.
- Becker, G.S., Tomes, N., 1986. Human capital and the rise and fall of families. *J. Labor Econ.* 4 (3), 1–39.
- Bell, F.C., Wade, A.H., Goss, S.C., 1992. Life tables for the United States social security area: 1900–2080. Social Security Administration, Office of the Actuary.
- Bosworth, B.P., Anders, S., 2011. Saving and Wealth Accumulation in the PSID, 1984–2005. NBER Working Paper 17689.
- Budría, S., Díaz-Giménez, J., Quadrini, V., Ríos-Rull, J.-V., 2002. Updated facts on the U.S. distributions of earnings, income and wealth. *Federal Reserve Bank Minneap. Q. Rev.* 26 (3), 2–35.
- Cagetti, M., De Nardi, M., 2006. Entrepreneurship, frictions and wealth. *J. Polit. Econ.* 114 (5), 835–870.
- Cagetti, M., De Nardi, M., 2008. Wealth inequality: data and models. *Macroecon. Dyn.* 12, 285–313.
- Cagetti, M., De Nardi, M., 2009. Estate taxation, entrepreneurship, and wealth. *Am. Econ. Rev.* 99 (1), 85–111.
- Carroll, C.D., 1998. Why do the Rich Save So Much? NBER Working Paper 6549.
- Castañeda, A., Díaz-Giménez, J., Ríos-Rull, J.-V., 2003. Accounting for U.S. earnings and wealth inequality. *J. Polit. Econ.* 111 (4), 818–857.
- Charles, K.K., Hurst, E., 2003. The correlation of wealth across generations. *J. Polit. Econ.* 111 (6).
- Chetty, R., Hendren, N., Kline, P., Saez, E., Turner, N., 2014. Is the United States Still a Land of Opportunity? Recent Trends in Intergenerational Mobility. Technical report, National Bureau of Economic Research.
- Conesa, J.C., Kitao, S., Krueger, D., 2009. Taxing capital? not a bad idea after all! *Am. Econ. Rev.* 99, 25–48.
- Cooley, T.F., Prescott, E.C., 1995. Economic growth and business cycles. In: Cooley, T.F. (Ed.), *Frontiers of Business Cycle Research*, Princeton University Press, Princeton, NJ, pp. 1–38.
- Council of Economic Advisors, 1998. Economic Report of the President. United States Government Printing Office, Washington.
- Cremer, H., Pestieau, P., 2003. Wealth Transfer Taxation: A Survey. CESifo Working Paper Series No. 1061.
- De Backer, J., Panousi, V., Ramnath, S., 2012. The Properties of Income Risk in Privately Held Businesses. Federal Reserve Board Working Paper 2012-69.
- De Nardi, M., 2004. Wealth inequality and intergenerational links. *Rev. Econ. Stud.* 71 (3), 743–768.
- De Nardi, M., French, E., Jones, J.B., 2009. Life expectancy and old age savings. *Am. Econ. Rev.: Pap. Proc.* 99 (2), 110–115.
- De Nardi, M., French, E., Jones, J.B., 2010. Why do the elderly save? The role of medical expenses. *J. Polit. Econ.* 118 (1), 39–75.
- De Nardi, M., French, E., Jones, J.B., 2013. Medicaid Insurance in Old Age. Working Paper 19151, National Bureau of Economic Research.
- De Nardi, M., Ren, L., Wei, C., 2000. Income inequality and redistribution in five countries. *Federal Reserve Bank Chic. Econ. Perspect.* 24 (2), 2–20.
- De Nardi, M., Yang, F., 2014. Bequests and heterogeneity in retirement wealth. *Eur. Econ. Rev.* 72, 182–196.
- Eriksson, T., Bratsberg, B., Raaum, O., et al., 2005. Earnings Persistence Across Generations: Transmission Through Health? Citeseer.
- Farhi, E., Werning, I., 2010. Progressive estate taxation. *Q. J. Econ.* 125, 635–673.
- French, E., De Nardi, M., Jones, J.B., Baker, O., Doctor, P., 2006. Right before the end: asset decumulation at the end of life. *Econ. Perspect.* 30 (3), 2–13.

- Gale, W.G., Hines, R.H., Jr., Slemrod, J. (Eds.), 2001. *Rethinking Estate and Gift Taxation*. Brookings Institution Press, Washington DC.
