Inheritance, Wealth Distribution, and Estate Taxation

Yanran Guo

Economics Department, UNC-Chapel Hill

October 2, 2022

Abstract

The estate tax has been considered by its supporters as a natural way to reduce wealth inequality because it hits the wealthy directly. However, this conclusion relies heavily on the underlying assumption that inheritance plays a crucial role in wealth accumulation for the rich. This paper documents that only 14% of the richest one percent's wealth is attributable to their inheritances. Then, in a quantitative model that accounts for novel facts on inheritance received by the rich, this paper finds that even if the estate tax rate were raised to 100%, the top one percent wealth holding would drop by only 3.5 percentage points. Moreover, compared with taxing the incomes of the top one percent earners, taxing estates generates a larger output loss for a given amount of wealth redistribution, suggesting that estate taxation may not be an effective tool for wealth redistribution.

Keywords: inheritance, household wealth, inequality, estate tax

JEL Codes: D14, D31, D64, E21, H21

Address: Gardner Hall, Chapel Hill, NC 27599, United States

Telephone: 919-360-3256

Email: yanran@live.unc.edu

Acknowledgments: I thank Lutz Hendricks, Oksana Leukhina, Matthias Kehrig, Can Tian, Stanislav Rabinovich, Gary Biglaiser, Cheng Chen, Roozbeh Hosseini, Fei Li, Roberto Samaniego, and Andrew Yates for their valuable comments. I also thank all participants at UNC Macro Workshop, UNC Micro Theory Workshop, I-85 Macroeconomics Workshop, and SEA for their questions, comments, and insights.

1 Introduction

This paper studies the implications of estate taxation for wealth distribution. In the United States, household wealth is highly concentrated. The richest one percent of households hold over 40% of overall wealth. Previous research has found that intergenerational transfers, especially bequests, are large and mostly received by rich households. The literature finds that around 40% of the U.S. capital stock is attributable to intergenerational transfers.[1] As for the concentration of bequests, the intergenerational transfers reported by the richest ten percent are seven times as high as those reported by the bottom half of the wealth distribution. Based on this evidence, researchers have concluded that inheritances contribute to wealth concentration at the top (e.g., De Nardi, 2004; Feiveson and Sabelhaus, 2018). This conclusion suggests that policies that tax and redistribute intergenerational transfers can significantly reduce wealth inequality.[2] This paper instead argues that the distributional effects of estate taxation are limited and costly. Furthermore, the estate tax is a less effective method of redistributing wealth than other major tax reforms, such as the progressive income tax. For a given amount of wealth redistribution, taxing the incomes of the top one percent earners has lower output loss but higher welfare gains.

The main innovation of this paper is the new evidence on inheritances received by the rich. Using the Survey of Consumer Finances data (SCF), I document that about half of the top one percent wealth holders report no inheritance.[3] Moreover, inheritances account for only 14% of the richest one percent's net worth. This finding is important because it

[1]Kotlikoff and Summers (1981) estimate that around 80% of the U.S. capital stock is attributable to intergenerational transfers. Even though Modigliani (1988) reaches a different conclusion, claiming that less than 20% of wealth can be attributed to transfers, this discrepancy is mainly due to methodological issues. After summarizing the findings of the literature, Davies and Shorrocks (2000) conclude that inheritances are responsible for approximately $35\% - 45\%$ of aggregate wealth.

[2]In a counterfactual thought experiment, Feiveson and Sabelhaus (2018) find that if all of the wealth transfers reported by each household had been equally distributed, the wealth share of the top decile would drop by 16 percentage points. Moreover, most of the wealth redistribution goes to the bottom half of the wealth distribution.

[3]Intergenerational wealth transfer includes both inter vivos gifts and bequests. However, throughout this paper, I will interchangeably use the two terms: inheritance and intergenerational wealth transfer. From the Survey of Consumer Finances data, around 85% of intergenerational transfers are in the form of inheritances. Therefore, in this paper, the term *inheritance* is used to refer to the total intergenerational wealth transfers a household receives.

generates new implications for changing estate taxation. The previous literature usually focuses on the inheritance value and documents that the bulk of wealth transfers flows to affluent households. Nevertheless, if the inheritance the rich received accounts for only a small fraction of their wealth, a more progressive estate tax would generate only minor effects on reducing inequality. Therefore, to understand the effects of estate taxes on wealth inequality, one should look at inheritances received by the rich as a proportion of their wealth instead of its value.

To quantify the importance of estate taxation for wealth distribution, I develop a quantitative model that can account for wealth distribution and the new facts on inheritances. The model is a variation of the standard general equilibrium dynamic framework by Castaneda, Diaz-Gimenez, and Rios-Rull (2003, CDR hereafter). Based on the CDR framework, I further include *imperfect altruism* and *heterogeneity in returns to wealth*. The strength of altruism is then calibrated to allow the model to match new inheritance evidence. Rate of return heterogeneity is introduced as a reduced form to account for private equity or entrepreneurship, as in Benhabib et al. (2019). For example, wealthy families are more likely to set up their children for future financial success by including them in lucrative family businesses. When inheritance is passed on in the form of business, a confiscatory estate tax would take away the seed money for being more affluent in the future and thus break down the wealth concentration. Therefore, it is necessary to incorporate this channel into the model to do reasonable counterfactuals later.

The quantitative contribution of this paper includes three experiments conducted in the long-run steady state. Additional tax revenues raised by changing tax rates are redistributed among all households by a lump-sum transfer. The first experiment investigates the equity versus efficiency trade-off of estate taxation. Increasing estate tax rates would reduce the wealth concentration at the top at the expense of reducing total output. However, the equalizing effect is small. Compared with the benchmark steady state, even if the tax rate were raised to 100%, the top one percent wealth holding would drop only by 3.5 percentage points (from 33.6% to 30.1%), with a cost of 0.81% decrease in output.

The limited equalizing effect is due to the low inheritance-to-wealth ratio of the richest one percent. The top one percent's wealth is seven times as high as the bequest they received. Inheritance alone cannot generate such large wealth, given the empirically estimated idiosyncratic returns. Hence, inheritance is not rich households' primary source of wealth accumulation. As a result, changes in estate tax rates would not significantly affect their wealth.

The second experiment calculates the optimal estate tax rate that maximizes welfare as measured by consumption equivalent variation in the new steady state. The resulting tax rate is 94%. Implementing the welfare-maximizing estate tax rate has disparate effects on households in different wealth groups. The top percentile suffers from a large welfare loss because a significant portion of their wealth will be taken away when they die. The rest of the economy, on the other hand, enjoys a small welfare gain. Although the welfare loss of the rich is large, as they account for only a small fraction of the total population, the overall economy experiences a welfare gain of 0.73%.

The effect of estate taxation is different in a model with or without being disciplined by empirical evidence on inheritances. In Appendix C, I provide discussion about a model that is calibrated only to match earnings and wealth distribution without any empirical evidence on inheritances to discipline the bequest motive. That model is still able to generate wealth inequality. However, in that model, the the top one percent wealth holding drops from 35% to 26% when the estate tax rate is taken from 0 to 100%. The distributional effect in that model is almost twice as large as that in the benchmark model, which is governed by the inheritance statistics. Moreover, the maximized welfare in that model is three times as large as that in the benchmark model.

Lastly, to present a clearer picture of whether estate taxation is an effective redistribution tool, I compare it with the progressive income tax. With an additional top marginal income tax rate of 28.5%, the wealth share of the richest one percent decreases to 30.1%, which is the same as the most equitable case by changing the estate tax (i.e., estate tax rate being 100%). However, it has a lower cost (0.65% decrease in output) and a higher welfare gain (10.27%). The outperformance of income tax is because estate tax hits the wealthy old households the most. They lower their savings when the tax rate is high. As a result, it drives down the aggregate capital, leading to a decrease in total output. However, when the top marginal income tax rate is increased, both the wealthy young and old are affected. They save less, which lowers the aggregate capital in the economy. Meanwhile, wealthy young households increase their labor supply in response to the tax change. Since they are of high productivity, the total efficient labor units rise. It mitigates the negative effect of decreased capital, leading to a small reduction in aggregate output. Moreover, a higher top marginal income tax rate generates large tax revenue. Poor households enjoy an increase in consumption due to the high lump-sum transfer, leading to a significant welfare gain.

Related Literature: This paper contributes to two strands of literature. First, it is closely related to the wealth inequality literature, especially the small subset of papers studying the effects of estate taxation in quantitatively calibrated models (e.g., Nishiyama, 2002; CDR, 2003; Cagetti and De Nardi, 2009; De Nardi and Yang, 2016). Understanding the economic impacts of estate taxation matters because this tax mainly hits the richest households that do most of the saving and hold a large fraction of total wealth.[4] Therefore, their behavior may have a large influence on the aggregates. My paper adds to this literature by developing a model to capture new moments on rich households' inherited wealth. The effects of estate tax policy depend crucially on how wealth is concentrated in the hands of the richest percentile of the distribution. Therefore, a quantitative model that carefully analyzes the role of inheritance in determining wealth inequality is the key to investigating the effects of changing estate taxation. My paper also contributes to the literature by providing a full set of quantitative analyses of estate taxation. Nishiyama (2002), CDR (2003), and Cagetti and De Nardi (2009) study the case of abolishing estate taxation. De Nardi and Yang (2016) quantify the effects when the tax rate is increased to 60%. The previous work concludes that increasing estate tax rates would reduce the wealth concentration at the top but reduce output without further discussing how much the effect is when the estates are fully taxed and what the

[4]The estate tax exemption level was around 11.5 million in 2020.

optimal estate tax rate is.

Second, this paper adds to the empirical work on intergenerational wealth transfers. The previous studies focus on the aggregate evidence either by studying intergenerational transfers as an essential determinant of household wealth in the overall economy (e.g., Kotlikoff and Summers 1981, Gale and Scholz 1994, Davies and Shorrocks 2000, Brown and Weisbenner 2004) or by looking at the aggregate value of inheritance received by the rich (e.g., Feiveson and Salbelhaus 2018). This paper provides a more detailed distribution by investigating what fraction of the wealth of the very rich is accounted for by inheritance. A closely related work is Hurd and Mundaca (1989), which studies the importance of inheritances in individual wealth holdings. However, they look at the income-rich households. Another paper closely related to mine is Wolff and Gittleman (2014), which discusses inheritances as a proportion of current net worth. But they focus on the aggregate economy and investigate how inheritances as a share of household wealth change over time. My paper completes the literature by characterizing the features of wealth transfers received by the richest few. It helps us better understand the quantitative importance of inheritances in determining wealth concentration at the top, which will generate new implications for changing estate taxation.

Layout: The rest of the paper is organized as follows. Section 2 presents motivating facts concerning inheritances received by the rich. Section 3 lays out the quantitative model and defines the equilibrium. Section 4 discusses the calibration procedure and evaluates the fit of the model against a number of important features of the data. Policy experiments are in Section 5. Section 6 concludes.

2 Motivating Facts

This section characterizes the features of wealth transfers received by rich households that will serve as inputs for the calibration of the quantitative model. A series of empirical findings is presented after a brief description of the primary data source and methodology. Discussions of robustness are in the last part of this section.

2.1 Data and Methodology

The primary data source is the Survey of Consumer Finances (SCF) 1989-2019, a cross-sectional survey conducted every three years. Since the group of interviewees changes in each survey year, I compute the statistics year by year and then average across years.[5] SCF asks the household to provide details for up to three inheritances, gifts, or trusts that they have received: the year in which the transfer was received, the value of the transfer when received, and the type of the transfer.[6] As more than 85% of transfers are in the form of inheritances, in this paper, the term *inheritance* is used to refer to the total wealth transfers (i.e., bequests and inter vivos) a household receives.

Adopting the standard approach in the literature (e.g., Brown and Weisbenner, 2004; Wolff and Gittleman, 2014), I use a 3% real interest rate to compute the present value of each transfer based on both the reported value and the receipt date. Then I sum up the value of all transfers received by a household in the past. Finally, I directly estimate the fraction of wealth attributable to transfers by taking the ratio of these two. The wealth concept used here is net worth, defined as the current value of all marketable assets less the current value of debts. Both the value of wealth and the value of inheritances are in 2019 dollars. As discussed by Brown and Weisbenner (2004), this direct estimation approach computes the maximum portion of wealth people hold today that can be attributable to transfers they have received in the past.[7]

On average, from 1989 to 2019, 21% of households in the U.S. received a wealth transfer at some point in the past, which accounts for 43% of their net worth. To investigate the total wealth transfers received over a lifetime, the facts presented next focus on households who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future. Over the lifetime, about 30% of households could expect to receive a wealth transfer, and these would account for close to 49% of their net worth.

[5] I also compute the statistics by pooling across all years. Similar results are obtained.

[6] The type of transfers in the SCF is defined as bequest or inter vivos.

[7] The question that is asked here is as follows: Assuming everyone currently alive had saved all transfers they received, along with the accumulated interest, what portion of wealth held by households today can be attributable to transfers they have received in the past?

2.2 Facts

Fact 1. The distribution of wealth transfers received over a lifetime is highly skewed.

Most households do not receive any wealth transfers over their lifetime, in the sense that more than 70% of all transfers are zero. At the other end of the size distribution, 10% of households receive wealth transfers that account for almost 90.0% of total dollars transferred. The top one percentile in wealth transfer distribution accounts for 51.5% of the total dollars transferred. On average, 2.9% of wealth transfers by count are greater than the top decile cutoff value in that year's wealth distribution, and they account for 68.8% of the total dollars transferred.

Fact 2. The bulk of intergenerational transfers are flowing to wealthy households.

When one is investigating the wealth transfers received over a lifetime by different wealth groups, one sees that households in the top decile of the wealth distribution receive 61% of the total dollars transferred. As shown in Figure 1, 24% of the total transferred dollars go to the wealthiest one percent. Less than 5% of the total amount transferred goes to households in the bottom half of the wealth distribution.

Fact 3. Wealth transfers received by rich households account for only a small fraction of their wealth holding.

The fraction of wealth directly accounted for by wealth transfers is calculated as the ratio of the present value of wealth transfers to the current net worth. I compute this statistic using households in the top decile wealth group who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future. As shown in Table 1, less than 20% of the richest ten percent's wealth is directly attributable to transfers. For the wealth top percentile, the fraction of their wealth accounted for by intergenerational wealth transfers is even smaller, only around 14%.

