Taxing the Dead: an analysis of intergenerational transfers and levies*

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Abstract

The most recent United States election revealed large differences in beliefs about the optimal structure of the U.S. estate tax regime. The contribution of this paper is to analyze the impact of differing methods of taxing intergenerational transfers, in the context of a general equilibrium overlapping generations model with differential fertility. This paper is the first to consider the impact of estate and inheritance taxes in the presence of differential fertility, and the fallout such a switch would have upon inequality and welfare.

Keywords: Intergenerational transfers, differential fertility, wealth inequality, life-cycle savings.

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1. Introduction

This paper extends the model created in Cooke et al. (2017) to answer two questions of policy relevance. What are the affects of changing or eliminating the estate tax, and what would be the impact of changing from an estate tax regime to an inheritance tax regime in the United States? This paper's unique contribution is to examine these questions in a model with differential fertility, using the wedge of differing fertility choices between high- and low-earning individuals to more accurately capture the reality of intergenerational transfers.

If higher-earning couples have fewer children, as is consistently reported in the literature (Jones and Tertilt (2008)), this could significantly impact how transfer taxes are realized, and raises questions about which method is most equitable and efficient. Transfers occurring at death may be taxed in the form of estate taxation, i.e. the tax may be imposed on the total amount of wealth left by the decedent. They may instead take the form of an inheritance tax, in which case the base is defined on the level of the recipient, and reflects the transfers to that particular individual (Kopczuk (2012)). Both forms of taxation usually have a supplemental gift taxation to ensure that the tax is not simply avoided by a transfer given prior to the time of death. In the U.S. the gift and estate tax has been integrated since the Tax Reform Act of 1976.

The structure of the estate tax can lead to strange distortions in the progressivity of the tax burden. Batchelder and Khitatrakun (2008) estimate that about 22% of heirs burdened by the U.S. estate tax have inherited less than $500,000, while 21% of heirs who inherit more than $2,500,000 bear no estate tax burden. The quantity of heirs thus has a large impact on the distributional effect if the tax is progressive, as it almost always is. Many U.S. states and countries currently use an inheritance tax, such as Iowa, Kentucky, Maryland, Nebraska, New Jersey, Pennsylvania, Japan, France, U.K., South Korea and Germany. Understanding the impact switching from a federal estate tax to a federal inheritance tax could have on the United States is an understudied element of U.S. tax policy.

Recent U.S. data shows a large concentration of wealth among few of its citizens. For instance, the top one percent holds nearly one third of the total wealth in the economy, and that share is growing according to Alvaredo et al. (2013). The top five percent holds over half. This trend has been accelerating in the years since the 2008 financial crisis (Saez and Zucman (2016)). In addition, wealth inequality is significantly higher than labor earnings or total income inequality. In 1995 the Gini coefficient for annual labor earnings was 0.63. The Gini for wealth holding was much higher, at 0.8 (Rodriguez et al. (2002)). Understanding the reasons for this relatively greater level of wealth inequality is important for the economic consequences faced by highly unequal economies, such as greater societal unrest and lower intergenerational mobility.

The role in increasing wealth inequality played by reductions in the estate tax over the past few decades remains contentious, and this paper will offer a quantifiable estimate as to the results of rate and exemption changes on the distribution of wealth. According to the IRS, in the past 16 years the rate has fallen from 55% to 40% and the exemption level has risen from 675,000 to 5.5 million. The number of taxable estate tax returns declined nearly 90 percent from 51,736 in 2001 to 5,219 in 2016 primarily due to the gradual increase in the filing threshold (IRS SOI Tax Statistics). Clearly these changes are not trivial and bear analysis. In addition, as the baby boomer generation begins to pass away, wealth transfers are expected to increase. Estimated transfers total between $40 and $135 trillion over the next half century according to Havens and Schervish (1999).

One of the major puzzles surrounding wealth inequality is why it is so much more pronounced than income inequality. Wealthy individuals act in a different way than traditional economic models would predict, relatively saving more and spending less, even as they reach the end of their lifespans Dynan et al. (2004). In addition to this, wealthier people are much more likely to give bequests to their children at the end of their lives, even when accounting for relative wealth. Standard dynamic models with heterogeneous agents have difficulty replicating this savings behavior and targeting the level of wealth inequality seen in the data. For instance, Aiyagari (1994) predicts in a calibrated simulation the top one percent will hold four percent of the wealth, while empirically the top one percent holds thirty percent. Why do rich people choose to possess such a high level of wealth instead of increasing their consumption?

One potential explanation is a bequest motive, especially since intergenerational transfer is a significant flow of wealth. Historically the amount of wealth derived from intergenerational transfer has varied between one-tenth and one-fifth Modigliani (1988), however, more recent estimates place it as high as one half Gale and Scholz (1994). The top 2% of households receive nearly 70% of lifetime inheritances Hendricks (2001).

Economists have long argued that there exists an inverse relationship between income and fertility.[1] For instance, Jones and Tertilt (2008) document a strong negative relationship between income and fertility choice for all cohorts of women born between 1826 and 1960 in the U.S. census data. They estimate an overall income elasticity of fertility of about -0.38. I argue that this significant fertility difference between the poor and the rich can amplify the impact of bequests on wealth inequality, because not only do rich parents leave a greater amount of bequests than their poorer counterparts, but the children of rich parents have fewer siblings to share their bequests with relative to the children of poor parents.

This paper will do the following. First is to build and run an overlapping generations model that includes differential fertility, intergenerational transfers, and a comprehensive estate tax regime. Second is to look at the impact changing rates and exemption levels would have on inequality and welfare. Third is altering the model to switch to an inheritance tax and analyzing the results such a change would have on the distribution of wealth and welfare.

