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DISCUSSION PAPER

# ESTATE TAXATION, INHERITED WEALTH AND RISING WEALTH INEQUALITY

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# Estate Taxation, Inherited Wealth and Rising Wealth Inequality*

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**Abstract**

What are the effects of changes in estate taxation on wealth distribution? Has the recent relaxation of estate tax policy contributed to rising wealth inequality in the U.S.? To address these questions, I developed a quantitative general equilibrium life-cycle model that incorporates generation-skipping transfers from grandparents. In the model, where return heterogeneity is the main source of wealth inequality, substantial transfers from parents and grandparents help young heirs accumulate wealth faster by securing excess returns, even without drawing high productivity. Calibrated to the U.S. economy, I find that relaxing estate taxes (with a 2 percentage-point decrease in the estate tax rate and a doubling of the exemption threshold from the benchmark) leads to a 1.2 percentage-point increase in the share held by the top 1 percent in the model. I also show that the grandparents-grandchild link (G-G link) is important for wealth accumulation, particularly for those at the top of the distribution.

**JEL Codes:** D14, D15, D31, D64, E21, H31

**Keywords:** Intergenerational transfers, household wealth, return heterogeneity, wealth inequality, estate tax

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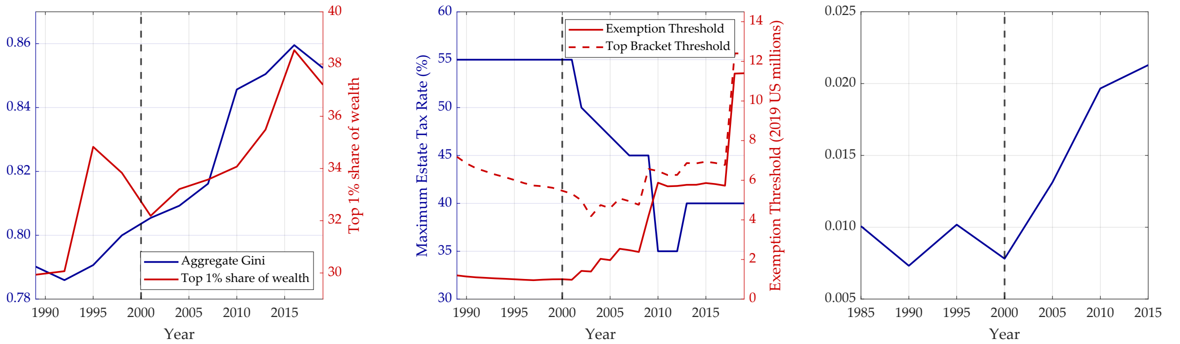
# 1 Introduction

Rising wealth inequality is a central concern for policymakers in developed countries around the world, particularly in the U.S. Over the past three decades, wealth has become increasingly concentrated in the U.S., with the aggregate Gini coefficient rising from 0.79 in 1989 to 0.86 in 2019 (Figure 1, left panel). At the same time, the federal estate tax policy in the U.S. has become more lenient since the turn of the century, so that under the current tax policy, only estates above $12 million are subject to federal estate tax (Figure 1, middle panel). The current administration's proposal includes a return to the 2009 provision starting from 2026.[1] Furthermore, there has been a substantial increase in the size of inheritances over the same period, and this trend is likely to persist as households from the aging baby-boom generation are set to pass on their wealth to offspring (Figure 1, right panel).

**Figure 1:** Gini coefficient, Estate Tax Policy and Inheritance-to-wealth Ratio




**(a)** U.S. Gini Coefficient **(b)** Federal Estate Tax Policy **(c)** Inheritance-to-wealth Ratio

What are the effects of changes in estate taxation on wealth distribution? Has the recent relaxation of estate tax policy contributed to rising wealth inequality? While inheritances have frequently been considered as one of potential contributing factors to wealth concentration, the extent to which bequests are a major source of wealth inequality remains a topic of debate, with previous studies failing to reach a consensus.[2] This leaves the actual impact and the implications of estate taxation indeterminate and unresolved.