Fact 4. Half of the rich households do not receive any wealth transfers over their lifetime.

Figure 2 shows the number of households within each inheritance-to-wealth ratio bin, reported as a fraction of the total number of households in each wealth group. 52% of the top one percent by wealth receive zero transfers over their lifetime. Also, about 35% of the richest one percent receive transfers that account for less than one-fifth of their wealth. Less than 10% of the top one percent fall into the category in which the wealth transfers account for at least half of their current net worth. Similar patterns are also found for households in the wealth $90 \sim 95^{th}$ and $95 \sim 99^{th}$ percentile groups.

2.3 Discussions

The main finding from SCF data, as discussed above, is that even though intergenerational wealth transfers are important for wealth accumulation for an average household, their role is less important for the rich. Nearly 90% of the wealthiest one percent either received nothing or only a small amount of transfers compared with their current net worth. This observation is consistent with facts documented by Korom et al. (2017). Using data from the annual American Forbes 400 ranking (1982-2013), Korom et al. (2017) find that 55% of the fortunes are self-made. They deem a fortune to be self-made only if the individual built it from scratch. Moreover, they find that around $60 - 70\%$ of the multimillionaires case either from families where the parents were blue-collar workers or from a lower-middle-class or middle-class background, but not a rich one.

The concerns regarding the empirical findings of this paper are as follows. First, the results are obtained by using a 3% real interest rate to compute the present value of inheritances. One may worry that the rich households have access to better investment portfolios, which give them a higher return. The high rate of return could potentially raise the importance of inheritance in wealth accumulation for the rich. Hubmer et al. (2021) estimate the excess return on net worth in expectation for households in the top decile of wealth distribution ranges from 3% to 6%. As a robustness check, I use a 6% real interest rate to calculate the present value of inheritance and re-compute all the statistics.[8] When I do so, all numbers in Table 1 increase, which is straightforward: the denominator does not change, but the numerator increases due to the higher interest rate. However, as shown in Figure 3, for most of the rich, their inheritances are small relative to their wealth holding. First, no matter which interest rate is used to compute

[8] According to the estimates by Hubmer et al. (2021), the mean excess returns for households in $90^{th} - 99^{th}$ is lower than 6%. In spite of that, I use the 6% real interest rate for all households. Therefore, this robustness check can be considered an upper bound.
Moreover, in this exercise, I am taking the risk-free rate of return to be zero.

the present value of inheritance, it does not affect half of the rich because they received zero wealth transfers. Second, when one uses a 6% real interest rate, the share of the richest one percent with the inheritance-to-wealth ratio of less than 0.2 only drops by 5 percentage points, from 34.5% to 29.6%, implying that most recipients received only small inheritances relative to their wealth. The conclusion that inheritances play a less important role in wealth accumulation for the rich primarily comes from the fact that half of them inherited nothing and one-third of them inherited little. This result is robust even when one uses a higher real interest rate to compute the present value of inheritances.

Nevertheless, there is another concern: there could be underreporting of received wealth transfers in the data. One possibility is recall error. The SCF collects information on bequests and gifts received by individual households in a retrospective way. The recall method of data collection is likely to suffer from under-reporting problems because households forget small inheritances, especially when they received them a long time ago. However, as for large inheritances, the problem of recall error tends to be less severe. De Nicola and Gine (2014) compare administrative records with retrospective, self-reported survey responses to study the accuracy of recall data. They find that variables of a higher value are better recalled.[9] My research focuses on inheritances received by the richest one percent, which tend to be significant in value. Hence, the recall error is less severe in this research. The second possibility leading to under-reporting is tax avoidance. However, the SCF is a cross-sectional household survey. Like most household surveys, the SCF does not ask detailed questions about household tax filing or tax liabilities. Therefore, interviewees have less incentive to misreport their inheritance.

Another possibility that may be potentially important in shaping wealth inequality but makes inheritance small in value is that wealth transfers could be conducted indirectly. For example, wealth transfers could be in the form of human capital investment, e.g., college tuition payment. It is not reflected in the value of inheritance received by the descendant. However, it may make the children more affluent and generate larger wealth dispersion in the future. These indirect links are interesting and worth exploring in future

[9]The data they use are on earnings. They find that monthly earnings higher than the median are better recalled.

research, but they are beyond the scope of this paper. The main goal of this paper is to investigate the implications of estate taxation for wealth distribution. Such indirect links are not subject to the estate tax.

3 The Model

The economic environment is a version of the life-cycle model with incomplete markets and a temporary superstar earning state commonly used to study the wealth distribution proposed by CDR (2003). The CDR framework can generate distributions for earnings and wealth that mimic their empirical counterparts with a simple model setup. It has been widely applied to the study of several problems for which inequality is a key determinant (e.g., Kaymak and Poschke, 2016; Kindermann and Krueger, 2022). I base my model on the CDR framework with two extensions. First, I introduce imperfect altruism and calibrate the bequest motive parameter by matching the model to empirical moments on inheritance. I also incorporate rates of return heterogeneity.

The assumption of rates of return heterogeneity is necessary for two reasons. First, as discussed by the previous literature, it is a key determinant of generating the highly skewed wealth distribution. Using administrative data, recent empirical studies provide evidence on returns heterogeneity (e.g., Bach et al., 2020; Fagereng et al., 2020). On the theoretical front, the recent heterogeneous-agent macroeconomic literature has stressed the importance of rates of return heterogeneity in shaping wealth inequality (Benhabib et al., 2011; Benhabib et al., 2019; Hubmer et al., 2021). More importantly, rate of return heterogeneity is incorporated into the model because it may affect the role of inheritance in wealth accumulation for the richest few. One can easily imagine that a wealthy family's descendant is more likely to receive some transfers from her parents. Usually, these transfers are in the form of private equity or a family business. The value of the transfer may be small, but it will make the heir experience rapid wealth growth due to the high returns. In this case, even though the inheritance-to-wealth ratio is small, which is consistent with the empirical evidence, a confiscatory estate tax would take away the seed money for being rich and thus break down the wealth concentration. Therefore, it is necessary to incorporate rates of return heterogeneity into the model to do reasonable counterfactuals later.

3.1 Environment

The economy is inhabited by a continuum of households of unit mass, by a single representative firm, and by a government. All markets are competitive, and the economy is in steady state. The model is in discrete time; the model period is one year.

3.1.1 Demographics and Endowments

Households go through two demographic states in life: working life and retirement. There are N^Y phases in the working life state and N^O phases in the retirement state.[10] In each period, households face a constant probability of moving to the next phase. When in the last phase of the retirement state, households face a constant probability of dying.

Households are endowed with a fixed amount of disposable time ι, which can be split up into working time and leisure. Working-age households experience idiosyncratic shocks to their individual endowment of efficiency labor units. Endowment with efficiency units of labor is captured in a one-dimensional state variable $s \in \mathcal{S}$ that follows a finite-state Markov chain with transition probabilities $\Gamma(s'|s) = Pr(s_{t+1} = s'|s_t = s)$. Retired households are endowed with zero-efficiency labor units. Hence, they stop working and start receiving retirement benefits $\overline{\tau}$, which is the same across all retired households regardless of their productivity when young. Still, I keep track of all retirees' last realization of efficiency labor units in their working life to model intergenerational earnings correlation. When a retired household dies, it is replaced by a working-age descendant who inherits

[10] Phases are introduced to avoid counterfactual demographic implications. Without phases, the probability of retiring is just the inverse of the expected duration of working life, 1/45, and the probability of dying is the inverse of the expected duration of retirement, 1/15. In an earlier version where I did not introduce life phases, I found that in the model economy, most households in the $95^{th} \sim 99^{th}$ percentile of the wealth distribution build their wealth by living an incredibly long life. By introducing life phases, I increase the probability of moving to the next demographic state. For example, when having three phases in working life (N^Y=3), the probability of moving to the next phase is $1/(45/3) = 1/15$. Having $N^Y = 45$ and $N^O = 15$ is equivalent to assuming deterministic aging.

the deceased household's estate and some of its earning abilities.[11] Descendants' first draw of productivity is correlated with the realization of efficiency labor units that their parents faced during the last period of working life.

3.1.2 Preferences

The household's instantaneous utility comes from consumption and leisure:

$$u(c_t, l_t) = \frac{c_t^{1-\sigma_1}}{1-\sigma_1} + \chi \frac{(\iota - l_t)^{1-\sigma_2}}{1-\sigma_2} \tag{1}$$

where l_t is the working time supplied by the household. Households are imperfectly altruistic in this model. Hence, they maximize the expected discounted sum of period utilities over their lifetime plus part of the value of their descendants.

3.1.3 Returns to Capital

In this model, households endogenously choose labor supply and saving. As for capital income, there is rate of return heterogeneity. Following Hubmer et al. (2021), the return on saving is specified as

$$\underline{r} + r^X(k_t) + \sigma^X(k_t)\eta_t \tag{2}$$

where $\underline{r}$ is an aggregate return component common across all households, $r^X(\cdot)$ is the mean excess returns which depends on wealth k_t, $\sigma^X(\cdot)$ captures the standard deviation of excess returns which is increasing in household's wealth holding, and η_t is an *i.i.d* standard normal idiosyncratic shock that hits the household in every period.

Register data in Norway (Fagereng et al. 2020) and Sweden (Bach et al. 2020) have revealed an average return which is increasing in household wealth and an idiosyncratic

[11] The stochastic aging assumption is borrowed from the original CDR framework. It simplifies the model because there is no need to keep track of age distributions. However, this assumption biases in favor of large role for inheritances. Due to this assumption, descendants receive inheritances upon entering the economy at age 20. They receive their inheritances too early compared with the data where households receive their inheritances at age 50. Nevertheless, this bias is not a shortcoming of this paper because it reinforces the paper's main point: the distributional effect of estate taxation is small even in a quantitative model that overestimates the role for inheritances.

return component whose variance is also increasing in wealth. Equation (2) mimics these two features observed in the data. Also, cross-sectionally, there is a limited amount of return persistence under this specification because wealth is persistent.[12] This is consistent with Fagereng et al. (2020) and Bach et al. (2020), who find both heterogeneity and persistence in idiosyncratic asset returns.

3.2 Government

The government taxes households' income and estates to finance the exogenous public expenditure G and to provide lump-sum transfers $\overline{\tau}$ to retired households.

Household income contains two parts. The ordinary gross income y_t is defined as the sum of labor income and the deterministic part of capital income, $(\underline{r} + r^X(k_t))k_t$. The second part is the stochastic capital income, $\tilde{y}_t = \sigma^X(k_t)\eta_t k_t$. The stochastic part of capital income is uncorrelated over time. Households at the top end of the wealth distribution have a high standard deviation of excess returns $\sigma^X(k_t)$. Therefore, they have sizable return risk and large capital income fluctuations from period to period. For simplicity, I follow Hubmer et al. (2021) and assume a flat capital gains tax, $\tau_k(\tilde{y}_t) = a_0\tilde{y}_t$, for this highly volatile part of capital income.

A household's ordinary gross income is subject to a progressive income tax $\tau_y(y_t)$

$$\tau_y(y_t) = a_1[y_t - (y_t^{-a_2} + a_3)^{(-1/a_2)}] \tag{3}$$

This income tax function was first proposed by Gouveia and Strauss (1994) to capture the progressivity of U.S. effective household income taxes. It has been widely employed in the quantitative public finance literature by Conesa and Krueger (2006), and Diaz-Gimenez and Pijoan-Mas (2019). a_1 controls the level of the average tax rate. The value of a_2 captures the curvature of the tax function, which determines the progressivity of the tax code. $a_2 = 0$ implies a proportional tax system, while other values encompass a wide range of progressive tax functions.

[12] But conditional on wealth, returns are uncorrelated over time.

The U.S. federal estate tax is a very progressive tax on the total value of net worth when a household dies. In line with the literature, I assume a constant marginal tax rate for simplicity (CDR 2003, Cagetti and De Nardi 2009, De Nardi and Yang 2016). Therefore, the tax is summarized by two parameters: an exemption level $\underline{z}$ and a constant marginal tax rate a_4 for estates above the exemption level.

$$\tau_e(k) = \begin{cases} 0 & \text{for } k \leq \underline{z} \\ a_4(k - \underline{z}) & \text{for } k > \underline{z} \end{cases} \tag{4}$$

3.3 Firm and Market Arrangements

In this model economy, asset markets are incomplete, and households cannot fully insure against idiosyncratic shocks. There is one representative firm producing goods according to a constant returns to scale production function $F(K, L)$, where K is the aggregate capital stock and L is the aggregate labor input. Capital depreciates geometrically at a constant rate δ.

$$Y_t = F(K_t, L_t) = K_t^{\theta} L_t^{1-\theta} \tag{5}$$

The firm rents factors of production from households in competitive spot markets at a wage rate w_t and an average market return on capital r_t.

3.4 The Household's Decision Problem

Households have four state variables: the phase of demographic state (n), individual asset holdings (k), the realization of efficiency labor unit (s), and the shock (η). The dynamic program of a household is given by

$$
\begin{aligned}
V(n,k,s,\eta) = \max\ & u(c,\iota - l) + \beta \cdot (1-\Omega) \cdot \mathbb{E}\Big[V(n,k',s',\eta')|s\Big] \\
& + \beta \cdot \Omega \cdot (1 - \mathbf{1}_{\{n=N^Y+N^O\}}) \cdot \mathbb{E}\Big[V(n',k',s',\eta')|s\Big] \\
& + \beta \cdot \Omega \cdot b \cdot \mathbf{1}_{\{n=N^Y+N^O\}} \cdot \mathbb{E}\Big[V(1,a',s',\eta')|s\Big] \\
s.t.\quad & k' + c = k + y - \tau_y(y) + \tilde{y} - \tau_k(\tilde{y}) \\
& y = (\underline{r} + r^X)k + wsl + \overline{\tau} \cdot \mathbf{1}_{\{s=0\}} \\
& \tilde{y} = \sigma^X \eta k \\
& a' = k' - \tau_e(k') \\
& k' \geq 0
\end{aligned} \tag{6}
$$

where Ω is the probability of moving to the next phase. $n = N^Y + N^O$ indicates that the household is currently in the last phase of retirement. With probability Ω, this retiree moves to the next phase, meaning it dies and is replaced by its descendant. $V(1,a',s',\eta')$ is the value function of its descendant, and $n = 1$ indicates that it is in the first phase of working-age. The descendant inherits its predecessor's estate after paying estate taxes. The first draw of its efficiency labor unit s' depends on its parent's last realization of labor efficiency during working life, s. Parameter b governs bequest motive, which shows how much parents care about their offspring's value.