The rest of paper is organized as follows. In section 2, I review the existing literature. In section 3, I describe the model and its stationary equilibrium. In section 4, I calibrate a benchmark specification using moment matching. In section 5, I discuss the results. In section 6, I use alternative formulation to answer the core questions of the paper. The final section concludes.

2. Literature Review

2.1. Inequality and Bequests

Inequality and its causes have become a political and economic touchstone in recent years. However, defining what exactly is unequal is often left unsaid by the bumper stickers. There exists unequal distributions of productivity, income, wealth, consumption, bequests, shocks, choices, etc. Some of these elements, especially income and wealth, are treated as

[1] See De La Croix and Doepke (2003), De la Croix and Doepke (2004), Jones and Tertilt (2008), Zhao (2011), Zhao (2014), among others.

if they are equivalent. But the data shows large differences in the distributions of income and wealth in the United States. As found by Diaz-Gimenez et al. (1997), the correlations between earnings and wealth and between income and wealth are surprisingly low, 0.230 and 0.321, respectively.

In 1992 the United State's Gini indexes for short term labor earnings, income, and wealth were, respectively, .63, .57, and .78 (Diaz-Gimenez et al. (1997)), while in 1995 they were .61, .55 and .80 (Rodriguez et al. (2002)). The shares of earnings and wealth of the households in the top 1 percent of the corresponding distributions are 15 percent and 30 percent, respectively (Castaneda et al. (2003)).

Standard quantitative macroeconomic models have had difficulties in generating the observed degree of wealth concentration (De Nardi and Yang (2016)). Specifically, these models fail to account for the extremely long and thin top tails of the distributions and for the large number of households in their bottom tails (Castaneda et al. (2003), Quadrini and Ríos-Rull (1997)). However, if it is intergenerational transmission of wealth and ability that drives wealth inequality, as Kotlikoff and Summers (1981) have argued, then a focus on life-cycle saving will fail to capture the relevant causes. Overlapping generations are an improvement at mimicking the data. Huggett (1996) predicts that the top one percent will hold seven percent of the wealth. This model only accounted for accidental bequests, distributed equally to all individuals.

There has been multiple papers that argue that bequest giving is crucial to explaining wealth differentials. Most recently, De Nardi (2004) and De Nardi and Yang (2016) incorporate bequest leaving into the utility function as a luxury good, allowing for rich parents to value bequests more. If bequests are a luxury good such that the rich gain greater utility from leaving them, then greater inequality is generated. This is due to the emergence of large estates, or dynasties, where wealthy parents have well educated, high productivity children who they then leave large bequests to. These persistent rich often have smaller families, leading to greater relative concentration. This is consistent with jon (2010), that smaller cohorts receive relatively large per child transfers from parents.

Bequests represent a large piece of intergenerational transfers. Gale and Scholz (1994) use the Survey of Consumer Finances to find the amount of inter-vivos transfers and inheritance from 1983-85. Between support given, college expenses paid and inheritance given, the amount totaled over $350 billion. Of this, inheritance was nearly 40 percent and over 60 percent of those who reported receiving inheritance were in the top decile. Their central estimate is that intended life-time transfers (which they define as inter-vivos transfers, trust accumulations, and life insurance payments to children) account for at least 20 percent of aggregate net worth, and bequests, accidental or intended, account for 31 percent more.

Kopczuk and Lupton (2007) find that three-fourths of the elderly single population has a bequest motive and about four-fifths of their net wealth will be bequeathed, half of which is due to a bequest motive as opposed to accidental bequests. This ratio is consistent with Lee and Tan (2017) and Hendricks (2001). Hendricks also finds that the effects of capital income taxes are nearly invariant to assumptions about bequest motives as well as to reasonable variations in the size of bequest flows.

There are six widely discussed motivations in the legal and economic literature surrounding intergenerational transfers (Batchelder (2008)). The first is an overabundance of precautionary savings, leading to accidental bequests. The second is commonly known as ”the capitalist spirit,” where the wealth of an individual directly impacts her utility function, and therefore she will have a positive balance at the time of death. The third is ”warm glow” where the individual likes the idea of giving to their heirs, but the actual status of those heirs, or how much that transfer is taxed, is unimportant. The fourth is the same as the third, but the individual only gets utility from the warm glow giving after taxes. The fifth is direct altruism, and the sixth is a strategic motivation, given for some compensatory action like old age care or social insurance. For computational ease, this paper will focus on the third motivation, following De Nardi and Yang (2016).

2.2. Taxation

Taxes on wealth transfer have been a common theme throughout human history. Early examples include 7th century B.C. Egypt and 1st century A.D. Rome. The first American wealth transfer tax dates from 1797. This was a simple stamp levy on receipts for legacies and wills. Since then multiple inheritance taxes have been put into place as short term funding mechanisms, usually for wars (Kopczuk (2012)). The modern day incarnation of the estate tax dates from 1916, and is much more complex and wide ranging. Today nearly every member of the OECD has some form of estate or inheritance tax (Gale and Slemrod (2001)).

Despite this ubiquity, there is substantial debate around both the size of this tax and whether it should exist at all. Opponents decry the morbidness of taxing corpses and the unfairness of ”double taxation,” as the recently deceased already paid taxes on their income before giving it to their inheritors. Conversely, supporters, ranging from liberals to libertarians, call large inheritances ”affirmative action for the wealthy” and support near-confiscatory taxes on bequests (Stelzer (1997)). I will be referring to transfer taxes more generally, and specifically estate, gift or inheritance tax throughout this paper.

Transfer taxes have several unique properties (Kopczuk (2012)). First, it affects a transfer that may be generating positive externalities. For example, if the transfer is intentional, the giver will be generating utility (whether from warm-glow, altruism, or some other motivation), while the recipient is gaining greater income in which to finance their own utility enhancing choices. Second it is infrequent, ofttimes occurring just once, at time of death. Finally, it generally affects a very small, usually very wealthy, subset of the population.