Several challenges arise when attempting to address this question. First, it is essential to have a model framework capable of generating sufficiently high concentration at the top of wealth distribution, as observed in the data. Second, in achieving the first, the model should incorporate various potential contributing factors to wealth inequality including bequests. In doing so, it is crucial to consider channels through which inheritances interact with existing heterogeneities in the model. Previous literature has utilised a so-called '*superstar*' productivity that simultaneously targets both earnings and wealth (Castaneda et al., 2003). While this approach enables the model to generate significant concentration, it may reduce the role of inheritance to a negligible factor by placing excessive emphasis on the earnings process.

[1] See, Appendix A.1 for more detail on the recent major legislative reforms in the U.S.
[2] Related literature will be discussed later.

To address these questions, I introduce heterogeneity in rates-of-return to match the wealth distribution in addition to earnings inequality. A growing body of literature documents a strong relationship between households' overall wealth and return characteristics.[3] This setup allows the model to capture wealth concentration while the earning process is calibrated solely to match the earnings distribution. Moreover, incorporating return heterogeneity naturally interacts with bequests in the model, as together they imply heterogeneity in returns on inherited wealth.[4] Second, I also explore another aspect that has not been addressed previously, namely the generation-skipping transfers. Empirical evidence suggests that for younger households, the link between households and their grandparents is particularly strong, with the size of inheritances from grandparents being significant and, even larger than those from parents. The introduction of the grandparent-grandchild link (G-G link, hereafter) also creates greater heterogeneity in bequests in terms of both the size and the timing of the transfers.[5]

The main contribution of this paper is twofold. First, it extends previous life-cycle models of bequests that study the impact of inheritances and estate taxes by incorporating generation-skipping transfers from grandparents. Second, it uses the calibrated model to assess the long-run aggregate and distributional consequences of relaxing estate tax policy and to investigate the importance of inheritances from grandparents for individual wealth accumulation and estate tax implications.[6]

In Section 2, I provide evidence, using data from the Survey of Consumer Finances (SCF), that, for younger households, the link between households and their grandparents is particularly strong. In this section, I also provide evidence of return heterogeneity arising from wealth portfolio composition: wealthy households hold a greater proportion of high-return assets. Therefore, young heirs from wealthy families are likely to accumulate wealth earlier and also, at a faster rate: not only because of the size of the inheritance they receive but also because they inherit high-return assets.[7]

I calibrate the model to match the key characteristics of the U.S. economy between 1990-2000, a period where estate tax policy was relatively stable. This involves matching the earnings and wealth distribution, the proportion of estates subjected to estate tax, the government revenue accrued from these taxes, and importantly, the fraction of young households who in-

[3]See, Benhabib et al. (2011); Fagereng et al. (2020); Bach et al. (2020); Hubmer et al. (2021), among others.

[4]Specifically, I assume that both return and risk increase with the level of wealth, following Hubmer et al. (2021). While this implies that wealthier individuals would earn higher returns at any given wealth level, in this paper, I assume they earn higher returns as they inherit larger amounts of wealth. This specification is known as scale-dependent heterogeneity. See Gabaix et al. (2016) and Xavier (2021) for alternative mechanisms.

[5]This aspect is also particularly crucial for accurately assessing estate tax reforms in countries like the U.S., where a separate estate tax applies to generation-skipping transfers.

[6]Among others, refer to relevant papers such as Huggett (1996); Gokhale et al. (2001); De Nardi (2004), which study the impact of bequests and Cagetti and De Nardi (2009); De Nardi and Yang (2016); Guo (2022) for insights into the distributional effects of estate tax reforms within a life-cycle framework.

[7]While this implies that they should earn higher returns for a given level of wealth in practice, in this paper, I assume that they earn higher returns as they inherit larger size of wealth.

herit from grandparents and the relative size of the transfers based on SCF data. The baseline model generates cross-sectional distributions of both earnings and wealth, as well as other moments that closely align with empirical counterparts. The baseline model features an estate tax exemption threshold of \$6.4 million and an estate tax rate of 18 percent, each within a reasonable range in effective terms.[8]

To assess the aggregate and distributional consequences of changes in estate taxes, I consider counterfactual revenue-neutral estate tax reforms. Specifically, I relax model estate tax parameters (with a 2 percentage-point decrease in the estate tax rate to 16 percent and a doubling of the exemption threshold to \$12.9 million), mimicking, to some extent, the actual changes in the estate tax policy in the U.S. over the sample period. In steady state, this policy change results in increased capital and output, but it also amplifies wealth concentration in the long run. The share held by the top 1 percent in the model increases by 1.2 percentage points (from 32.1 percent to 33.3 percent). This accounts for 25 percent of the observed increase in the top 1 percent share in the U.S. from 2001 to 2019.