3.5 Stationary Equilibrium

Define $x = (n,k,s,\eta)$ as the state vector. Given excess return schedule $r^X(\cdot)$ and $\sigma^X(\cdot)$, a stationary equilibrium is defined by the household value function $V(x)$, their decision rules $c(x)$, $l(x)$, $k'(x)$, public policies $\{\tau_y, \tau_k, \tau_e, \overline{\tau}\}$, factor prices $\{r, w\}$, aggregate return component $\underline{r}$, and a distribution over households $\Lambda(x)$, such that, given prices and government tax and transfer schedules:

(i) policy functions $c(x)$, $l(x)$, and $k'(x)$ maximize household's value function;

(ii) the firm maximizes profit

$$w = (1-\theta)\big(\frac{K}{L}\big)^{\theta}$$
$$r = \theta\big(\frac{K}{L}\big)^{(\theta-1)} - \delta \tag{7}$$

(iii) the government budget is balanced

$$G + \int \overline{\tau} \cdot \mathbf{1}_{old}(x) d\Lambda(x) = \int \big[\tau_y(y(x)) + \tau_k(\tilde{y}(x))\big] d\Lambda(x) + \int \tau_e(k(x)) \cdot \mathbf{1}_{new}(x)\Lambda(x) \tag{8}$$

where $\mathbf{1}_{old}(x) = 1$ if the household is an old retiree, and $\mathbf{1}_{new}(x) = 1$ if the households is a newcomer replacing its deceased predecessor;

(iv) the goods market clears

$$Y = \int c(x) d\Lambda(x) + K' - (1-\delta)K + G \tag{9}$$

(v) the labor market clears

$$L = \int l(x)s(x)\Lambda(x) \tag{10}$$

(vi) the capital market clears

$$K = \int k(x)\Lambda(x) \tag{11}$$

Due to the non-trivial excess return schedule $r^X(\cdot)$, household capital income is no longer proportional to their asset. Hence, in addition to the standard capital market-clearing condition, there is a second condition

$$rK = \int (\underline{r} + r^X(k) + \sigma^X(k)\eta)k(x)d\Lambda(x) \tag{12}$$

(vii) the distribution of household over the state variables, $\Lambda(x)$, is stationary.

4 Quantitative Evaluation

This section sets out to discuss the calibration procedure and present the characteristics of the benchmark equilibrium. The calibrated model generates realistically skewed distributions for wealth, earnings, and moments on transferred wealth, and is thus a good laboratory to use to study the effects of estate taxation.

4.1 Calibration

The model is calibrated through the simulated method of moments (SMM) in two steps. In the first step, a subset of the parameters is externally calibrated with estimates independent of the model or commonly used values in the literature. The first step parameters are listed in Table 2. In the second step, the remaining parameters are endogenously determined in the model to match features of the US economy of the late 1990s and early 2000s, a period during which the estate tax was relatively stable. Parameters calibrated to match model-generated moments with moments in the data are listed in Table 3.

4.1.1 Demographics and Preference

Households first enter the model economy at age 20. I assume there are three phases in working life and retirement, respectively. The probability of moving to the next phase in working life is calibrated to match the expected duration of working life being 45 years. Similarly, the probability of moving to the next phase in retirement is calibrated to match the average duration of retirement being 15 years.

I set the coefficient of risk aversion σ_1 in utility function to be 1.5, which is in the middle of the range typically used in the literature. In line with existing studies, the value of σ_2 is chosen so that the corresponding Frisch elasticity of labor is one.[13] χ is the weight

[13] For example, Conesa et al. (2009) obtain a Frisch labor elasticity around 1.

of disutility of labor. It is pinned down by targeting the average share of time endowment allocated to working. The targeted value is 0.3 (McGrattan and Rogerson, 2004). ι is the endowment of disposable time. It is set to be 3.3, because this value makes the aggregate labor input approximately equal to one. The value of discount factor β is pinned down by targeting a capital to output ratio of 3. The parameter that governs bequest motive, b, is calibrated to match the empirical statistics on wealth transfers computed using SCF data.

4.1.2 Labor Efficiency Process

Following CDR (2003), to keep the process on s as parsimonious as possible, I choose four different realizations of efficiency labor units, $s \in [s_1, s_2, s_3, s_4]$ and normalize the lowest labor state to be one, i.e. $s_1 = 1$. The labor efficiency process is calibrated such that it generates distributions for wealth and earnings that match their empirical counterparts. The calibration procedure implies the endowments with efficiency labor units and stationary distribution of working age households presented in Table 4.

As in CDR (2003), descendants' first draw of productivity is assumed to be correlated with the realization of efficiency labor units that their deceased parents faced during the last working period. I adopt the same approach to compute the transition of earnings ability between parents and their offspring as in CDR (2003). This transition captures the life-cycle profile of earnings as well as the intergenerational transmission of earnings ability. These two goals can be modeled very parsimoniously using two additional parameters, ϕ_1 and ϕ_2. ϕ_1 governs the intergenerational persistence of earnings, and ϕ_2 captures the life-cycle profile of earnings.[14] These two parameters are calibrated by targeting two moments: the ratio of average earnings of senior workers (i.e., workers between 41 and 60 years old) to those of new junior workers (i.e., workers between 21 and 40 years old), 1.303, and the cross-sectional correlation between average lifetime earnings of one generation of households and that of the subsequent generation, 0.4.

[14]The formula that I use to compute the transition of earnings ability between parents and their offspring from ϕ_1 and ϕ_2 can be found in Appendix B. I borrow it directly from CDR (2003). The interested reader may be referred to the more detailed description by CDR (2003).

4.1.3 Returns to Capital and Technology

The aggregate return component $\underline{r}$ is calibrated so that the aggregate capital income $r_t K_t$ is equal to the aggregate individual capital income. The $i.i.d$ idiosyncratic shock η is drawn from a standard normal distribution in each period. For the mean excess returns $r^X(k)$ and return dispersions $\sigma^X(k)$, I resort to the estimates by Hubmer et al. (2021). Therefore, in my calibration, both $r^X(\cdot)$ and $\sigma^X(\cdot)$ are treated as exogenous objects which are taken from data.

The production function is of the Cobb-Douglas form: $F(K, L) = K^\theta L^{1-\theta}$. The capital share parameter θ is set to the conventional value of 0.36 (Cooley and Prescott, 1995). The discount rate δ is set to be 0.06 (Stokey and Rebelo, 1995).

4.1.4 Government Policy

The stochastic part of capital income, $\tilde{y}$, is subject to the capital gains tax, which is described by the function

$$\tau_k(\tilde{y}) = a_0 \tilde{y}$$

In the US economy, the capital gains tax schedule is progressive, though much less so than the one on ordinary income. In order to simplify the model economy, following Hubmer et al. (2021), I consider a flat tax with tax rate $a_0 = 0.147$, which is the average effective capital gains tax rate in the year 2004 reported in U.S. Department of the Treasury (2016).

Household's ordinary gross income y, defined as the sum of labor income and the deterministic part of capital income, is subject to a progressive income tax. Household income taxes are described by the function

$$\tau_y(y) = a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}]$$

Since a_1 and a_2 are unit-independent, I use the values reported by Gouveia and Strauss (1994) for these parameters, namely, $a_1 = 0.258$ and $a_2 = 0.768$. The last parameter in income tax function, a_3, is calibrated so that the average effective federal income tax rate is 0.11, which is defined as total income tax raised divided by total taxable income (IRS, 2000-2004).

Estate taxation is another source of income for government. Estates larger than a given value $\underline{z}$ are taxed at rate a_4 on the amount in excess of $\underline{z}$. I choose the tax parameters $\underline{z}$ and a_4 to match the fraction of estates that pay estate taxes (2.0%, Gale et al. 2001, Gale and Slemrod 2001) and the fraction of estate tax revenue to output (0.33%, Gale et al. 2001, Gale and Slemrod 2001).

The lump-sum transfer $\overline{\tau}$ from the government to retirees is calibrated so that transfers to output ratio is 5.1%, which is computed as the share of GDP accounted for by Medicare and two-thirds of Social Security transfers using data reported by Congressional Budget Office, 2000-2004. Social Security transfers in the U.S. are progressive. However, only a lump-sum transfer is considered in my model. Therefore, I take two-thirds of Social Security transfers as the lump-sum components.

4.2 Goodness of Fit

After having calibrated and solved the benchmark model, this section gives a brief summary of the model fit. Table 5 summarizes the relevant macroeconomic ratios. Overall the model hits its calibration targets well, especially the fraction of estates who pay tax and the share of estate tax revenue in output.

I calibrate the process for efficiency labor units targeting several moments from the earnings and wealth distributions. Tables 6 and 7 present the earnings and wealth distribution generated by the model as well as their empirical counterparts from 2004 SCF data. The earnings and wealth distributions in the benchmark economy are very close to the targeted empirical distributions. As this model is developed to discuss the effects of tax policies that depend crucially on wealth inequality, the benchmark model must hit the upper tail of wealth distribution. The model successfully replicates the top end of wealth distribution, where it deviates from the data by only 0.4 percentage points.

One contribution of this paper is that it enriches a standard CDR framework to account for the new evidence on inheritance received by the rich. Table 8 presents the distribution of transferred wealth received by households. Inheritances are less unequally distributed in the model economy than in the data. Nevertheless, since this model aims to quantify the role of wealth transfers in wealth accumulation of households in the top wealth groups, it is more important to hit the targets of the inheritance-to-wealth ratio of the rich. As shown in Table 9, the model successfully generates some rich households who do not rely on inheritances to accumulate their wealth.

As the entire wealth top percentile group is subject to estate tax, it is important to make sure it is well represented in the model before running policy experiments within the calibrated framework. Therefore, it is helpful to check for a few non-targeted moments, for instance, wealth mobility of the richest one percent. To give a sense of realistic wealth mobility, I use the transition probabilities provided by Bach et al. (2020) as a comparison. Using an administrative panel containing the full balance sheet of every Swedish resident between 2000 and 2007, Bach et al. (2020) calculate the transition probabilities between a household's net wealth rank in 2000 and the net wealth rank in 2007, conditional on the survival of the household. The first row in Table 10 presents the transition probabilities of the richest one percent provided by Bach et al. (2020). The second row reports the wealth mobility in the model economy, which is very close to its empirical counterparts. Note that I have not targeted any of these statistics in my calibration exercise. Hence, I interpret my mobility results as an additional success of the model.

5 Policy Implications

In this section, I study the effects of changing the estate tax rate. Due to the tax exemption, most households do not need to pay the estate tax, while the entire wealth top percentile group is subject to the tax. However, on the other hand, the top one percent happens to be those who have the most savings and hold a large fraction of total wealth. As a result, changing the estate tax rate will hit them directly, affect their behavior, and thus potentially generate effects on the aggregate economy and wealth inequality.

In the benchmark model, the calibrated estate tax rate is 0.39, consistent with the estimates of the effective estate tax rate provided by other papers (e.g., 0.35 in Luo, 2015). In the policy experiments, I vary the tax rate from 0 to 1 while keeping the tax exemption fixed at its calibrated level. The government expenditure is fixed at the benchmark economy level. The additional tax revenue is redistributed by paying a lump-sum transfer, T, to all households to re-establish the government budget balance. A negative lump-sum transfer is equivalent to collecting a lump-sum tax to compensate for the decrease in tax revenue. All policy experiments are conducted in general equilibrium, and thus prices change correspondingly. Households' rates of return include two parts: the aggregate return component $\underline{r}$ and the excess return schedule. The aggregate return component is the same across all households. It is interpreted as the return on risk-free assets. As discussed by Hubmer et al. (2021), the excess return schedule is heterogeneous across households because different wealth groups have different asset portfolios. The level of the excess return schedule is irrelevant, as the aggregate return component $\underline{r}$ adjusts for market clearing. Therefore, when changing the tax rate, I find a new aggregate return component $\underline{r}$ to clear the capital market while keeping the excess return schedule fixed as in the benchmark model economy. My policy experiments focus only on the steady-state comparison.

5.1 Equity Versus Efficiency Trade-off

Figure 4 reports the effects on aggregate variables when varying the estate tax rate from 0 to 1. The upper left panel in Figure 4 is the lump-sum transfer used to balance the government budget when changing the tax rate. It has a Laffer curve feature. The government needs to collect a lump-sum tax from households to compensate for its revenue loss when abolishing the estate tax. This lump-sum tax decreases as the tax rate increases because the estate tax revenue loss is getting smaller. When the tax rate is above 0.39, the government has extra revenue from estate taxation and thus gives households a lump-sum transfer. However, wealthy households have less incentive to save when the tax rate is too high, which drives down the government's income tax revenue. Therefore, the government, again, needs to collect a lump-sum tax from households to balance its budget. In terms of magnitude, the lump-sum transfer is between -0.007 and 0.002. 0.002 is 0.05% of the average annual labor income in the benchmark model economy, which is about 20 dollars per year. The small lump-sum transfer is due to the fact that the estate tax provides only less than one percent of the government income (0.33% of GDP). A change in the estate tax rate does not generate a significant unbalanced government budget.

Abolishing the estate tax increases the return to leaving a bequest for the rich. In addition, in the aggregate, the increased savings of the rich are large enough to counterbalance the decreased savings of everyone else due to the lower interest rate. Therefore, when the estate tax is abolished, the aggregate capital stock (K) goes up by 1.99%, driving up the aggregate output by 0.75%. Increasing the tax rate on estate impacts rich households the most. They start saving less. This change in their saving behavior drives down the aggregate capital. In the extreme case of a confiscatory tax rate, aggregate capital decreases by 2.32%. Accordingly, aggregate output drops by 0.81%.