Stiglitz (1978) raises a major concern with the estate taxes effect on the economy. If the estate tax lowers savings, then this will lead to a reduction in the capital stock and lead to a lowering of the marginal product of labor and therfore wages. In short, abolition of the estate tax could raise wages and lead to a improvement in wage dependent household's welfare. Laitner and Juster (1996) finds that Stiglitz is correct, and a lowering or removal of the tax on bequests would raise savings. However it would also increase wealth inequality, specifically among the top 1 percent who are most effected by the estate tax. This also does not take into account the finding in Cooke et al. (2017), that expected inheritances reduce savings among beneficiaries by around 3%.

The level of taxes has effects on the amount of bequests given. Joulfaian (1998) finds that an increase in the gift tax that was passed in 1977 led to a large increase in transfers made before the tax went into affect.

Concern that estate taxes unfairly impact small business and farms has led to provisions that allow transfers of closely held businesses to value themselves at use value rather than the much higher market value. They can also spread their tax burden across many years. In addition, the amount of small businesses that are affected by the estate tax is rather small.

Farm assets and real estate were just 1.7 percent of taxable estate value on 2000 according to the IRS. Limited Partnership and ”other noncorporate business assets” were 2.6 percent. Even generous estimates of the definition of a small business results in them being about one tenth of the total wealth transfer affected by the tax (Gale and Slemrod (2001)).

The last decade has seen major changes in the estate tax, with the basic exclusion amount rising from 1.5 million in 2004 to 5.5 million in 2016. The top bracket tax rates also saw major changes, decreasing from 55 percent (in 2001) to 35 percent (in 2010), and then increasing to 40 percent (in 2013) according to the IRS. Recently an overhaul of the tax code has called for an abolition of the Estate Tax. Understanding the mechanisms and effects of this tax policy is therefore very important.

3. Model

Consider an economy inhabited by overlapping generations of agents who live three periods. In the first period individuals are not economically active. In the second period they make the fertility and labor supply decisions, and save for retirement. In the final period they receive bequests from their parents, consume some of their wealth and leave the remainder as bequests to their children in the next period. These bequests are taxed, and the tax is distributed equally among that cadre of children. This allows the estate tax to redistribute wealth within each generation.

3.1. Consumer's Problem

3.1.1. Period One

An individual makes no economic decisions in the first period, but imposes a time cost on her parents. She inherits an ability level from her parents. An individual's ability ψ (effective units of labor representing human capital, luck or inherent ability) depends on their parental ability ψ^p, and the log of ability is assumed to follow the AR(1) process,

$$\log(\psi) = \rho \log(\psi^p) + \epsilon_\psi$$

where

$$\epsilon_\psi \sim N\left(0, \sigma_\psi^2\right), \quad \text{i.i.d.}$$

in which ρ is the intergenerational persistence of productivity. I discretize the AR(1) into 11-state Markov chain using the method introduced in Tauchen (1986), and the corresponding transition matrix I obtain is denoted by $M[\psi, \psi']$.

3.2. Period Two

Individuals in the second period differ along three dimensions: earning ability ψ, number of siblings n^p (or the parent's fertility), and current wealth of their elderly parents x^p. In this period, they jointly choose current consumption and save for period three. In addition, they choose to have n children, and have to reduce their labor market allocation as a result of that choice. Therefore, the value function of an individual in period two can be specified as follows:

$$V_2\left(\psi, n^p, x^p\right) = \max_{c,a,n\geq 0}\left[\frac{c^{1-\sigma}}{1-\sigma} + \lambda_1 n^{\lambda_2} + \beta\left[V_3(x)\right]\right]$$

subject to

$$\begin{aligned} c + a &\leq \psi w(1-\gamma n) \\ x &= g + a + \frac{G(B\left(x^p\right))}{n^p} \end{aligned}$$

The individual can calculate an expected bequest value as a function of parental wealth and the number of siblings in the next period, $G(b^p(x^p))/n^p$, where b^p is the total amount of bequests left by her parents and $G(/cdot)$ is the taxation function. Thus the total wealth the individual possesses going into period 3 is $x = a + G(b^p(x^p)/n^p)$, where a is the life-cycle saving from period 2 to period 3 and n is number of children. η_1 is the weight on the utility derived from children, and η_2 controls the curvature of the utility from children. g is a governmental transfer payment, the equally divided share of all tax on the bequests.

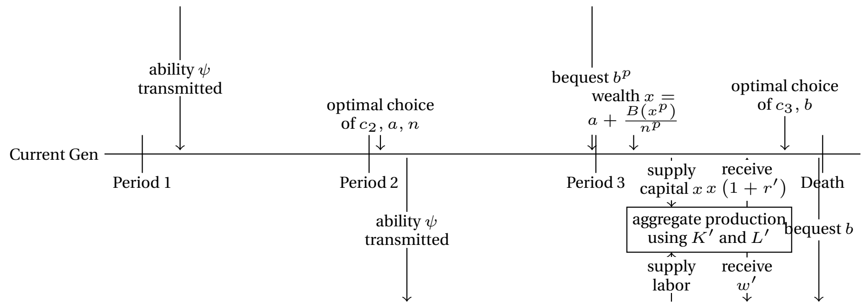


Figure 1: Sequence of Events for Current Generation

3.2.1. Period Three

Individuals retire in the third period and jointly choose current consumption and the amount of bequests for her children. Their state in this period can be captured by a single variable, x, the amount of wealth held, which is simply the sum of life-cycle savings, the governmental transfer and the share of bequests received from their dying parents at the beginning of Period 3. Individuals in Period 3 face the following utility-maximization problem:

$$V_3(x) = \max_{c,b} \left[\frac{c^{1-\sigma}}{1-\sigma} + \phi_1 \left(b + \phi_2\right)^{1-\sigma} \right]$$

subject to

$$c + b \leq (1+r)x,$$

where b is the total amount of bequests left for children in the next period. Here I follow De Nardi (2004) and assume that parents have "warm glow" motive, where they enjoy giving to their children but do not directly care about the children's wellbeing, and in addition bequest is assumed to be a luxury good. As I reviewed in the introduction, this assumption is consistent with sizable empirical evidence. The term ϕ_1 measures the relative weight placed on the bequest motive, while ϕ_2 measures the extent to which bequests are a luxury good. From this maximization problem, I obtain two policy functions: optimal consumption $C_3(x)$ and optimal bequests $B(x)$.