I find that the G-G link has non-negligible implications. When the G-G link is removed, the model economy converges to a new stationary distribution with reduced capital accumulation by the wealthiest top 5 percent; the share held by the top 5 percent reduces by 1.2 percentage points. Furthermore, it reduces wealth inequality across all age groups in the model, and this reduction in inequality tends to increase with age. Applying the same estate tax reforms, I show that, in the absence of the G-G link, the same policy change increases the share held by the top 1 percent by only 0.6 percentage points, which is half the effect observed in the model where the G-G link is active. These findings confirm that this channel is important for wealth accumulation, particularly for those at the top of the distribution.

I then examine the individual effects of each of these tax instruments by relaxing one parameter at a time while holding the other at the benchmark. When the government only increases the exemption threshold, it increases the share of wealth held by the 95th-99th percentile while reducing the share held by the top 1 percent. However, when the government only lowers the estate tax rate, the distributional effect is the opposite; it lowers the share of wealth held by the 95th-99th percentile and increases the share held by the top 1 percent. This is because raising the exemption threshold primarily benefits the marginal household group (who are sitting on 95th-99th percentile in the model). In contrast, households with wealth exceeding the new threshold even before the tax reform lose their shares. Conversely, relaxing the estate tax rate only benefits wealthy households previously subject to estate tax by reducing their tax burden. When both instruments change simultaneously, some offsetting effects from each dimension cancel out.

[8]In practice, estate tax is also progressive. However, in this paper, I assume estate taxation as a piece-wise linear function, $T(b) = \max\{0, \tau_b(b - \chi_b)\}$ where $\tau_b$ is the estate tax rate and $\chi_b$ is the exemption threshold. Using data from the Internal Revenue Service, I estimate the average effective estate tax rate over 1989-2001 was 18.2 percent and the highest tax bracket threshold was \$6.2 million (in 2019 values).

**Related Literature.** This paper contributes to the literature examining the impact of inheritances and estate taxes on wealth inequality. A number of studies find inheritances have equalising effects on wealth inequality and estate taxes would counteract the equalising effects unless estate tax revenues are re-distributed.[9] Others find that inheritances increase wealth inequality; however, even within these studies, views vary on the significance of estate taxes in alleviating wealth concentration.[10]

This paper is closely related to previous studies by De Nardi and Yang (2016) and Guo (2022), both of which investigate estate tax reforms within a life-cycle framework and conclude that estate tax has limited effects on wealth concentration. My approach differs from these studies in that I calibrate the earnings process in the model to match only the empirical earnings distribution, not the wealth distribution, which is instead targeted through return heterogeneity. In an environment where the distribution of wealth is not dominated by the earnings process, the impact of inheritances—and hence estate taxes—becomes more pronounced. Furthermore, neither of these studies considers inheritances from grandparents within a life-cycle framework, which are potentially significant for shaping wealth distribution and for the implications of estate tax.

This paper is also similar to Gokhale et al. (2001) in that, both use SCF data to compute a portfolio-weighted rate of return to characterise return heterogeneity.[11] They assume different rates are randomly assigned to each household in their simulation, which implies, zero correlation between rates of return earned by parent and child households. In contrast, I assume returns are increasing in the level of wealth, implicitly creating some correlation between rates of return earned within dynasties.