Figure 5 presents the effects of estate taxation reforms on measures of wealth inequality. It plots the Gini coefficient and the share of wealth held by the richest one percent when taking the estate tax rate from 0 to 1. The share of wealth held by the top one percent is monotonically decreasing in tax rates. The richest one percent holds 33.6% of the total wealth in the benchmark economy. Eliminating the estate tax would increase the share of total wealth in the top percentile to 35.1%. When the tax rate increases to 1, the share of wealth held by the richest one percent drops to 30.1%.

Putting together the aggregate and distributional effects of changing estate tax rates, I find that repealing the estate tax increases aggregate output and capital but also increases wealth inequality, while increasing the estate tax rate has the opposite effect. This finding is consistent with the commonly accepted view about the estate tax – there exists an equity versus efficiency trade-off. Tax rate being 1 is the most equitable case we could get via estate taxation reform, where the share of wealth held by the top one percent is 30.1%. On the other hand, it comes with a cost of a 2.3% reduction in total capital and a 0.8% reduction in GDP.

5.2 Welfare Effects

Starting from the calibrated steady state of the benchmark economy, I change the estate tax rate from 0 to 1, and then calculate the welfare using consumption equivalent variation (CEV). Following McGrattan (1994), the CEV is defined as the percentage by which every household's initial steady-state per-period consumption would have to be permanently increased to be indifferent between the initial and the new steady state, keeping everything else constant. Positive values of CEV indicate that the average welfare is higher in the new steady state, and households would not be willing to stay in the benchmark steady state unless they were compensated by more consumption.

Figure 6 shows the CEV for estate tax rates between 0 and 1. The CEV when the estate tax is abolished is -0.53%, whereas the CEV when the estate tax rate is raised to 1 is 0.60%. The estate tax rate that maximizes welfare is 0.94, at which the average welfare gain is 0.73%. Increasing the estate tax rate to its welfare-maximizing level decreases the total capital, labor supply, and output. Two important channels shape this response: the direct effects of the tax increase on the incentives to work and save, and the indirect effects through adjustments in general equilibrium prices. Table 11 presents the changes in aggregate variables when the estate tax rate is set at its welfare-maximizing level for the general equilibrium case and the partial equilibrium case.

The first row in Table 11 shows the changes in the aggregate variables when the tax rate is increased to 0.94, but prices stay at their benchmark level. The second row is for the general equilibrium case where prices adjust to clear capital and labor markets. When the tax rate is 0.94, wealthy households bear a high cost of leaving bequests. In the partial equilibrium case, the rich are purely affected by the high tax rate since there is no price adjustment. As a result, the rich, especially the wealthy old, save less, driving down the aggregate capital stock. Since labor supply is decreasing in wealth in this model, a lower saving rate of the rich makes them poorer and thus supply more labor. Moreover, in the partial equilibrium case, poor households also increase their labor supply, to compensate for the loss from the lump-sum tax. Because the poor households are those who have low working productivity, the increase in efficient labor units, L, is lower than that in working hours, N.

In the general equilibrium case, prices start to adjust (i.e., higher interest rates, lower wages). Higher interest rates have mitigating effects on the drop in capital. The poor, who account for a larger share of the economy, supply less labor due to the lower wage. Therefore, the extra working time supplied by the wealthy cannot compensate for the reduction in the total working time of the poor, leading to a 0.04% drop in aggregate labor. However, because the rich usually have higher productivity, the drop in the efficient labor units is much smaller, only 0.007%.

Underlying these aggregate movements are the reactions of households in the economy in response to the tax increase and the ensuing change in general equilibrium prices. The above discussion also indicates that households' reactions differ by productivity and wealth holding, leading to a large degree of heterogeneity in welfare gains. Figure 7 displays welfare gains and losses for each demographic and productivity group when the estate tax rate is set at the welfare-maximizing level, 0.94. Each demographic state has three phases. There are four productivity states in the benchmark economy. s_4 is the highest productivity state, which is almost 100 times as high as s_3. Once a household gets s_4, it becomes the richest one percent in the model economy and is subject to the estate tax. In general, households with the highest labor state (i.e., s_4) are worse off when the estate tax rate is high. However, as the wealthy households take only a small fraction of the economy, the welfare gain from the majority of the economy outweighs the welfare loss of the rich.

When the estate tax rate is at the welfare-maximizing level, 0.94, interest rates increase, and wages decrease compared to the benchmark steady state. Moreover, to balance the government budget, every household pays a lump-sum tax. Most of the households have a welfare gain in this case. The upper panel of Figure 7 shows the CEV for young households. Generally, they are better off due to the high estate tax rate. It is worth noting that young households in the first phase with the lowest productivity s_1

suffer from a small welfare loss, because most of these young households are newcomers to the model economy. As they just came into the economy, they have not accumulated enough wealth to take advantage of the high interest rate that can compensate for their loss from a lower wage and a lump-sum tax. Moreover, for the young households with low productivity, their CEV is higher in later phases, because the earlier phase they are in, the longer they will suffer from low wages and lump-sum taxes. Besides, young households in later phases have accumulated some wealth to benefit from the higher interest rate. Households with the top labor state are the top wealth holders in the model economy. Therefore, they will be hit by the high estate tax rate, leading to a welfare loss.

The bottom panel of Figure 7 shows the CEV for old households. Even though the productivity of all the old households is zero, I keep track of their productivity in their last working period. Therefore, the s_1 old household in Figure 7 means the last productivity realization of this household is s_1. Since old households do not supply labor, they are unaffected by the change in wage. All the s_1, s_2, and s_3 old households are better off due to the high interest rate. On the other hand, the s_4 households suffer from a large welfare loss because they are the ones who need to pay the tax when they die. Wealthy old households in phase 3 have the most negative CEV, because they will soon be affected by the high estate tax rate. One thing worth mentioning is that in the steady state with a high estate tax rate, the positive CEV is small in magnitude, which is around 1%, whereas the negative CEV of wealthy households could be as high as 30%. Nevertheless, since only very few households are the top wealth holders, the aggregate welfare reaches the maximized level when the tax rate is 0.94.

5.3 Comparison with Income Taxation

The above discussion shows the equity-efficiency trade-off as well as the welfare effect of the estate tax. To give a better idea about the performance of estate taxation as a policy tool to reduce wealth inequality, this section sets out to investigate if there exists a more effective method of redistributing wealth than the estate tax.

Given this goal, in this section, I adjust the top marginal income tax rate to a level that can generate a similar wealth share of the top one percent as when we fully tax estates. Then I quantify the effect of the change in income tax and compare it with that of having the estate tax rate be 1. To be clear about my claims from the outset, the goal of this section is not to find the most effective tax with the most attractive equity-efficiency trade-off. Rather, the objective is to show that compared with other major tax reforms, for example, the progressive income tax, estate taxation is a less effective method for wealth redistribution. The same amount of equity can be obtained with a lower output loss and a higher welfare gain using tax policies other than the estate tax.

The progressive income tax system is given by $\tau_y(y) = a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}]$. y is the pre-tax ordinary gross income, and (a_1, a_2, a_3) are parameters. In the policy experiment, I change the tax code to

$$\tau_y(y) = \begin{cases} a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}] & \text{if } y < y_H \\ a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}] + \tilde{a}(y - y_H) & \text{if } y \geq y_H \end{cases} \tag{13}$$

where y_H is the cutoff value for top 1% income. Hence, the marginal tax rate for top incomes is

$$\tau_y'(y) = \frac{\partial \tau_y(y)}{\partial y} = a_1(1 - (1 + a_3 y^{a_2})^{-1/a_2 - 1}) + \tilde{a} \tag{14}$$

I fix (a_1, a_2, a_3) at their benchmark level and find the value of $\tilde{a}$ that generates the same amount of wealth inequality as in the case of a confiscatory estate tax rate. A lump-sum transfer is used to re-establish the government budget.

When $\tilde{a}$ is set to 0.285, the share of wealth owned by the top one percent drops to 30.1%, the same reduction in wealth concentration as when we fully tax estates. However, as presented in Table 12, the effects on the aggregate economy from the two tax policy changes are quite different. When the estate tax rate is 1, the wealthy old households are hit the most. Therefore, the reduction in total capital mainly comes from the old households. The young, on the other hand, experience only a mild tax effect, leading to a limited increase in efficient labor supply, L. A 2.32% decrease in capital together with a mild increase in efficient labor units leads to a 0.81% reduction in total output. The welfare gain associated with the high estate tax rate is also limited, 0.6%, with the same mechanism as discussed in the previous section.

In the case of increasing the top marginal income tax rate, both the wealthy young and old are affected. They lower their savings, resulting in a more significant reduction in aggregate capital. Even though all other young households start to work less due to the low wage, the most productive young (i.e., workers with s_4) increase their labor supply. Hence, the resulting efficient labor units L experience a 2.08% increase in spite of the decreased total working time N. Moreover, the high efficient labor supply mitigates the reduction in capital, leading to a small decrease in total output. From the perspective of welfare, a higher top marginal income tax rate generates extra government tax revenue, which will be redistributed in the form of a lump-sum transfer. Households get an annual transfer of 3500 dollars ($T = 0.175$), which improves their welfare significantly.

From Table 12, it is clear that for similar distributional effects, the estate tax has a higher cost in output and a lower welfare gain, compared with the income tax. In that sense, the estate tax is not an effective way of redistributing wealth. That is to say, even though it targets the wealthy directly, the estate tax is a less effective method for wealth redistribution than other major tax policies, for example, the progressive income tax.

6 Conclusion

Tax changes for estates are now being debated. Households who pay this tax are also those that hold a large share of total wealth. Thus, any changes in their behavior may generate effects on the aggregate economy. To understand the impact of such changes and quantify the equity versus efficiency trade-off, it is important to understand how many of these rich households are affected and how strongly they are affected. This paper presents a model that can generate wealth concentration at the top. Moreover, the role of intergenerational wealth transfers in wealth accumulation for the rich in this model is disciplined by the new empirical findings from the data. Thus this model is a good laboratory to study the effects of estate taxation.

There are two key findings in this paper. First, from the empirical perspective, this paper documents that even though intergenerational wealth transfers are concentrated in wealthy households, transfers are not the key factor for the rich to accumulate their fortune. For the richest one percent in the U.S. economy, inheritances account for only 14% of their net worth. Second, from the policy perspective, several policy experiments are conducted within the calibrated model framework. As we expected, the estate tax rate trades off equity and efficiency. When we fully tax the estate, the share of wealth held by the top one percent has a 3.5 percentage-point drop. But it comes at the expense of an 0.8% decrease in GDP. Changing the income tax can generate similar distributional effects with a lower cost and a higher welfare gain. This result suggests that not only from the perspective of equity-efficiency trade-off but also from the welfare aspect, the estate tax is not an effective policy device to reduce wealth inequality.

7 References

Bach, Laurent, Laurent E. Calvet, and Paolo Sodini, "Rich Pickings? Risk, Return, and Skill in Household Wealth", *American Economic Review*, 2020, 110(9): 2703-2747

Benhabib, Jess, Alberto Bisin, and Mi Luo, "Wealth Distribution and Social Mobility: A Quantitative Analysis of U.S Data", *American Economic Review*, 2019, 109(5): 1623-1647

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu, "The Distribution of Wealth and Fiscal Policy in Economies with Finitely Lived Agents", *Econometrica*, 2011, 79(1): 123-157

Brown, Jeffrey, and Scott Weisbenner, "Intergenerational Transfers and Savings Behavior", NBER chapeters, in *Perspectives on the Economics of Aging*, 2004, 181-204, National Bureau of Economic Research, Inc.

Cagetti, Marco, and Mariacristina De Nardi, "Wealth Inequality: Data and Models", *Macroeconomic Dynamics*, 2008, 12: 285-313

Cagetti, Marco, and Mariacristina De Nardi, "Estate Taxation, Entrepreneurship, and Wealth", *American Economic Review*, 2009, 99(1): 85-111

Castaneda, Ana, Javier Diaz-Gimenez, and Jose-Victor Rios-Rull, "Accounting for the U.S. Earnings and Wealth Inequality", *Journal of Political Economy*, 2003, 111(4): 818-857

Conesa, Juan Carlos, and Dirk Krueger, "On the Optimal Progressivity of the Income Tax Code", *Journal of Monetary Economics*, 2006, 53(7): 1425-1450

Conesa, Juan Carlos, Sagiri Kitao, and Dirk Krueger, "Taxing Capital? Not a Bad Idea After All!", *American Economic Review*, 2009, 99(1): 25-48

Cooley, Thomas F., and Edward C. Prescott, "Economic Growth and Business Cycles", *Frontiers of Business Cycle Research*, 1995, 1-38

Davies, James, and Anthony F. Shorrocks, "The Distribution of Wealth", In *Handbook of Income Distribution*, 2000, 1: 605-675 from Elsevier

De Nardi, Mariacristina, "Wealth Inequality and Intergenerational Links", *Review of Economic Studies*, 2004, 7: 743-768

De Nardi, Mariacristina, and Fang Yang, "Wealth Inequality, Family Background, and Estate Taxation", *Journal of Monetary Economics*, 2016, 77(C): 130-145

De Nicola, Francesca, and Xavier Gine, "How Accurate Are Recall Data? Evidence from Coastal India", *Journal of Development Economics*, 2014, 106: 52-65

Diaz-Gimenez, Javier, and Josep Pijoan-Mas, "Investment Expensing and Progressivity in Flat Tax Reforms", *SERIEs*, 2019, 10(3): 365-399

Dynan, Karen E., Jonathan Skinner, and Stephen P. Zeldes, "The Importance of Bequests and Life-Cycle Saving in Capital Accumulation: A New Answer", *American Economic Review*, 2002, 92(2): 274-278

Elinder, Mikael, Oscar Erixson, and Daniel Waldenstrom, "Inheritance and Wealth Inequality: Evidence from Population Registers", *Journal of Public Economics*, 2018, 165: 17-30

Fagereng, Andreas, Luigi Guiso, Davide Malacrino, and Luigi Pistaferri, "Heterogeneity and Persistence in Return to Wealth", *Econometrica*, 2020, 88(1): 115-170

Farhi, Emmanuel, and Ivan Werning, "Progressive Estate Taxation", *The Quarterly Journal of Economics*, 2010, 125(2): 635-673

Farhi, Emmanuel, and Ivan Werning, "Estate Taxation with Altruism Heterogeneity", *American Economic Review Papers and Proceedings*, 2013, 103(3): 489-495

Feiveson, Laura, and John Sabelhaus, "How Does Intergenerational Wealth Transmission Affect Wealth Concentration?," *FEDS Notes. Washington: Board of Governors of the Federal Reserve System*, 2018

Gale, William G., and John Karl Scholz, "Intergenerational Wealth Transfers and the Accumulation of Wealth", *Journal of Economic Perspectives*, 1994, 8(4): 145-160.