- Gale, W.G., Perozek, M.G., 2001. Do estate taxes reduce saving?. In: Gale, W.G., Hines, J.R., Slemrod, J. (Eds.), *Rethinking Estate and Gift Taxation*, Brookings Institution Press, Washington DC.
- Gale, W.G., Scholz, J.K., 1994. Intergenerational transfers and the accumulation of wealth. *J. Econ. Perspect.* 8 (4), 145–160.
- Gale, W.G., Slemrod, J., 2001. *Rethinking the Estate and Gift Tax: Overview*. Working Paper 8205, National Bureau of Economic Research, Cambridge, Massachusetts.
- Greenwood, J., Guner, N., Knowles, J.A., 2003. More on marriage, fertility, and the distribution of income. *Int. Econ. Rev.* 44 (3), 827–862.
- Hansen, G.D., 1993. The cyclical and secular behaviour of labour input: comparing efficiency units and hours worked. *J. Appl. Economet.* 8 (1), 71–80.
- Heathcote, J., Storesletten, K., Violante, G., 2010. The macroeconomic implications of rising wage inequality in the United States. *J. Polit. Econ.* 118, 681–722.
- Hines, J.R., 2013. Income and substitution effects of estate taxation. *Am. Econ. Rev.* 103, 484–488.
- Huggett, M., 1996. Wealth distribution in life-cycle economies. *J. Monet. Econ.* 38 (3), 469–494.
- Huggett, M., Ventura, G., Yaron, A., 2011. Sources of lifetime inequality. *Am. Econ. Rev.* 101 (7), 2923–2954.
- Hurd, M.D., Smith, J.P., 1999. *Anticipated and Actual Bequests*. Working Paper 7380, National Bureau of Economic Research, Cambridge, Massachusetts.
- Keane, M.P., Wolpin, K.I., 1997. The career decisions of young men. *J. Polit. Econ.* 105, 473–522.
- Kopczuk, W., Lupton, J., 2007. To leave or not to leave: the distribution of bequest motives. *Rev. Econ. Stud.* 74, 207–235.
- Kotlikoff, L.J., Smetters, K.A., Walliser, J., 1999. Privatizing social security in the united states: comparing the options. *Rev. Econ. Dyn.* 2 (3), 532–574.
- Kotlikoff, L.J., Summers, L.H., 1981. The role of intergenerational transfers in aggregate capital accumulation. *J. Polit. Econ.* 89 (4), 706–732.
- Kuhn, M., 2014. *Trends in Income and Wealth Inequality*. Mimeo.
- Laitner, J., Juster, T.F., 1996. New evidence on altruism, a study of taa-cref retirees. *Am. Econ. Rev.* 86 (4), 893–908.
- Lee, S.Y., Roy, N., Seshadri, A., 2015. *The Causal Effect of Parent's Education on Children's Earnings*. Mimeo.
- Lee, S.Y., Seshadri, A., 2014. *Economic Policy and Equality of Opportunity*. Mimeo.
- Mazumder, B., 2015. *Estimating the Intergenerational Elasticity and Rank Association in the U.S.: Overcoming the Current Limitations of Tax Data*. Federal Reserve Bank of Chicago Working Paper 2015-4.
- Modigliani, F., 1988. *Measuring the contribution of intergenerational transfers to total wealth: conceptual issues and empirical findings*. In: Kessler, D., Masson, A. (Eds.), *Modeling the Accumulation and Distribution of Wealth*, Clarendon Press, Oxford.
- Pestieau, P., Sato, M., 2006. *Estate taxation with both accidental and planned bequests*. CESifo Working Paper Series 1799.
- Scholz, J.K., Seshadri, A., 2012. *Health and Wealth in a Lifecycle Model*. Mimeo.
- Solon, G., 1992. Intergenerational income mobility in the United States. *Am. Econ. Rev.* 82 (3), 393–408.
- Stokey, N.L., Rebelo, S., 1995. Growth effects of flat-tax rates. *J. Polit. Econ.* 103, 519–550.
- Tauchen, G., 1986. Finite state Markov-chain approximations to univariate and vector autoregressions. *Econ. Lett.* 20 (2), 177–181.
- Yang, F., 2013. Social security reform with impure intergenerational altruism. *J. Econ. Dyn. Control* 37, 52–67.
- Zimmerman, D.J., 1992. Regression toward mediocrity in economic stature. *Am. Econ. Rev.* 82 (3), 409–429.