My paper is also related to papers that study the sources of life-time inequality. These include Huggett et al. (2011) and Griffy (2021). Huggett et al. (2011) find that initial human capital is substantially more important than learning ability or initial wealth in determining the life-time utility, earnings and wealth while Griffy (2021) finds a significant role of initial wealth. The importance of initial wealth, however, hinges crucially on the role of initial wealth in these two studies. Huggett et al. (2011) consider initial human capital and initial wealth separately whereas in Griffy (2021), agents use initial wealth to attain initial human capital.[12]

[9]This view reflects the notion that wealth transfers are relatively greater for poorer individuals than for richer ones in terms of their pre-inheritance wealth. See Gokhale et al. (2001); Wolff and Gittleman (2014); Bönke et al. (2017); Elinder et al. (2018) among others. Recently, Nekoei and Seim (2023), using a quasi-experimental design and Swedish administrative data, find that such equalising effects are reversed in the long run since the different depletion rates, arising from return heterogeneity, widen the inequality in inherited wealth over time.

[10]For instance, Nishiyama (2002); De Nardi and Yang (2016); Guo (2022) find that estate taxes have only marginal effects on wealth inequality as inheritances is not the main cause of the wealth concentration, whereas Benhabib et al. (2011) and Nekoei and Seim (2023) argue that estate taxes can significantly reduce wealth inequality.

[11]Gokhale et al. (2001) find that most of wealth inequality stems from earning inequality rather than heterogeneous in rates-of-return and conclude that bequests reduce wealth inequality in the absence of social security.

[12]While this is also an interesting and potentially important aspect, I abstract from this channel. Nevertheless, scale-dependent return heterogeneity allows early inheritances, to some extent, to play a larger role without

The remainder of this paper is organised as follows: Section 2 documents, using data from SCF, inheritance patterns and return characteristics across different wealth groups, which motivated present analysis. In Section 3, I detail the full life-cycle quantitative model. Section 4 discusses the calibration strategy and compares the baseline model's overall characteristics with empirical data. Section 5 presents the main quantitative results from counterfactual policy experiments, including the aggregate and distributional effects of estate taxes, with and without the G-G link. Finally, Section 6 concludes and suggests potential directions for future research.

endogenising the human capital investments.

## 2 Survey of Consumer Finances

This section presents selected stylised facts on intergenerational transfers and household wealth using data from the SCF that motivated the current research.[13] The SCF is a triennial survey that is useful in analysing cross-section wealth and income distributions in the U.S. due to its oversampling of rich households. The SCF also includes a distinct section on inheritance status and preferences, making it particularly valuable for studying the characteristics of heirs and the size and the source of transfers. I utilise a total of 11 SCF survey datasets spanning from 1989 to 2019.[14]

### 2.1 Stylised Facts from the SCF (1989 - 2019)

*Stylised Fact 1. Intergenerational transfers, predominantly taking the form of inheritance, apply only to a small proportion of the population.*

Table 1 shows that only 21 percent of the population has reported receiving substantial assets in the past, with more than 80 percent of the transfers taking the form of inheritances. Notably, for some households, such transfers are not one-time events and may occur multiple times. In contrast, the majority, 70 percent, neither have received nor expect to receive such transfers in the future.

**Table 1:** Status and Types of Intergenerational Transfers

| | Future Transfers | | Types of Transfers (%) | | |
|---|---|---|---|---|---|
| | Expected | Not expected | Inheritance | Gift | Trust |
| (%) Received | 4.4 | 16.6 | 81.4 | 13.9 | 4.7 |
| (%) Not received | 9.3 | 69.7 | | | |

*Source.* Federal Reserve Board, 1989 - 2019 SCF.

*Stylised Fact 2. The link between households and their grandparents is particularly pronounced for younger households.*

Second, Table 2 highlights the importance of inheritances from grandparents for younger households. Among households under the age of 30 who reported receiving inheritances, 50 percent have inherited from their grandparents. This is likely due to the fact that most households in this age group would typically have both, or at least one of their parents still alive at the time of the survey. The proportion of heirs generally increases with age, and the parent-child link begins to dominate as individuals reach middle age.

[13] Wealth is defined as the net worth of households, as in Kuhn et al. (2020) and Bricker et al. (2020). See Appendix B.1 for more information on data and methodology used in this section.

[14] Unless stated otherwise, the numbers reported in the tables in this section, represent the average across 11 sets of SCF data spanning from 1989 to 2019.