Gale, William G., Jr. James R. Hines, and Joel Slemrod, "Rethinking the Estate and Gift Tax", *Brookings Institution Press, Washington DC*, 2001

Gale, William G., and Joel Slemrod, "Rethinking the Estate and Gift Tax: Overview", *NBER Working Paper*, 2001

Gouveia, Miguel, and Robert Strauss, "Effective Federal Individual Tax Functions: An Exploratory Empirical Analysis", *National Tax Journal*, 1994, 47(2):

317-339

Guvenen, Fatih, "An Empirical Investigation of Labor Income Processes", *Review of Economic Dynamics*, 2009, 12(1): 58-79

Guvenen, Fatih, Greg Kaplan, Jae Song, and Justin Weidner, "Lifetime Earnings in the United States over Six Decades", *BFI Working Paper*, 2021

Heer, Burkhard, and Mark Trede, "Efficiency and Distribution Effects of a Revenue-Neutral Income Tax Reform", *Journal of Macroeconomics*, 2003, 25(1): 87-107

Hubmer, Joachim, Per Krusell, and Tony Smith, "Sources of U.S. Wealth Inequality: Past, Present, and Future", *NBER Macroeconomics Annual*, 2021, 35: 391-455

Hurd, Michael D., and B. Gabriela Mundaca, "The Importance of Gifts and Inheritances Among the Affluent", in R. E. Lipsey and H. S. Tice (eds.) *The Measurement of Saving, Investment and Wealth*, 1989, 737-758

Kaymak, Baris, and Markus Poschke, "The Evolution of Wealth Inequality over Half a Century: The Role of Taxes, Transfers and Technology", *Journal of Monetary Economics*, 2016, 77: 1-25

Kindermann, Fabian, and Dirk Krueger, "High Marginal Tax Rates on the Top 1%? Lessons from a Life Cycle Model with Idiosyncratic Income Risk", *AEJ: Macroeconomics*, 2022, 14(2): 319-366

Kopczuk, Wojciech, "Bequest and Tax Planning: Evidence from Estate Tax Returns", *The Quarterly Journal of Economics*, 2007, 122(4): 1801-1854

Kopczuk, Wojciech, and Joseph P. Lupton, "To Leave or Not to Leave: The Distribution of Bequest Motives", *Review of Economic Studies*, 2007, 74: 207-235

Korom, Philipp, Mark Lutter, and Jens Beckert, "The Enduring Importance of Family Wealth: Evidence from the Forbes 400, 1982 to 2013", *Social Science Research*, 2017, 65: 75-95

Kotlikoff, Laurence J., and Lawrence H. Summers, "The Role of Intergenerational Transfers in Aggregate Capital Accumulation", *Journal of Political Economy*, 1981, 89: 706-732

Krusell, Per, and Anthony A. Smith, Jr., "Income and Wealth Heterogeneity in the Macroeconomy", *Journal of Political Economy*, 1998, 106(5): 867-896

Kuhn, Moritz, and Jose-Victor Rios-Rull, "2019 Update on the U.S. Earnings, Income, and Wealth Distributional Facts: A View from Macroeconomics", 2020

Luo, Mi, "Unintended Effects of Estate Taxation on Wealth Inequality", *Working Paper*, 2015

McGrattan, Ellen R., "The Macroeconomic Effects of Distortionary Taxation", *Journal of Monetary Economics*, 1994, 33(3): 573-601

McGrattan, Ellen R., and Richard Rogerson, "Changes in Hours Worked, 1950-2000", *Federal Reserve Bank of Minneapolis, Quarterly Review*, 2004, 28(1): 14-33

Modigliani, Franco, "The Role of Intergenerational Transfers and the Accumulation of Wealth", *Journal of Economic Perspectives*, 1988, 2: 15-40

Nishiyama, Shinichi, "Bequests, Inter Vivos Transfers, and Wealth Distribution", *Review of Economic Dynamics*, 2002, 5(4): 892-931

Schmalbeck, Richard, "Avoiding Federal Wealth Transfer Taxes", *Rethinking Estate and Gift Taxation*, Washington, DC: Brookings Institution Press, 2001

Stokey, Nancy L., and Sergio Rebelo, "Growth Effects of Flate-Rate Taxes", *Journal of Political Economy*, 1995, 103(3): 519-550

Wan, Jing, and Shenghao Zhu, "Bequests, Estate Taxes, and Wealth Distributions", *Economic Theory*, 2019, 67: 179-210

Wolff, Edward, "Inheritances and Wealth Inequality, 1989-1998", *American Economic Review*, 2002, 92: 260-264

Wolff, Edward, and Maury Gittleman, "Inheritances and the Distribution of Wealth or Whatever Happened to the Great Inheritance Boom?", *Journal of Economic Inequality*, 2014, 12: 439-468

Appendix A SCF Data

I obtained data for earnings and wealth distributions, as well as intergenerational wealth transmission statistics, from the Survey of Consumer Finances (SCF). The regular SCF cross-sectional surveys are conducted every three years to provide detailed information on the finances of U.S. families. Each survey year consists of a core representative sample. Since the group of interviewees changes in each survey year, I compute the statistics year by year, and then average across years.

Household wealth is defined as the net worth of a household, which is the difference between the current value of all marketable assets and the current value of debts. Assets include both financial assets and nonfinancial assets. Financial assets include liquid assets, certificates of deposit, directly held pooled investment funds, bonds; stocks, quasi-liquid retirement assets, whole life insurance, other managed assets, and other financial assets. Nonfinancial assets include vehicles, houses, businesses, and other nonfinancial assets. Total liabilities are the sum of mortgage debt, and consumer and other debt.

The SCF also provides information on bequests and gifts received by individual households. The information is collected in a retrospective way. Households are asked to record the amount of the transfer they received, the year when they received it, and the type of the transfer (bequest or inter vivos). The survey also asks interviewees if they expect to receive a substantial transfer in the future. To look at how much inheritance a household would receive over a lifetime, I focus on households who are at least 60 years old and report not expecting to receive substantial wealth transfers in the future.

In the main text, I argue that many of the rich received only small transfers. To have a notion of *small*, I compute extra statistics presented in Table 13. Using 2019 SCF, Kuhn and Rios-Rull (2020) document that the average earnings of the whole economy is $\$77,800$. Using the average earnings of the whole economy as a criterion, I find that only 44% of the wealth top percent received transfers greater than it. It implies that more than half of the wealth top percent either inherited nothing, or received an inheritance even smaller than the average earnings of the aggregate economy. Guvenen et al. (2021) estimate the threshold value for the 99^{th} percentile of lifetime earnings distribution to be \$9,335,650. Using the lifetime earnings of the top one percent earners as the approximation for earnings of the wealth top percent, I find that less than 25% of the super-rich inherited more than 10% of the lifetime earnings of a typical top one percent by lifetime earnings. Clearly, a large share of the top one percent by wealth inherited only a reasonably small fraction of their lifetime resources. Using the cutoff of the top one percentile of wealth distribution as a notion for *small*, only 27% of wealth top percent have wealth transfers greater than one-tenth of the cutoff value for the 99^{th} percentile of wealth distribution.

Appendix B Additional Tables

B.1 Labor Efficiency Process

Table 14 presents the transition probabilities of working-age households' labor efficient units.

B.2 Transition of Earning Ability between Old and Young

Let p_{ij} denote the probability of a descendant's first draw of productivity being s_j when the realization of efficiency labor units that their deceased parent faced during the last working period is s_i. $p*$ is the stationary distribution of labor efficiency endowments that can be found in Table 4. Following CDR (2003), p_{ij} is computed in two steps.

Step 1:

$$p_{11} = p_1 * + \phi_1 p_2 * + \phi_1^2 p_3 * + \phi_1^3 p_4 *$$

$$p_{12} = (1 - \phi_1)(p_2 * + \phi_1 p_3 * + \phi_1^2 p_4 *)$$

$$p_{13} = (1 - \phi_1)(p_3 * + \phi_1 p_4 *)$$

$$p_{14} = (1 - \phi_1) p_4 *$$

$$p_{21} = (1 - \phi_1) p_1 *$$

$$p_{22} = \phi_1 p_1 * + p_2 * + \phi_1 p_3 * + \phi_1^2 p_4 *$$

$$p_{23} = (1 - \phi_1)(p_3 * + \phi_1 p_4 *)$$

$$p_{24} = (1 - \phi_1) p_4 *$$

$$p_{31} = (1 - \phi_1) p_1 *$$

$$p_{32} = (1 - \phi_1)(\phi_1 p_1 * + p_2 *)$$

$$p_{33} = \phi_1^2 p_1 * + \phi_1 p_2 * + p_3 * + \phi_1 p_4 *$$

$$p_{34} = (1 - \phi_1) p_4 *$$

$$p_{41} = (1 - \phi_1) p_1 *$$

$$p_{42} = (1 - \phi_1)(\phi_1 p_1 * + p_2 *)$$

$$p_{43} = (1 - \phi_1)(\phi_1^2 p_1 * + \phi_1 p_2 * + p_3 *)$$

$$p_{44} = \phi_1^3 p_1 * + \phi_1^2 p_2 * + \phi_1 p_3 * + p_4 *$$

Step 2: For $i = 1, 2, 3, 4$

$$p_{i1} = p_{i1} + \phi_2 p_{i2} + \phi_2^2 p_{i3} + \phi_2^3 p_{i4}$$

$$p_{i2} = (1 - \phi_2)(p_{i2} + \phi_2 p_{i3} + \phi_2^2 p_{i4})$$

$$p_{i3} = (1 - \phi_2)(p_{i3} + \phi_2 p_{i4})$$

$$p_{i4} = (1 - \phi_2) p_{i4}$$

B.3 Excess Return Schedule

Hubmer et al. (2021) provide estimates for excess return schedule. They calibrate the schedules of mean excess returns $r^X(\cdot)$ and return dispersions $\sigma^X(\cdot)$ based on data from Bach et al. (2020). Hubmer et al. (2021) have a detailed breakdown up to the top 0.01%. I collapse their detailed estimates to get the excess return schedule of the whole top percentile because of jumps in the cumulative distribution of wealth in my model economy that do not allow a clean separation among wealth groups smaller than percentile. Table 15 shows the excess return schedule used in my model.

Appendix C Model Comparison

To place the contribution of this paper in the literature, and to show why it is important to account for inheritance in the model, I will compare the benchmark model and a model that is calibrated only to match earnings and wealth distribution without any empirical evidence on inheritances to discipline the bequest motive. I call the model in the main text as the *benchmark model*, and the model in this section as the *comparison model*.

Without the modifications to match inheritance, the model setup is just the original CDR framework. Hence,

- Households are perfectly altruistic, namely $b = 1$.
- There is no rate of return heterogeneity.
- Income tax system follows the function

$$\tau_y(y) = a_0 y + a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}] \tag{15}$$

  The term of $a_1[y - (y^{-a_2} + a_3)^{(-1/a_2)}]$ is the same as that in the main text. Strictly following CDR (2003), the linear term $a_0 y$ is based on the assumption that government in the model economy uses a proportional income tax to collect all the non-income tax revenues levied by the U.S. government (e.g. tax revenue from property, consumption). a_0 is calibrated so that the balanced government budget constraint holds and the government spending to output ratio is 18.8%.[15] Therefore, in this model economy, government collects income tax and estate tax to finance its expenditure and retirement benefit to the old. There is no capital gains tax.

The Bellman equation of the household decision problem is the following:

$$
\begin{aligned}
V(n,k,s) = \max\ & u(c, \iota - l) + \beta \cdot (1-\Omega) \cdot \mathbb{E}\Big[V(n,k',s')|s\Big] + \beta \cdot \Omega \cdot \mathbb{E}\Big[V(n',k',s')|s\Big] \\
s.t.\quad & a' + c = k + y - \tau(y) \\
& y = rk + wsl + \overline{\tau} \cdot 1_{\{s=0\}} \\
& k' \geq 0 \\
& k' = \begin{cases} a' & \text{if } s > 0 \ \&\ s' > 0 \text{ or } s = 0 \ \&\ s' > 0 \ \&\ k' \leq \underline{z} \\ a' - \tau_b \cdot (a' - \underline{z}) & \text{if } s = 0 \ \&\ s' > 0 \ \&\ a' > \underline{z} \end{cases}
\end{aligned}
\tag{16}
$$

C.1 Calibration

The set of parameters imposed exogenously on the comparison model is the same as that in the benchmark model. Four different realizations of efficiency labor units are chosen in this calibration process, $s \in [s_1, s_2, s_3, s_4]$. Adopting the same approach, I normalize the lowest labor state to be one, i.e. $s_1 = 1$. The labor efficiency process is calibrated such that it generates distributions for wealth and earnings that match their empirical counterparts. Tables 16 and 17 summarize calibration results for labor efficiency process. Table 18 reports parameters that are jointly calibrated in the equilibrium.

The calibration results are presented in Tables 19, 20, and 21. As shown in CDR (2003), this model framework can successfully generate realistically skewed distributions for wealth and earnings.

[15] From the 2005 Economic Report to the President, Table B-79, the average total federal receipts as percent of GDP from 1995 to 2004 is 18.8%. Hence, I use wasteful government spending at 18.8% of GDP as targeted moment.

C.2 Policy Experiment

The comparison model replicates the empirical distributions of earnings and wealth very well. In this section, I conduct the same policy experiment within the comparison model framework as the one I did in the main text: I change the estate tax rate while keeping the exemption level at its calibrated level. Moreover, the additional tax revenue is redistributed by paying a lump-sum transfer to all households (T) to re-establish the government budget balance. The policy experiment is conducted in general equilibrium.

Figure 8 shows the distributional effect and welfare gains when changing the estate tax rate from 0 to 1 in the calibrated comparison framework. In the comparison model economy, a higher estate tax rate would improve equality: the share of wealth held by the richest one percent decreases from 35% to 26% when taking the estate tax rate from 0 to 1. The change is greater than that in the benchmark economy. The welfare-maximizing estate tax rate is 0.8. Notably, the maximized welfare in the comparison model economy is above 2%, which is larger than that in the benchmark model (around 0.7%).