Figure 1 contains the timeline summing up the sequence of events that happen throughout the lifecycle.

3.3. Firm's Problem

Firms are identical and act competitively. Their production technology is Cobb-Douglas, which combines aggregate capital K and aggregate labor L to produce output Y as follows

$$Y = zK^{\theta}L^{1-\theta}$$

in which θ is the capital share and z is the total factor productivity (TFP).

The profit-maximizing behaviors of firms imply that

$$r = z\theta K^{\theta-1}L^{1-\theta} - \delta$$

and

$$w = z(1-\theta)K^{\theta}L^{-\theta},$$

where δ represents the capital depreciation rate.

3.4. Government and Taxes

The Government runs a balanced budget every time period. They levy taxes either on the estates of the deceased before distribution, or on the heirs directly, depending on whether it is an estate or inheritance tax.

Let Φ_2 represent the population distribution of individuals in period 2.

$$G = \int_{\psi}\int_{n^p}\int_{x^p}\left[\frac{(B^p\left(x^p\right) - \chi)(\tau)}{n^p}\right] d\Phi_2\left(\psi, n^p, x^p\right) \forall B^p\left(x^p\right) > \chi$$

and the individual payment g will be the equal distribution of all tax revenue.

$$g = \frac{G}{\int_{\psi}\int_{n^p}\int_{x^p}\Phi_2\left(\psi, n^p, x^p\right)}$$

In the benchmark model, the estate tax has a rate τ and an exemption level χ. All be-

Table 1: A simple example of the estate and inheritance taxes

Type	Rate	Exemption	A_1	B_1	B_2	C_1	C_2	C_3	Total Tax
Estate	0.5	0.5	0.75	0.375	0.375	0.25	0.25	0.25	0.75
Inheritance	0.5	0.25	0.625	0.375	0.375	0.29	0.29	0.29	0.75

quests below the exemption level are immune from taxation, all bequests above that level are taxed at a fixed rate on the amount the is above the exemption level.

The payment is distributed to the same generation that would have received the inheritance. This means that it functions as a lump sum transfer, and the government distribution will have a similar affect to bequests in that it will reduce savings rates among the recipients.

3.5. A simple comparison of the estate and inheritance tax

Consider a simple economy with 3 families, A, B and C. Family A has one child, family B has 2 children and family C has 3 children. In this economy there is an estate tax, with a rate and exemption level. In this example we will set both to .5. Each family's parents die leave their children their remaining wealth, which is equal to 1 for all three families.

In this situation, all three families will pay the same amount in taxes, .25, and the remainder will be distributed to the children. So the child from family A will receive .75, the children in family B will receive .375 each and the children in family C will receive .25 each. The total government receipts amount to .75.

Let us now assume that the tax regime switches to an inheritance tax with no changes to the rate or exemption level. Family A's tax burden will remain the same, but family B and C will pay no taxes because each child's share falls below the exemption level.

Then let us lower the exemption level so that the government receives the same amount of revenue. In this case it is to .25. Now family A's only child is paying .375 in taxes and keeping .625, family B's 2 children are paying .125 each and keeping .375 and family C's 3 children are paying .04 each and keeping .29.

It is clear that the estate tax favors families with fewer children, which as we know are associated with wealthier families.

3.6. Stationary Equilibrium

Let Φ_2 and Φ_3 represent the population distributions of individuals in period 2 and 3. A steady state in this economy consists of a sequence of allocations $[c_2, c_3, a, b]$, aggregate inputs $[K, L]$ and prices $[w, r]$ such that

1. Given prices, the allocations $[c_2, c_3, a, b]$ solve each individual's utility maximization problem
2. Given prices, aggregate capital and labor $[K, L]$ solve the firm's problem.
3. The Government's budget is balanced, $g = \dfrac{G}{\Phi_2\left(\psi, n^p, x^p\right)}$
4. Markets clear:

$$K' = \int_{\psi}\int_{n^p}\int_{x^p}\left[A\left(\psi, n^p, x^p\right) + \frac{\left(B^p\left(x^p\right) - \chi\right)(1-\tau)}{n^p}\right] d\Phi_2\left(\psi, n^p, x^p\right)$$

$$L' = \widehat{n}\int_{\psi}\int_{n^p}\int_{x^p}(1 - \gamma N'(\psi, n^p, x^p))\psi d\Phi_2(\psi, n^p, x^p)$$

where $\widehat{n}$ is the average number of children the current period two individuals have.