**Table 2:** Percentage of Heirs across Different Age groups

| Age | % of Population Inherited | % Inherited from Grandparents | Parents | Others |
|---|---|---|---|---|
| Under 30 | 7.1 | 50.4 | 33.7 | 16.0 |
| 31 - 40 | 10.7 | 42.6 | 42.7 | 14.8 |
| 41 - 50 | 14.9 | 26.6 | 54.0 | 19.4 |
| 51 - 60 | 21.0 | 10.2 | 70.2 | 19.6 |
| 61 - 70 | 28.4 | 4.6 | 76.1 | 19.3 |
| 71 - 80 | 27.6 | 3.2 | 70.3 | 26.5 |
| 81 and over | 25.5 | 5.1 | 61.2 | 33.7 |

*Source.* Federal Reserve Board, 1989 - 2019 SCF.

It is also worth noting that the numbers in Table 2 are based on the households' age at the time of the survey. Therefore, respondents who are older than 30 but received an inheritance when they were under 30 are not captured in the first row 'Under 30', but are recorded under their current age interval. Nonetheless, the G-G link in the early stages remains more prevalent than the parent-child link, even when accounting for households who were older than 30 at the time of the survey but had inherited before turning 30.[15]

*Stylised Fact 3. The distribution of bequest is highly skewed, predominantly concentrated within the highest wealth quintile.*

Finally, among the under 30 heirs, 45 percent belong to the 5th wealth quintile, yet their inheritances constitute over 80 percent of the total received. Table 3 show that, even within the highest wealth quintile, those who are positioned in the top 1 percent are allocated substantial inheritances. As well, the size of inheritance from grandparents is indeed mostly larger than those from parents for most wealth groups.

**Table 3:** Distributions of Inheritances (Under 30 Heirs)

| | Share of total sample (in %) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Wealth Quintiles | | | | | Top (%) | | |
| | 1st | 2nd | 3rd | 4th | 5th | 90-95 | 95-99 | 99-100 |
| (%) Heirs | 11.0 | 8.2 | 14.1 | 21.4 | 45.3 | 12.9 | 11.5 | 4.8 |
| From grandparents | 7.6 | 4.1 | 6.1 | 11.2 | 21.3 | 7.0 | 5.0 | 2.1 |
| From parents | 1.4 | 2.4 | 5.9 | 6.7 | 16.8 | 4.2 | 4.9 | 1.0 |
| From both | 0.0 | 0.0 | 0.2 | 0.1 | 1.3 | 0.0 | 0.4 | 0.7 |
| From others | 2.0 | 1.7 | 1.9 | 3.3 | 4.6 | 1.7 | 0.7 | 0.7 |
| (%) Total Inheritance | 2.0 | 1.8 | 3.4 | 8.6 | 84.3 | 14.3 | 16.2 | 42.8 |
| From grandparents | 1.5 | 1.0 | 1.3 | 2.5 | 42.5 | 9.8 | 8.0 | 20.1 |
| From parents | 0.3 | 0.5 | 1.9 | 4.9 | 35.7 | 3.6 | 8.0 | 18.8 |
| From others | 0.3 | 0.3 | 0.2 | 1.1 | 6.1 | 0.9 | 0.2 | 3.9 |

*Source.* Federal Reserve Board, 1989 - 2019 SCF.

[15] See Table B6 in Appendix B.2.

Next, I present evidence on return heterogeneity that stems from portfolio heterogeneity. In addition to early inheritances from grandparents, heterogeneity in returns is also crucial aspect in understanding the role inheritances play in individual wealth accumulation. In recent work, Bach et al. (2020) and Fagereng et al. (2020),using Scandinavian administrative data from Sweden and Norway respectively, document a strong relation between a household's overall wealth and return characteristics. While it may not offer the extensive details present in the Swedish and Norwegian administrative data, several prior studies such as, Fagereng et al. (2016), Xavier (2021), and Kartashova and Zhou (2021), employ SCF data to demonstrate that a similar pattern exists in the U.S.[16]

*Stylised Fact 4. Substantial heterogeneity exists in returns on wealth, stemming from differences in the composition of wealth portfolios across different wealth groups.*

First, Table 4 suggests that substantial heterogeneity exists in the wealth portfolios across different wealth groups. Households at the top of the distribution hold a greater proportion of private and public equities, while real estate comprises the majority of net worth for most of the population.[17]