Changes in estate tax policy in the comparison model have larger effects on the overall economy. The difference in the effectiveness of estate taxation reform between the comparison framework and my model is due to the following reason. The benchmark model is calibrated to match earnings distribution, wealth distribution, and empirical findings on inheritances received by the rich. In the benchmark economy, inheritance is not the key mechanism to generate wealth concentration. Only around 20% of the wealth top percenters are born with a silver spoon in their mouths. Moreover, the households have a weak incentive to leave a bequest (the bequest motive parameter is $b = 0.2$). Therefore, changes in estate tax do not affect the wealth holding of the majority of the rich. In the comparison model, the role of inheritances in wealth accumulation is crucial (as discussed in the following section). Since wealth accumulation of the rich in that model relies heavily on inheritances, their behavior will be significantly affected by a change in the estate tax rate.

C.3 Comparison

The benchmark model is calibrated to match earnings and wealth distribution and the empirical evidence on inheritances received by the rich, whereas the comparison model is disciplined only by earnings and wealth distribution. Both of them can generate the highly skewed wealth distribution as observed in the data. However, they have different model implications.

C.3.1 Source of Wealth

Tables 22 and 23 investigate the source of wealth of the richest one percent. There are mainly two ways for a household to accumulate enough wealth to be a wealth top percenter in the comparison model economy: having received large wealth transfers so that they were born as the richest one percent, and having had the highest realization of the labor efficiency unit. In the benchmark model, only around 20% wealth top percenters are born with a silver spoon in their mouths, whereas in the comparison model, more than 40% of the wealthy households rely heavily on inheritance to become rich.

C.3.2 Wealth Mobility

Table 24 reports the share of the richest 1% in each wealth group over eight years. The first row presents transition probabilities of the richest 1% provided by Bach et al. (2020). I calculate wealth mobility of the top one percenters in my benchmark model and the comparison model economy, respectively. The benchmark model mimics wealth mobility observed from data very well, whereas there is less mobility in the comparison model. The difference about wealth mobility between these two models is because inheritance plays a crucial role in wealth accumulation in the comparison model. Households have a strong incentive to leave large inheritances to their offspring. Hence the large fortune is passed through generations, leading to a lower level of wealth mobility.

C.3.3 Fraction of Wealth Accounted for by Inheritances

Table 25 presents the fraction of wealth of the rich that can be directly accounted for by wealth transfers. In the data, around 14% of the wealth of the richest one percent is accounted for by wealth transfers, whereas in the comparison model, this fraction is 70%. Figure 9 shows the number of wealth top percentile households within each inheritance-to-wealth bin, reported as a fraction of total number of wealth top one percent households. The rich households in the comparison model economy rely heavily on inheritance, because half of the wealth top percentile receive inheritance greater than their current wealth. However, in the data, very little wealth is inherited. Moreover, only about 4% of the wealth top percentile households have an inheritance-to-wealth ratio greater than one. These findings suggest that the comparison model overstates the role of inheritance in wealth accumulation for the rich.

Appendix D Welfare

D.1 Consumption Equivalent Variation (CEV)

Following Heer and Trede (2003), aggregate welfare W is defined as the aggregate lifetime utility of all households:

$$\begin{aligned} W &= \int V(x) d\Lambda^*(x) \qquad (17) \\ &= \int \mathbb{E}_0 \Big[\sum_{t=0}^{\infty} \beta_i^t u(c_t, \iota - l_t) \Big] d\Lambda^*(x) \\ &= \int \mathbb{E}_0 \Big[\sum_{t=0}^{\infty} \beta_i^t \big(\frac{(c_t^*)^{1-\sigma_1}}{1-\sigma_1} + \chi \frac{(\iota - l_t^*)^{1-\sigma_2}}{1-\sigma_2} \big) \Big] d\Lambda^*(x) \end{aligned}$$

Policy functions in steady state of the benchmark economy are marked with an asterisk. x is the state vector for a household. Λ^* is the stationary distribution over household types in the benchmark economy.

Welfare in the new steady state is denoted by $\tilde{W}$. The CEV is defined as the percentage (Δ^{CEV}) by which benchmark consumption c^* has to be increased to make a household indifferent between the two steady states. Therefore,

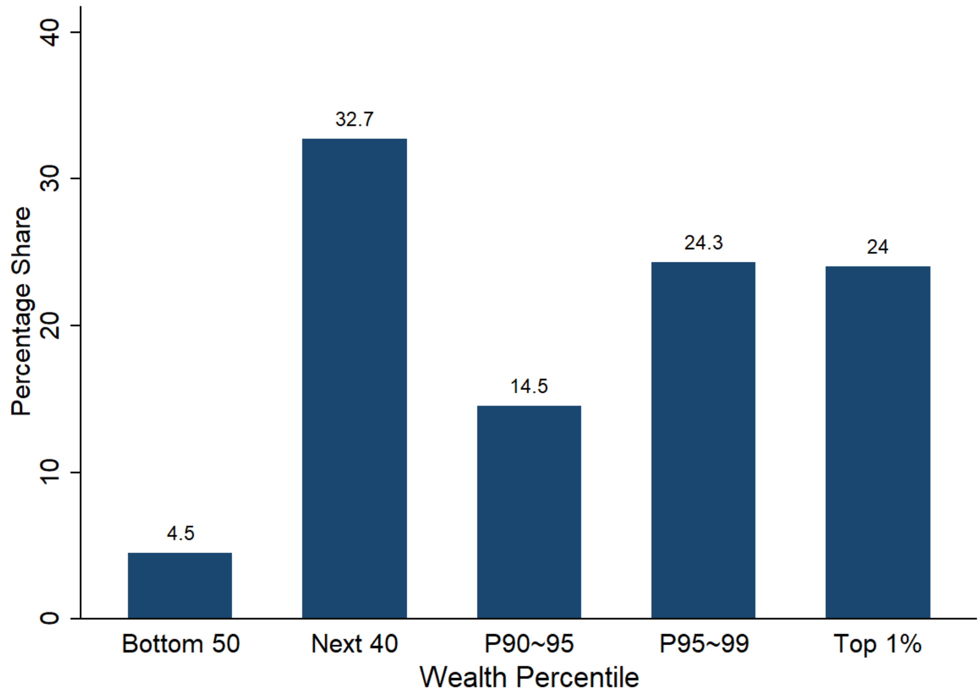
$$\begin{aligned}\tilde{W} &= W(\Delta^{CEV}) \\ &= \int \mathbb{E}_0 \Big[\sum_{t=0}^{\infty} \beta_i^t \big(\frac{((1+\Delta^{CEV})c_t^*)^{1-\sigma_1}}{1-\sigma_1} + \chi \frac{(\iota - l_t^*)^{1-\sigma_2}}{1-\sigma_2} \big) \Big] d\Lambda^*(x)\end{aligned} \tag{18}$$

The expression for the CEV can be obtained by rearranging the equation above.

$$\Delta^{CEV} = \Big[\frac{\tilde{W} - W}{\int \mathbb{E}_0 \Big[\sum_{t=0}^{\infty} \beta_i^t \frac{(c_t^*)^{1-\sigma_1}}{1-\sigma_1} \Big] d\Lambda^*(x)} + 1 \Big]^{\frac{1}{1-\sigma_1}} - 1 \tag{19}$$

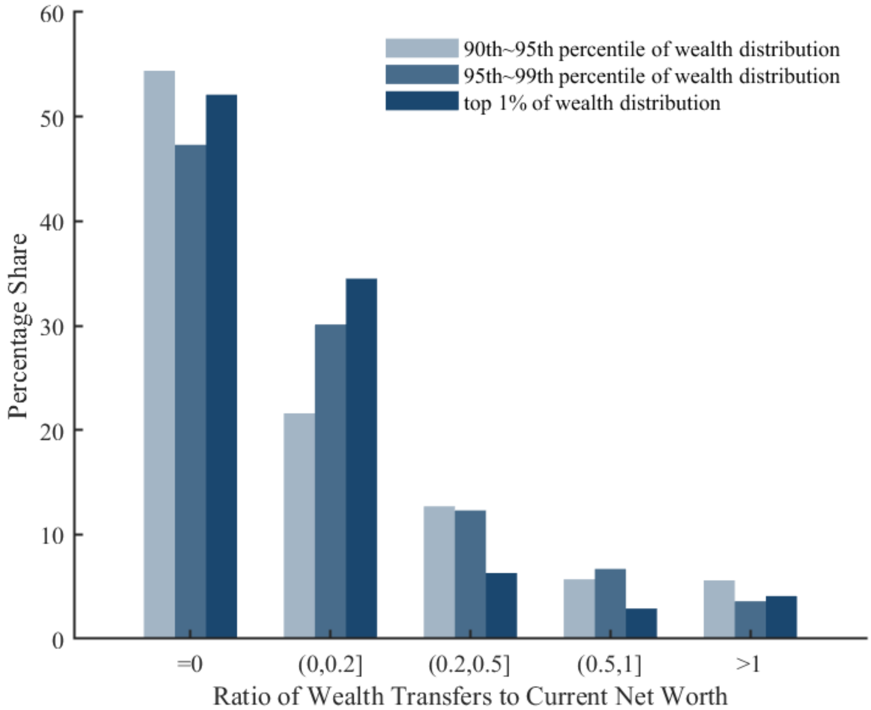
Figures and Tables

Figure 1: Concentration of Intergenerational Transfers Received by Wealth



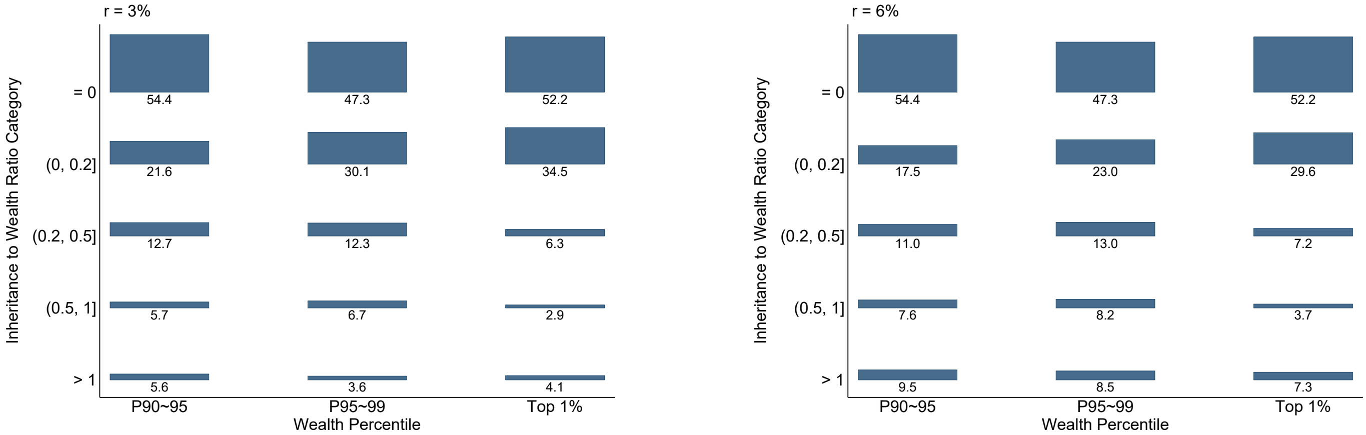
This figure shows the percent of aggregate wealth transfers received by various groups of households defined in terms of percentiles of the wealth distribution. More precisely, I look at households in each wealth group who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future.

Figure 2: Share of Households in Each Inheritance-to-Wealth Ratio Category



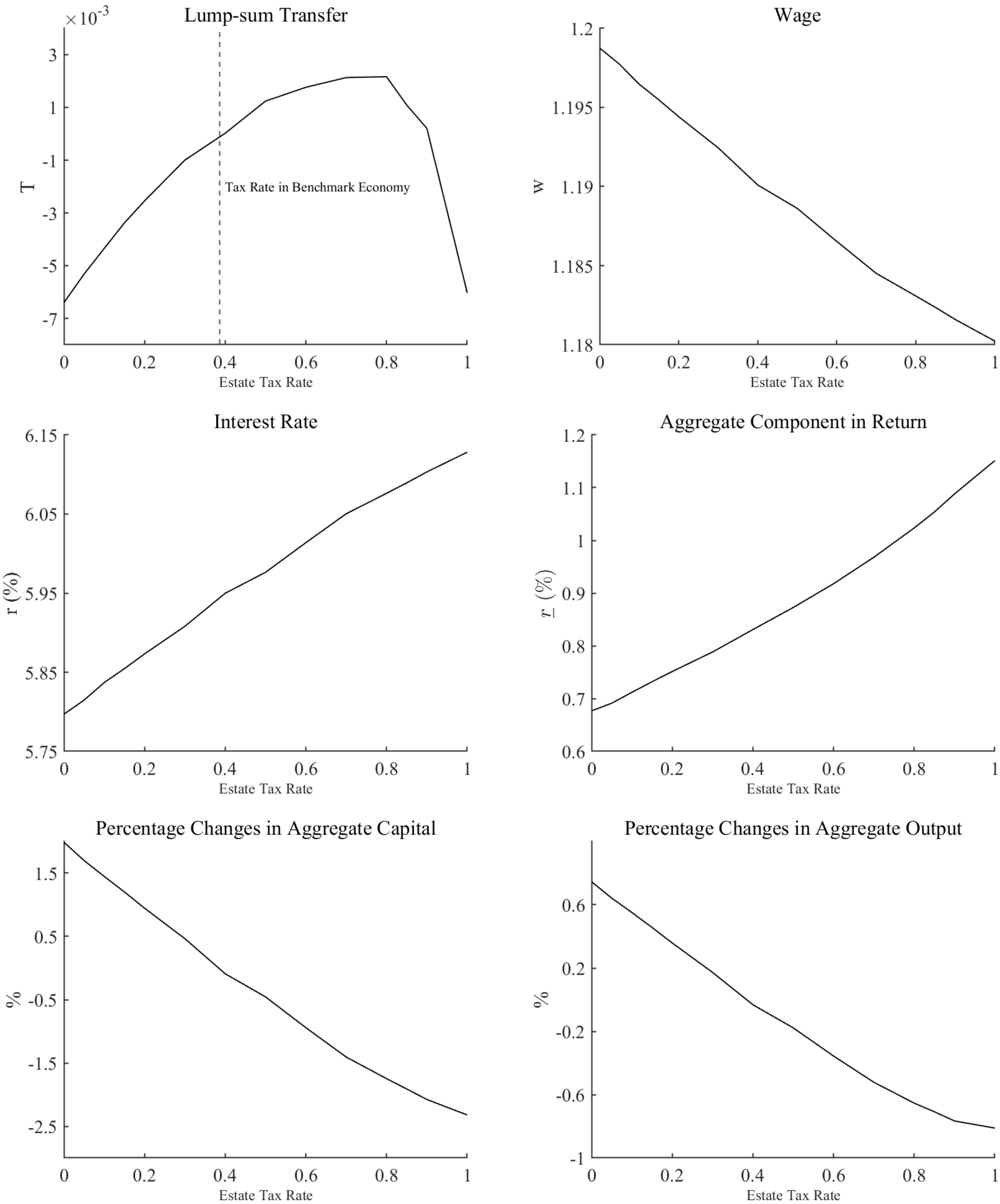
This figure shows the number of households within each inheritance-to-wealth ratio bin, reported as a fraction of the total number of households in different wealth groups. More precisely, there are three subgroups of households within the top decile of wealth distribution: $90 \sim 95$ percentile, $95 \sim 99$ percentile, and the top 1%. In each wealth group, households, who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future, are divided into five categories according to the ratio of wealth transfers they received to their current net worth. The y-axis shows the share of households that belong to each category.