5. The distributions Φ_2 and Φ_3 are stationary in the steady state and evolve according to the following laws of motions:

$$\Phi_2\left(\psi', n^{p'}, x^{p'}\right) = \frac{1}{\widehat{n}}\int_{\psi}\int_{n^p}\int_{x^p} I_{x^{p'}=A(\psi,n^p,x^p)+\frac{b^p(x^p)}{n^p}} I_{n^{p'}=n(\psi)} M\left[\psi, \psi'\right] n(\psi) d\Phi_2\left(\psi, n^p, x^p\right)$$
$$\Phi_3(x^{p'}) = \frac{1}{\widehat{n}}\int_{\psi}\int_{n^p}\int_{x^p} I_{x=A(\psi,n^p,x^p)+\frac{b^p(x^p)}{n^p}} d\Phi_2(\psi, n^p, x^p)$$

where $M[\cdot]$ is the Markov transition matrix, I's are the indicator functions. The ability distribution in the next period depends on the current period young's fertility. In the third period, an individual's wealth is what he has saved in the previous period, as well as what he has received in bequests from his parents. Note that the distribution of the elderly's wealth holdings is identical to the distribution of the young's parental wealth holdings (i.e., $x = x^{p'}$).

Table 2: The Benchmark Calibration

Parameter	Value	Source
z	1.0	Normalization
σ	0.9	Cooke, Lee and Zhao (2017)
θ	0.36	Macro Literature
δ	0.04	Macro Literature
γ	0.2	Haveman and Wolfe (1995)
ρ	0.4	Solon (1992)
χ	5.5 million	IRS
τ	0.4	IRS
Parameter	**Value**	**Moment to match**
β	0.915	annual interest rate: 0.04
ϕ_1	-0.33	bequest/wealth ratio: 0.31
ϕ_2	0.086	pop. share with bequests ($<$ third of avg. income)
σ^2_ψ	1.15	Income Gini: 0.63

The rest of the paper focuses on stationary equilibrium analysis. Since analytical results are not obtainable, numerical methods are used to solve the model.

4. Calibration

I calibrate the model to match the current U.S. economy, and the calibration strategy I adopt here is the following. The values of some standard parameters are predetermined based on previous studies, and the values of the rest of the parameters are then simultaneously chosen to match some key empirical moments in the U.S. economy.

4.1. Demographics and Preferences

One period in my model is equivalent to 30 years. Individuals enter the economy when they are 30 years old (Period 2). They retire at 60 years old (Period 3) and die at the end of the third period (at 90 years old).

The parameter in CRRA utility, σ, is set to 0.9 to ensure that a negative fertility elasticity is possible (see Cooke, Lee and Zhao 2017). The subjective discount factor β is calibrated to match an annual interest rate of 0.04, which gives us an annual discount factor of 0.915. I calibrate my bequest parameters to ensure that the level and distribution of bequests generated from my benchmark model matches their respective data counterparts. Specifically, ϕ_1 is calibrated to match the aggregate bequest to wealth ratio: 0.31 according to the estimation by Gale and Scholz (1994). A positive value of ϕ_2 implies that bequests are luxury goods, and its value controls the skewness of the bequests distribution. According to the empirical estimation by Hurd and Smith (2002), about 90 % of the population do not leave a significant amount of bequests (i.e. less than a third of average lifetime income)[2]. Gale and Scholz (1994) report that 96% do not receive inheritances above 3 thousand. In the benchmark calibration, I calibrate the value of ϕ_2 so that 90% of agents in the benchmark model receive bequests that are less than a third of median lifetime income.

I use the 1990 U.S. census data to calibrate the fertility choices for each group in my benchmark model[3]. I follow the approach in Jones and Tertilt (2008) and use the Children Ever Born to a woman as the fertility measure. Specifically, I use the sample of currently married women ages 40-50 (birth cohort 1940-50), and then organize the respondents into 11 ability groups corresponding to my model distribution by Occupational Income, corrected for a 2% growth rate.[4] I believe the propensity of death on childbirth during this time period is low enough that the child mortality risk is not a significant issue. I take the mean fertility rate for each group and assign it to the corresponding group of agents in my benchmark model to generate the appropriate level of differential fertility by income.[5] The resulting fertility-income relationship from my calibration exercise is reported in Table 4, which is consistent with the estimation results in Jones and Tertilt (2008). For instance, the income elasticity of fertility is estimated to be -0.20 to -0.21 for the cohorts of women born

[2]In nominal terms, that value equals $187,600 in 1993 dollars or $324,700 in 2017 dollars.

[3]Courtesy of Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek. Integrated Public Use Micro data Series: Version 6.0 [dataset]. Minneapolis: University of Minnesota, 2015. http://doi.org/10.18128/D010.V6.0.

[4]Here I follow Jones and Tertilt (2008) closely and use the husband's occupational income to avoid the selection bias in women's employment status.

[5]Note that the fertility choice in my model is the per parent fertility so I follow the tradition in the fertility literature and halve these fertility rates calculated from the data when using them in the model.

between 1940 and 1950 in Jones and Tertilt (2008), while the implied income elasticity of fertility from my calibrated fertility distribution is -0.22.

4.2. Technology and Earning Ability

The capital share θ is set to 0.36, and the capital depreciation rate is set to 0.04. Both are commonly used values in the macro literature. The value of TFP parameter, z, is normalized to one.

I approximate the AR(1) process for earning ability ψ by an 11-state Markov chain using the method introduced in Tauchen (1986). The coefficient of intergenerational persistence, ρ, is set to 0.4 according to the estimates in Solon (1992). I calibrate the income variance σ_{ψ}^2 so that the income Gini coefficient generated from the model matches the value of 0.63 that Castaneda et al. (2003) estimated using the 1992 Survey of Consumer Finances data. I report the resulting ability levels in Table 4 and the corresponding transition matrix can be seen in Section A of the Appendix. In addition, I set the time cost of children γ to be 0.2 of parental time per child based on the empirical estimates of Haveman and Wolfe (1995).

The key parameter values and their sources are summarized in Table 2.