Figure 3: Share of Households in Each Inheritance-to-Wealth Ratio Category



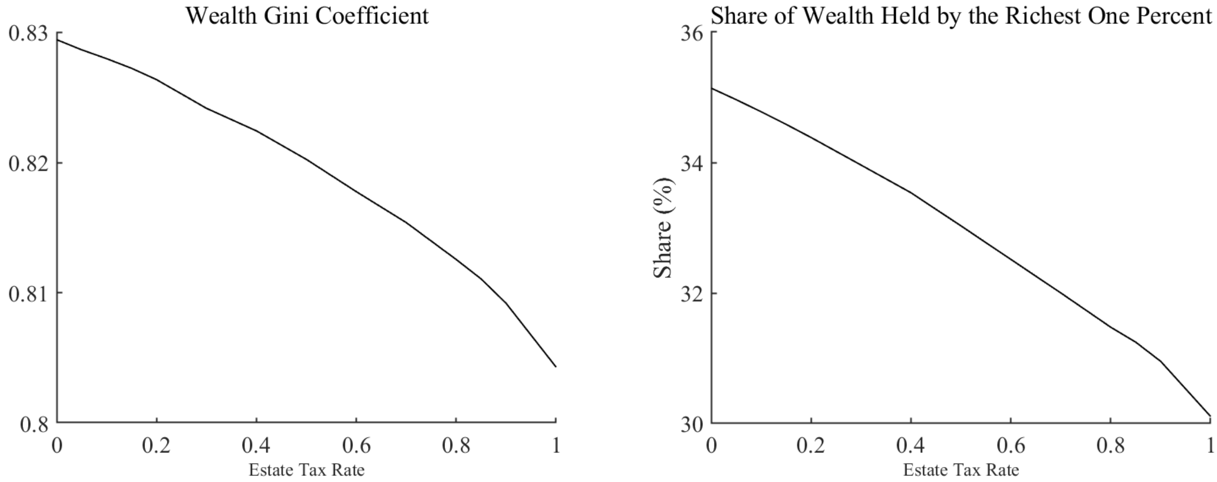
This figure shows the number of households within each inheritance-to-wealth ratio bin, reported as a fraction of total number of households in different wealth groups. The x-axis shows the three subgroups of households within the top decile of wealth distribution: the $90^{th} - 95^{th}$ percentile, the $95^{th} - 99^{th}$ percentile, and the top 1%. Households in each of these three wealth groups are divided into five categories, which are on the y-axis, according to the ratio of wealth transfers they received to their current net worth. For example, the number 52.9 in the third column means 52.9% of households in wealth $90^{th} - 95^{th}$ percentile have inheritance-to-wealth ratio 0. The summation of all numbers in each column should be 100. Present value of inheritance in the figure on the left is computed using a 3% real interest rate. Present value of inheritance in the figure on the right is computed using a 6% real interest rate.

Figure 4: Aggregate Effects of Changing the Estate Tax Rate



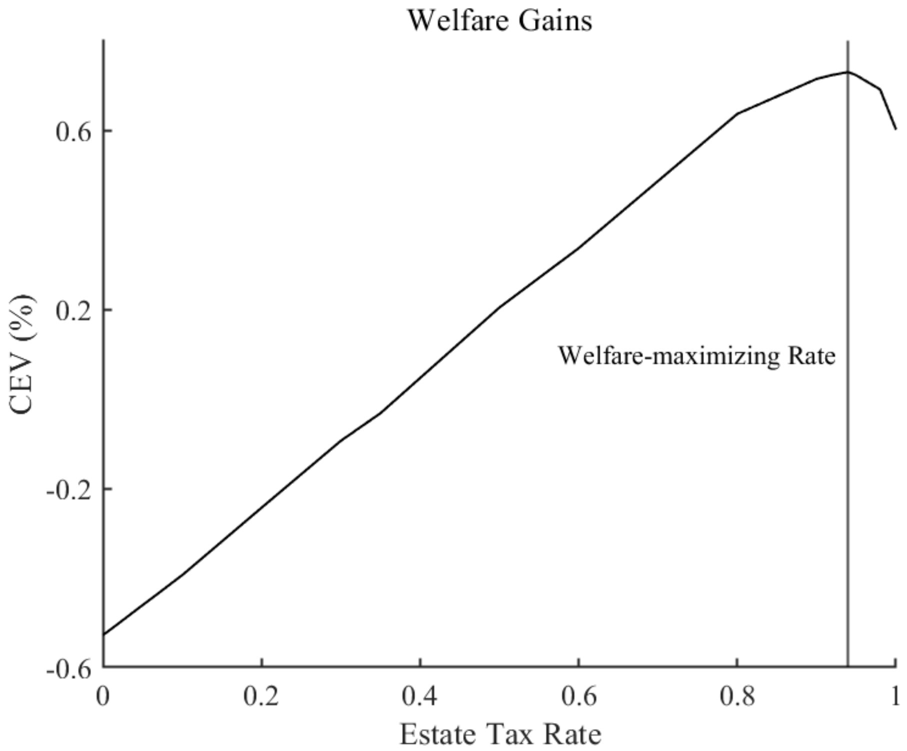
This figure shows the aggregate effects of changing the estate tax rate while keeping the exemption value fixed at its calibrated benchmark level. The upper left panel is the lump-sum transfer used to balance government budget when changing the estate tax. The upper right panel shows the wage rate. The middle left panel presents the average market return on capital at which firms rent capital of production from households. The middle right panel is the aggregate return component, $\underline{r}$, in individual idiosyncratic asset returns schedule. It is calibrated to be 0.83% in the benchmark economy. The mean excess returns $r^X(\cdot)$ and the standard deviation of returns $\sigma^X(\cdot)$ are kept at their original level as in the benchmark economy. The two panels at the bottom are percentage changes in aggregate capital and aggregate output compared with their benchmark economy counterparts.

Figure 5: Distributional Effects of Changing the Estate Tax Rate



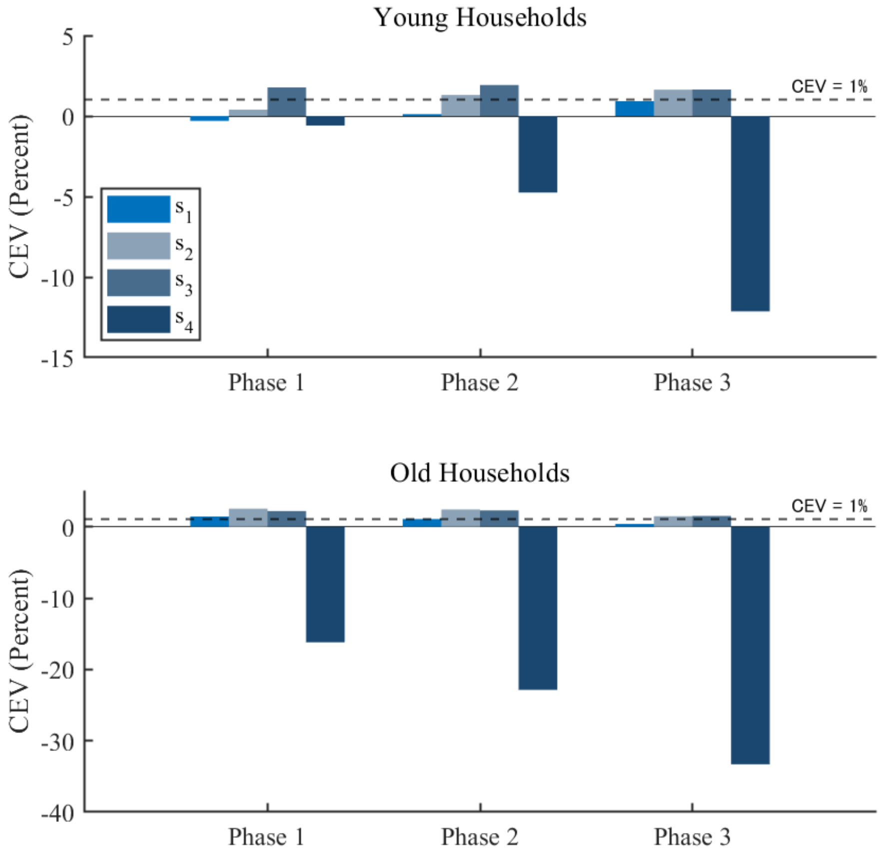
The left panned presents the wealth Gini coefficients when the estate tax rate is changed from 0 to 1. The right panel shows the share of wealth held by the richest one percent. A lump-sum transfer to all households is used to balance the government budget when varying the tax rate.

Figure 6: Welfare Effects of Changing the Estate Tax Rate



Welfare is calculated using consumption equivalent variation (CEV), which is defined as the percentage by which every household's initial steady-state per-period consumption would have to be permanently increased to be indifferent between the initial and the new steady state, keeping everything else constant. Positive values of CEV indicate that a household benefits from the new estate tax rate.

Figure 7: CEV at the Welfare-Maximizing Estate Tax Rate



This figure shows welfare gains and losses for each demographic and productivity group when the estate tax rate is set at the welfare-maximizing level, 0.94. The welfare costs and benefits are expressed in terms of consumption equivalent variation (CEV). There are three phases in each demographic state. In each period, households face a constant probability of entering the next phase. s_1 is the lowest labor productivity state, whereas s_4 is the highest labor state.

Figure 8: Inequality Measure and Welfare Gains of Changing the Estate Tax Rate in the Comparison Framework

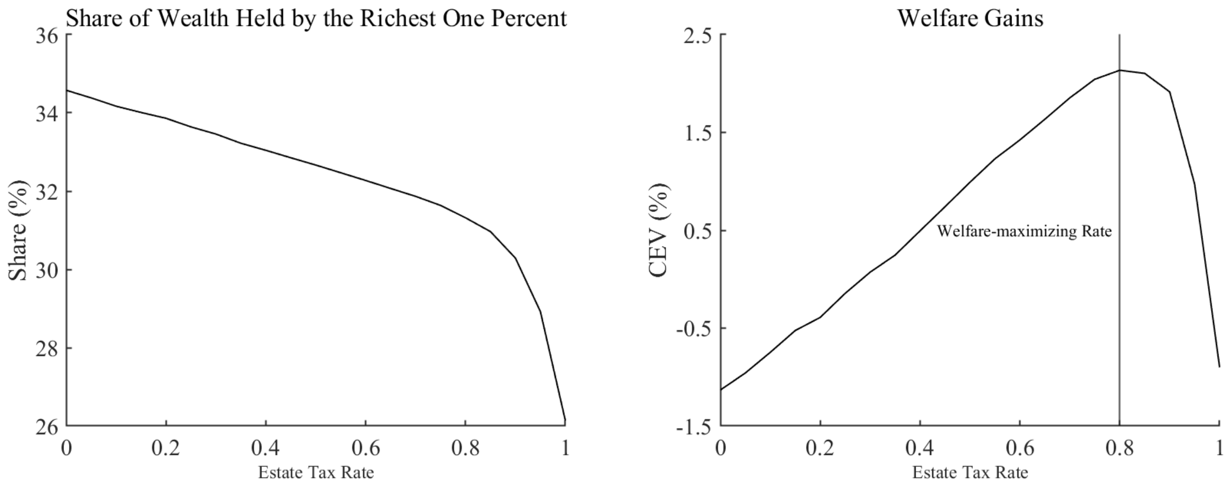
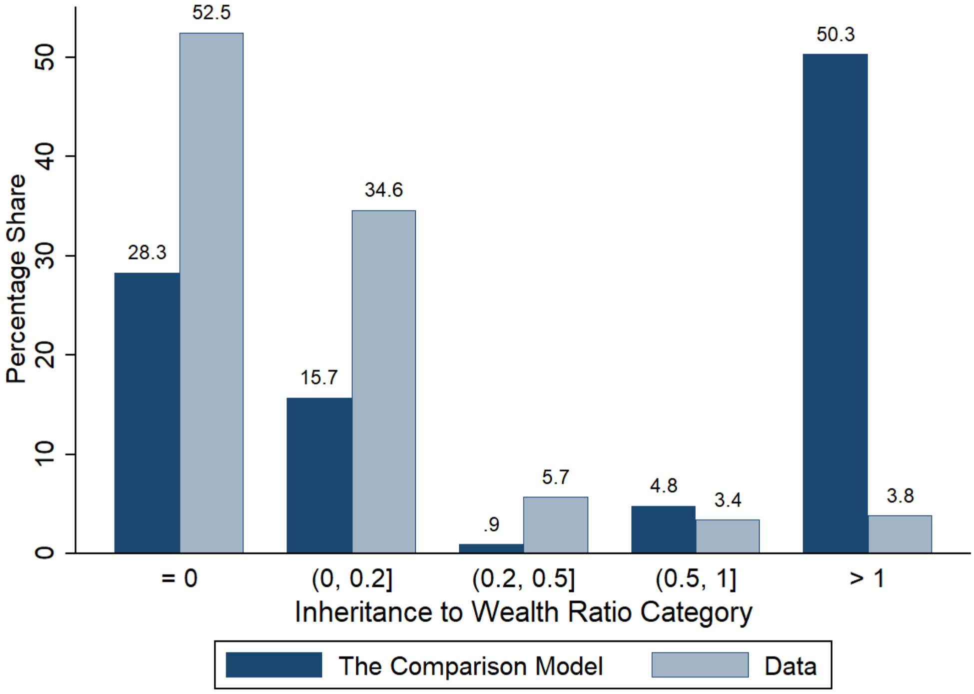


Figure on the left shows the share of wealth held by the richest one percent. Figure on the right shows the welfare which is calculated using consumption equivalent variation (CEV). A lump-sum transfer to all households is used to balance the government budget when the estate tax is changed.