4.3. Taxation

The two taxation coefficients, τ and χ are taken from the 2017 CFR 601.602: Tax forms and instructions. The section titled ”Unified Credit Against Estate Tax” states ”for an estate of any decedent dying in calendar year 2017, the basic exclusion amount is \$5,490,000 for determining the amount of the unified credit against estate tax under S2010.” I combine this with table 5 - section 1(e) ”Estates and Trusts” which states that the rate of taxation for estates that are greater than \$12,500 is ”\$3,232.50 plus 39.6% of the excess over \$12,500.”

This gives us an estimated value of τ of .4 and a value of χ of 5.5 million in my benchmark. Since my model is normalized, I set χ to match a multiple of median lifetime income, which I estimate as \$1,180,000 which is \$59,039 per household in 2017 (U.S. Census Bureau) times 40 years divided by 2 people. This means that the estate tax exemption is 4.66 times the median lifetime income.

Table 3: Benchmark Model Statistics

Name	Model	Data
Annual Interest Rate	0.04	0.04
US Aggregate Bequest/Wealth Ratio	0.31	0.31
Average fertility rate per household	2.3	2.3
Gini Coefficient of the US Income Distribution	0.64	0.63
Income Elasticity of Fertility	-0.22	-0.20/-0.21

5. Quantitative Results

I start this section by reviewing the main properties of the benchmark model at the steady state, with special attention given to its implications for wealth inequality and welfare inequity. I then run the counter-factual policy experiments analyzing the abolition of the estate tax, the increase of the estate tax back to 2001 levels and the changing of the structure of the intergenerational tax from a estate tax to an inheritance tax.

5.1. Some Key Properties of the Benchmark Economy

A key element of my theory is the negative income-fertility relationship, which is best measured by the income elasticity of fertility. As I mentioned previously, the income elasticity of fertility implied by my benchmark model is very close to its empirical counterpart estimated by Jones and Tertilt (2008). Another important part of my theory is the skewed distribution of bequests with a long right tail. I ensure the model matches the bequest distribution I observe in the data by modelling bequests as luxury goods in the fashion of De Nardi (2004) and De Nardi and Yang (2016). In addition, my calibration strategy implies that my benchmark model matches the bequest-capital ratio and the 90th percentile of bequest amount.

Table 3 contains some key statistics of the benchmark economy together with their data counterparts. As can be seen, my calibrated benchmark model matches the key empirical moments from the US economy fairly well. Table 4 summarizes the ability distribution generated by my benchmark model, along with how the average fertility calculated by ability

Table 4: Fertility-Income Relationship from the Benchmark Model

Ability Group i	1	2	3	4	5	6	7	8	9	10	11
ψ_i	0.02	0.04	0.09	0.21	0.46	1.0	2.19	4.81	10.56	23.16	50.80
Cumulative Mass	0.004	0.015	0.064	0.185	0.383	0.617	0.815	0.937	0.985	0.996	1.0
Fertility per Parent	1.61	1.61	1.4	1.38	1.25	1.15	1.08	1.07	0.96	0.89	0.86
Data	1.6	1.6	1.4	1.4	1.24	1.15	1.08	1.07	0.96	0.86	0.89

Data source: 1990 U.S. Census

groups match up against the data. The first row represents the relative value of the ability ψ_i for Group i, in which the value for Group 6 is normalized to unity. The second row is the share of the population whose ability is equal to or less than that group. Hence, Group 11—the highest ability group in my model—corresponds to the top 0.4% and the top two groups together correspond to the top 2% of the population.

6. Counterfactual Models

In order to determine the impact of the taxation regime that I have instated in this model, I run several counterfactual models. All these models are recalibrated to match the bequest wealth ratio, the 90th percentile of bequest moment, the average fertility and elasticity of fertility, the interest rate and the Gini coefficient of the income distribution.

6.1. No Estate Tax

The first counterfactual attempts to ascertain the quantitative effect of abolishing the estate tax. In this model the tax rate is set to zero, so that no estates pay taxes no matter how large. No government revenue is generated. No transfer payments occur.

6.2. 2001 Estate Tax

The second counterfactual changes rates and exemption level to match the estate tax law in 2001. This means a top rate of 55% and an exemption level of $675,000. This is an exemption level that is 1/8 the exemption level of the benchmark. The higher rate and lower exemption level will generate larger government revenues and the transfer payment outlays will be larger as a result. As with the benchmark model this is an overstatement of the actual affects of the estate tax, as there are numerous avoidance strategies that allow individuals to not pay their full tax burden that this model does not take into account.

6.3. Inheritance Tax

The final counterfactual will replace the estate tax with an inheritance tax. The rate will remain at 55%, and the exemption level will be calibrated to match the total government revenue from the 2001 case. I chose 2001 as more individuals are affected by the tax and therefore the comparison will be more clear cut. This means the the transfer payment from the inheritance tax will be identical to the transfer payment in the 2001 estate tax case. The only difference is that a larger burden will fall on families with fewer children and a lighter burden will fall on families will more children relative to the estate tax.

7. Distributionary Effects

In this section, I examine the distributions generated by my benchmark model and compare them to the counterfactuals. I analyze the distribution of wealth, savings, bequests and welfare.

7.1. Wealth

I compute the proportion of overall wealth held by each percentile group in my benchmark model and compare it against the data. Some key statistics of the wealth distribution are reported in Table 5. The richest 1% from my benchmark model hold less wealth than the data, but overall my model does moderately accurate job of matching the actual distribution of wealth in the U.S., especially among the top 20%. As can be seen in the last column, my benchmark model also matches the Gini coefficient of the wealth distribution closely. It is important to note that these statistics of the wealth distribution are not used as my targeted moments in the calibration.

Comparing my benchmark to the counterfactuals yield some interesting observations. As expected, abolishing the estate tax increases overall inequality. Specifically it increases the wealth holding of the top 1% by 12% and the wealth holding of the top 20% by 2.5%.

This is not a very large amount due to the fact that very few individuals are actually paying estate taxes and they are clustered at the far end of the right side of the wealth distribution. So outside the extremely rich, few were affected by the estate tax. However, the loss of the transfer payment generated from the estate tax does lead to interesting welfare effects, discussed later in this section.

The 2001 estate tax has a much lower exemption (about one eighth) than the benchmark model. In addition it has a higher rate, .55 from .4. This means a larger amount of individuals will have to pay the tax, as well as the individuals already affected paying a much larger share. The impact of this is that the impact on the wealth distribution is no longer felt solely by the super rich. The top 1% drop their share of wealth from the benchmark model by 6% and the top 20 drop by 4%. Comparing the 2001 estate tax counterfactual to the no bequest counterfactual yields even more extreme results. Abolishing the estate tax from 2001 levels increases the wealth holdings of the top 1% by 19% and the top 20% by 6%. While the estate tax affects relatively few households, the fact that it affects the extremely rich means that its wealth distributional influence is significant.

The inheritance tax also leads to a drop in wealth inequality. This is because in the model, lower ability individuals have more children. So given an equally sized bequest, the children of lower ability individuals (who are themselves more likely to be lower ability) will pay relatively lower taxes than the children of higher ability individuals. However, because lower ability individuals rarely give large bequests in this model the influence of the taxation regime is limited. I do see a decrease in the wealth holding of the top 20% by about 2.5% though.

7.2. Bequests

I compute the proportion of overall bequests made by each percentile group in my benchmark model and compare it against the data. Some key statistics of the bequest distribution are reported in Table 6.

The bequest distribution comparison between the benchmark and the counterfactual models is largely what would be expected. Abolishing taxes increases the bequest share of the top 1% by nearly 30% compared to the benchmark model. As the tax rate is increased and exemption lowered to the 1990 counterfactual model, the share of the top 10% also

Table 5: Wealth Distribution

Percentile	$< 60\%$	60−80 %	$> 80\%$	90−95 %	95−99 %	>99%	Gini Coef.
Data	0.08	0.13	0.79	0.13	0.24	0.30	0.78
Benchmark Model	0.05	0.15	0.80	0.19	0.28	0.17	0.78
No Estate Tax	0.05	0.13	0.82	0.18	0.30	0.19	0.79
2001 Estate Tax	0.09	0.14	0.77	0.18	0.27	0.16	0.74
Inheritance Tax	0.10	0.15	0.75	0.17	0.27	0.15	0.71

Data source: Diaz-Gimenez et al. (1997)

Table 6: Bequest Distribution

Percentile	$< 90\%$	90−95 %	95−99 %	>99%	Gini Coef.
Benchmark	0.01	0.30	0.38	0.31	0.93
No Estate Tax	<0.01	0.13	0.47	0.40	0.96
2001 Estate Tax	0.05	0.20	0.43	0.32	0.93
Inheritance Tax	0.05	0.23	0.42	0.31	0.93

drops by 4%, as more and more individuals have to pay the estate tax.

Changing to an inheritance tax does not alter the distribution of bequests very much, though there is a slight drop in the bequests given by the top 1%. This is intuitive, as the top 1% have the lowest number of children and would be more relatively effected by an inheritance tax.

7.3. Savings

I compute the proportion of overall savings chosen by each percentile group in my benchmark model and compare it against the data. Some key statistics of the savings distribution are reported in Table 7.

The savings distribution reveals the impact of the transfer payments. Because these payments increase an individuals wealth as they enter retirement, an individual saves less as a result. This means that raising the estate tax actually increases the savings share of the

Table 7: Savings Distribution

Percentile	$< 90\%$	90−95 %	95−99 %	>99%	Gini Coef.
Benchmark	0.40	0.13	0.27	0.20	0.75
No Estate Tax	0.42	0.14	0.26	0.18	0.72
2001 Estate Tax	0.37	0.17	0.28	0.19	0.75
Inheritance Tax	0.33	0.15	0.31	0.23	0.81

top 1%. Of special note is the inheritance tax, which massively increases savings among the top of the distribution. This is because these individuals are receiving a lower amount of bequests after taxes and therefore save more as a result.

7.4. Welfare

To calculate welfare for each ability group I compared the steady states of each potential tax regime. The reader may think of this as comparing separate countries who are identical in every way except estate tax regimes. This allows the general equilibrium effect to be readily apparent.

The welfare changes causes by the abolishing of the estate tax is largely as expected. The top groups, who give and receive the majority of bequests, see relative (to median welfare) welfare gains of between .02% and .39%. The lower ability groups who lose the transfer payment see relative welfare losses of between 5.63% and 8.76%.