Figure 9: The Ratio of Inheritance to Wealth for the Richest One Percent



This figure shows the number of wealth top percentile households within each inheritance to wealth ratio bin, reported as a fraction of total number of households in different wealth groups. Dark blue bars are the comparison model economy, light blue bars are the data. Households are divided into five categories according to the ratio of wealth transfers they received to their current net worth. The y-axis shows the share of households that belong to each category.

Table 1: Ratio of Wealth Transfers to Current Net Worth

Wealth Top decile	Sub-groups in top decile		
	$90 \sim 95$	$95 \sim 99$	Top 1%
0.18	0.24	0.21	0.14

$1989 \sim 2019$ SCF data.

This table shows the ratio of wealth transfers to the current net worth of households in each top wealth group who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future. Wealth transfers are calculated as the present value using a 3% real interest rate based on both the reported value and the recipient date. Since the value of wealth is in 2019 dollars, correspondingly, the value of inheritance is also converted to 2019 dollars.

Table 2: Parameters Estimated Independently of the Model or Provided by Other Studies

Parameter		Source	Value
Demographics			
N^Y	Phases in working life state	-	3
N^O	Phases in retirement state	-	3
Preferences			
ι	Endowment of disposable time	Aggregate labor is normalized to be 1	3.3
σ_1	Risk aversion	Attanasio et al. (1999)	1.5
σ_2	Frisch labor supply elasticity	Conesa et al. (2009)	2.33
Earning Process			
s_1	Lowest labor state	Normalization	1
Returns to Capital			
$r^X(\cdot)$	Mean excess return	Hubmer et al. (2021)	See Appendix B
$\sigma^X(\cdot)$	Idiosyncratic return dispersion	Hubmer et al. (2021)	See Appendix B
Technology			
θ	Elasticity of the capital stock	Cooley, Prescott (1995)	0.36
δ	Depreciation rate	Stokey, Rebelo (1995)	0.06
Government			
a_0	Flat capital gains tax	U.S. Department of the Treasury	0.147
a_1	Income tax parameter	Gouveia and Strauss (1994)	0.258
a_2	Income tax parameter	Gouveia and Strauss (1994)	0.768

Table 3: Parameters Used to Match Some Features in the Data

	Parameter	Value
Preferences		
Weight of disutility of labor	χ	1.59
Discount factor	β	0.94
Bequest motive parameter	b	0.20
Earning Process		
Labor efficiency	$[s_2, s_3, s_4]$	[2.57, 7.90, 974.14]
Transition probabilities	$[p_{12}, ..., p_{43}]$	See Appendix B
Earnings life-cycle controller	ϕ_1	0.97
Intergenerational earnings persistence controller	ϕ_2	0.53
Returns to Capital		
Aggregate return component	$\underline{r}$	0.83%
Government		
Income tax parameter	a_3	0.20
Estate tax exemption level	$\underline{z}$	45.90
Estate tax rate	a_4	0.39
Lump-sum transfer to retiree	$\overline{\tau}$	0.72

Table 4: Labor Efficiency Endowments and the Stationary Distribution

	s_1	s_2	s_3	s_4
Value	1.00	2.57	7.90	974.14
Stationary Distribution (%)	51.86	37.95	10.10	0.09

Table 5: Values of the Targeted Ratios and Aggregates in the U.S. and in the Model Economies

Target	Source	Data	Model
Average hours worked	McGrattan and Rogerson (2004)	0.3	0.43
Ratio of capital to annual output	BEA	3	3.02
The ratio of average earnings of senior workers to those of new junior workers	CDR (2003)	1.303	1.23
The cross-sectional correlation between average lifetime earnings of father and son	CDR (2003)	0.4	0.25
Aggregate transfers to output ratio	Congressional Budget Office (2000-2004)	5.1%	3.93%
Ratio of estate tax revenues to GDP	Gale et al. (2001)	0.33%	0.30%
Proportion of estates that pay estate taxes	Gale et al. (2001)	2.0%	1.84%
Average effective federal income tax rate	IRS (2000-2004)	0.11	0.14

Table 6: Targeted Moments: Earnings Distribution (%)

		Quintile				Top Groups (Percentile)		
	Gini	$1^{st}+2^{nd}$	3^{rd}	4^{th}	5^{th}	$90-95^{th}$	$95-99^{th}$	$99-100^{th}$
Data	0.62	4.3	12.1	21.7	61.8	12.2	15.7	16.5
Model	0.59	7.2	13.0	20.6	59.3	9.8	17.2	17.0

Table 7: Targeted Moments: Wealth Distribution (%)

		Quintile				Top Groups (Percentile)		
	Gini	$1^{st}+2^{nd}$	3^{rd}	4^{th}	5^{th}	$90-95^{th}$	$95-99^{th}$	$99-100^{th}$
Data	0.81	0.9	4.4	11.8	82.9	12.0	24.1	33.2
Model	0.82	0.3	3.4	11.5	84.8	14.8	22.2	33.6

Table 8: Targeted Moments: Wealth Transfers Distribution (%)

	Bottom 50	Next 40	Top 10
Data	0	10.01	89.99
Model	0	17.52	82.48

Table 9: Targeted Moments: Present Value of Wealth Transfers to Wealth Ratio

	Wealth Top Decile	Sub-groups in Wealth Top Decile		% of Richest 1% with Ratio ≤ 0.2
		$95 \sim 99$	Top 1%	
Data	0.18	0.21	0.14	86.60%
Model	0.20	0.20	0.13	86.75%

Table 10: Untargeted Moments: Wealth Mobility of the Richest 1%

	Wealth Percentiles			
	Bottom 90	$P90-95$	$P95-99$	Top 1%
Bach et al. (2020)	3.1	3.4	30.1	63.3
Model	0	3.9	30.7	65.5

Using an administrative panel containing the full balance sheet of every Swedish resident between 2000 and 2007, Bach et al. (2020) calculate the transition probabilities between a household's net wealth rank in 2000 and the net wealth rank in 2007, conditional on the household being observed at both dates. The first row in the table presents the transition probabilities of the richest one percent provided by Bach et al. (2020). One should read the first row as follows: among households belonging to the top 1% of the wealth distribution in 2000 and still in existence in 2007, 3.1% are in the bottom 90% of the distribution in 2007. The second row presents the transition probabilities of the richest 1% over eight years in my model economy, conditional on the survival of the household.

Table 11: Aggregate Effects When Increasing the Tax Rate to 0.94

	T	K	N	L	Y
Partial Equilibrium	-0.010	-5.50%	$+0.49\%$	$+0.39\%$	-1.78%
General Equilibrium	-0.001	-2.18%	-0.04%	-0.007%	-0.79%

This table presents the lump-sum transfer T and percentage changes of various macro aggregates when increasing the estate tax rate to 0.94. N is the hours worked, and L is the efficient labor units. Thus, L is the working hours multiplied by working productivity.

Table 12: Effects of Changing the Estate Tax Rate vs. Changing the Income Tax Rate

	T	K	N	L	Y	Welfare	Top Wealth Share
Estate Tax Rate = 1	-0.006	-2.32%	$+0.05\%$	$+0.05\%$	-0.81%	0.60%	30.11%
$\tilde{a} = 0.285$	0.175	-5.33%	-3.85%	$+2.08\%$	-0.65%	10.27%	30.11%

This table presents the lump-sum transfer T and percentage changes of various macro aggregates when increasing the estate tax rate to 1 and when having an additional top marginal income tax rate of 28.5%. N is the hours worked, and L is the efficient labor units. Thus, L is the working hours multiplied by working productivity.

Table 13: Fraction of the Richest One Percent

Wealth transfer $>$ average earnings of the whole economy	44%
Wealth transfer $>$ $0.1\times$cutoff for the 99^{th} percentile of lifetime earnings distribution	24%
Wealth transfer $>$ $0.1\times$ wealth top percentile cutoff value	27%

1989 $\sim$ 2019 SCF data

This table shows the percentage share of households in the top one percent of wealth distribution who are at least 60 years old and do not expect to receive a substantial inheritance or transfer of assets in the future and with wealth transfers that satisfy the requirement.

Table 14: Transition Probabilities of Working-age Households' Labor Efficiency Units

	s'_1	s'_2	s'_3	s'_4
s_1	0.971	0.024	0.005	0.000
s_2	0.029	0.965	0.006	0.000
s_3	0.038	0.007	0.953	0.002
s_4	0.106	0.000	0.085	0.809

Table 15: Excess Return Schedule

	Bottom 40	$P40-50$	$P50-60$	$P60-70$	$P70-80$	$P80-90$	$P90-95$	$P95-99$	Top 1%
Mean excess return r^X	0.000	0.011	0.017	0.020	0.022	0.026	0.031	0.036	0.055
Return dispersion σ^X	0.023	0.056	0.081	0.093	0.095	0.095	0.094	0.094	0.167

Table 16: Labor Efficiency Endowments and the Stationary Distribution

	s_1	s_2	s_3	s_4
Value	1.00	3.07	10.15	1033.1
Stationary Distribution (%)	48.07	37.47	14.37	0.09

Table 17: Transition Probabilities of Working-age Households' Labor Efficiency Units

	s_1'	s_2'	s_3'	s_4'
s_1	0.975	0.022	0.003	0.000
s_2	0.025	0.972	0.004	0.000
s_3	0.017	0.002	0.980	0.001
s_4	0.124	0.003	0.088	0.786

Table 18: Parameters Used to Match Some Features in the Data

	Parameter	Value
Preferences		
Weight of disutility of labor	χ	1.99
Discount factor	β	0.93
Earning Process		
Labor efficiency	$[s_2, s_3, s_4]$	[3.07, 10.15, 1033.1]
12 transition probabilities	$[p_{12}, ..., p_{43}]$	See Table 17
Earnings life-cycle controller	ϕ_1	0.96
Intergenerational earnings persistence controller	ϕ_2	0.53
Government		
Income tax parameter	a_0	0.10
Income tax parameter	a_3	0.23
Estate tax exemption level	$\underline{z}$	52.54
Estate tax rate	τ_b	0.29
Lump-sum transfer to retiree	$\overline{\tau}$	0.68
Government expenditure	G	0.89

Table 19: Values of the Targeted Ratios and Aggregates in the U.S. and in the Model Economy

Target	Source	Data	Model
Average hours worked	McGrattan and Rogerson (2004)	0.3	0.40
Ratio of capital to annual output	BEA	3	3.00
The ratio of average earnings of senior workers to those of new junior workers	CDR (2003)	1.303	1.09
The cross-sectional correlation between average lifetime earnings of father and son	CDR (2003)	0.4	0.26
Ratio of government expenditure to GDP	Economic Report to the President (1994-2004)	18.8%	18.63%
Aggregate transfers to output ratio	Congressional Budget Office (2000-2004)	5.1%	3.67%
Ratio of estate tax revenues to GDP	Gale et al. (2001) Gale and Slemrod (2001)	0.33%	0.33%
Proportion of estates that pay estate taxes	Gale et al. (2001) Gale and Slemrod (2001)	2%	2.16%
Average effective federal income tax rate	IRS (2001-2004)	0.11	0.15

Table 20: Targeted Moments: Earnings Distribution

		Quintile (%)				Top Groups (%)		
	Gini	$1^{st} + 2^{nd}$	3^{rd}	4^{th}	5^{th}	$90 \sim 95$	$95 \sim 99$	$99 \sim 100$
Data	0.62	4.3	12.1	21.7	61.8	12.2	15.7	16.5
Model	0.60	6.2	12.1	21.1	60.7	11.9	17.0	15.5

Table 21: Targeted Moments: Wealth Distribution

		Quintile (%)				Top Groups (%)		
	Gini	$1^{st}+2^{nd}$	3^{rd}	4^{th}	5^{th}	$90\sim95$	$95\sim99$	$99\sim100$
Data	0.81	0.9	4.4	11.8	82.9	12.0	24.1	33.2
Model	0.79	0.8	4.7	13.6	80.9	14.2	18.8	33.5

Table 22: Benchmark Model: Source of Wealth

<table>
<tr><td colspan="2" rowspan="2">% of the wealth top percenters</td><td colspan="2">Born in a wealth top percentile household</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td rowspan="2">Have had the highest labor state</td><td>Yes</td><td>2.3</td><td>38.0</td></tr>
<tr><td>No</td><td>18.8</td><td>40.9</td></tr>
</table>

Table 23: Comparison Model: Source of Wealth

% of the wealth top percenters		Born in a wealth top percentile household: Yes	Born in a wealth top percentile household: No
Have had the highest labor state	Yes	2.3	39.7
	No	40.6	17.4

Table 24: Wealth Mobility for the Richest 1% Over Eight Years

	Wealth Percentiles			
	Bottom 90	$P90-95$	$P95-99$	Top 1%
Bach et al. (2020)	3.1	3.4	30.1	63.3
Benchmark model	0	3.9	30.7	65.5
Comparison model	0	0	13.3	86.7

Table 25: Present Value of Wealth Transfers to Wealth Ratio

	Wealth Top Decile	Sub-groups in Top Decile		% of Richest 1% with Ratio ≤ 0.2
		$95 \sim 99$	Top 1%	
Data	0.18	0.21	0.14	86.6
Benchmark model	0.20	0.20	0.13	86.8
Comparison model	0.68	0.56	0.70	50.7