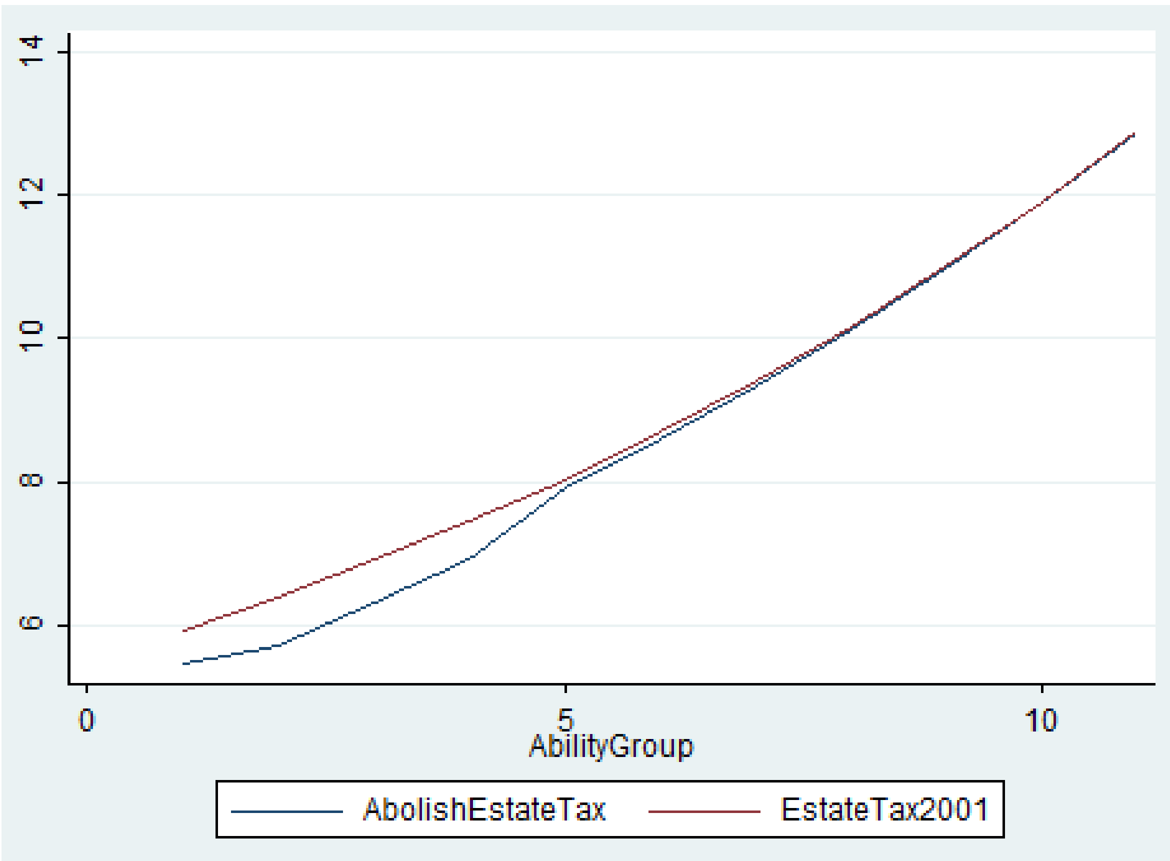
Increasing the estate tax from the benchmark to 2001 levels also has a intuitive result. The richest groups lose welfare, requiring a CEV of between .27% and .55% to compensate them. The poorest groups enjoy the additional government payment, increasing their consumption as a result by between .59% and .87%.

Finally, changing to an inheritance tax has very little effect on welfare. This is because table 8 reports mean welfare for each group, and most of the impact of the inheritance tax is intra-group.

Table 8: Welfare Comparison

Ability Group i	1	2	3	4	5	6	7	8	9	10	11
No Estate	5.47	5.73	6.33	6.92	7.91	8.60	9.33	10.1	11.0	11.9	12.9
2001 Estate	5.94	6.39	6.91	7.44	8.03	8.69	9.40	10.2	11.0	11.9	12.9
2001 Inheritance	5.94	6.39	6.91	7.45	8.03	8.69	9.39	10.2	11.0	11.9	12.9

Data source: 1990 U.S. Census



8. Conclusion

This paper pursued three goals. First, to build and run a simple overlapping generations model including intergenerational transfers and a simple representation of the estate tax. I did this using a three period model with childhood, adulthood and retirement, where individuals chose differential fertility and gave bequests to their children. Second, to match the wealth-income inequality disparity seen in the data, where wealth inequality is higher than income inequality. Although the wealth held by the top 1% from our model does not completely match the data, I come very close and match various other important moments. And third to quantitatively analyze the policy experiment of switching from an estate tax regime to an inheritance tax regime. I did this, and was able to show that a switch would generate a more equitable distribution of wealth. Overall, my results show that the estate tax exemption levels and rates have an outsize affect on inequality for how small a number of households are actually affected by it.

I conclude the paper by drawing attention to a few potentially important issues from which this paper has abstracted. This paper simplifies the life-cycle savings process. A model with a larger number of time periods and income shocks would generate greater variance in life-cycle savings and thus more wealth inequality. This model also simplifies the bequest motive and how it interacts with taxes. A more nuanced model is left for future research.

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Appendices

A Markov Matrix and Ability Distribution

In this section we show the Markov chain generated from our Tauchen (1986) process for the ability shock.

	ψ^p_{11}	$\psi^p_1 0$	ψ^p_9	ψ^p_8	ψ^p_7	ψ^p_6	ψ^p_5	ψ^p_4	ψ^p_3	ψ^p_2	ψ^p_1
ψ_{11}	0.05	0.03	0.02	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ψ_{10}	0.11	0.08	0.05	0.03	0.02	0.01	0.0	0.0	0.0	0.0	0.0
ψ_9	0.21	0.17	0.13	0.09	0.06	0.04	0.02	0.01	0.01	0.0	0.0
ψ_8	0.26	0.25	0.22	0.19	0.15	0.11	0.08	0.05	0.03	0.02	0.01
ψ_7	0.21	0.24	0.25	0.25	0.24	0.21	0.17	0.13	0.09	0.06	0.04
ψ_6	0.11	0.15	0.19	0.22	0.25	0.26	0.25	0.22	0.19	0.15	0.11
ψ_5	0.04	0.06	0.09	0.13	0.17	0.21	0.24	0.25	0.25	0.24	0.21
ψ_4	0.01	0.02	0.03	0.05	0.08	0.11	0.15	0.19	0.22	0.25	0.26
ψ_3	0.0	0.0	0.01	0.01	0.02	0.04	0.06	0.09	0.13	0.17	0.21
ψ_2	0.0	0.03	0.0	0.0	0.0	0.01	0.02	0.03	0.05	0.08	0.11
ψ_1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.02	0.03	0.05

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