**Table 4:** Heterogeneity in Wealth Portfolio Composition

| | Financial assets | | | Non-financial assets | | | Total Debt | |
|---|---|---|---|---|---|---|---|---|
| | Interest-earning asset | Public equity | Other | Real estate | Private business | Other | | |
| Top 0.1% | 0.11 | 0.23 | 0.04 | 0.14 | 0.49 | 0.01 | (0.01) | 1.000 |
| Next 0.9% | 0.13 | 0.26 | 0.06 | 0.26 | 0.32 | 0.01 | (0.04) | 1.000 |
| Next 4% | 0.13 | 0.28 | 0.09 | 0.36 | 0.20 | 0.02 | (0.07) | 1.000 |
| Next 5% | 0.13 | 0.26 | 0.12 | 0.47 | 0.10 | 0.03 | (0.12) | 1.000 |
| Next 40% | 0.13 | 0.18 | 0.11 | 0.74 | 0.06 | 0.08 | (0.30) | 1.000 |
| Bottom 50% | 0.26 | 0.18 | 0.16 | 2.55 | 0.04 | 0.63 | (2.83) | 1.000 |
| Overall | 0.13 | 0.24 | 0.09 | 0.45 | 0.21 | 0.04 | (0.16) | 1.000 |

*Note.* Table shows the wealth portfolio composition by the Bottom 50 wealth percentiles, 50th-90th wealth percentile (Next 40%), 90th-95th wealth percentiles (Next 5%), 95th-99th percentiles (Next 4%), 99th-99.9th percentile (Next 0.9%) and Top 0.1%.
*Source.* Federal Reserve Board, 1998 - 2019 SCF.

[16]In doing so, I generally follow the methodologies employed by existing studies. See Appendix B.3 for more details on the definition of each wealth component and the methodology used to compute the portfolio-weighted average rate of return on wealth.

[17]The weights of each component are computed as a share of net worth such that the total assets and total debt must sum to 1. While the share of real estate for bottom 50% seems very high, but their net worth is negative as the value of debt exceeds the value of total assets.

If different asset classes yield different rates, heirs from different wealth groups would earn different returns on their inherited wealth based on the nature of the wealth inherited from their parents and/or grandparents. Indeed, Table 5 reports the average returns on each wealth component over the sample period. Private business (including both corporate and non-corporate businesses), have yielded persistently higher returns than other assets.[18]

**Table 5:** Average Returns on Each Wealth Component

| | Financial assets | | | Non-financial assets | | | Total Debt |
|---|---|---|---|---|---|---|---|
| | Interest-earning asset | Public equity | Other | Real estate | Private business | Other | |
| 1999 - 2001 | 0.04 | 0.02 | - | 0.11 | 0.29 | 0.02 | 0.07 |
| 2002 - 2004 | 0.02 | 0.00 | - | 0.12 | 0.27 | 0.02 | 0.06 |
| 2005 - 2007 | 0.03 | 0.10 | - | 0.09 | 0.40 | 0.02 | 0.06 |
| 2008 - 2010 | 0.02 | (0.06) | - | (0.07) | 0.06 | 0.02 | 0.06 |
| 2011 - 2013 | 0.02 | 0.14 | - | 0.05 | 0.28 | 0.02 | 0.04 |
| 2014 - 2016 | 0.02 | 0.10 | - | 0.10 | 0.26 | 0.02 | 0.04 |
| 2017 - 2019 | 0.02 | 0.12 | - | 0.06 | 0.36 | 0.02 | 0.04 |
| Average | 0.02 | 0.06 | - | 0.06 | 0.21 | 0.02 | 0.06 |

*Note.* Values in parenthesis indicate negative returns.
*Source.* Federal Reserve Board, 1998 - 2019 SCF.

Having the portfolio shares and the average returns for each wealth component for each episode, Table 6 presents the average portfolio-weighted returns to net worth across different wealth groups over the sample period.[19] Both returns, and standard deviations generally exhibit an increasing trend with overall wealth, which is consistent with findings from Bach et al. (2020) and Fagereng et al. (2020).

**Table 6:** Heterogeneity in Returns across Different Wealth Group

| Wealth Percentile | 0 - 50 | 50 - 90 | 90 - 95 | 95 - 99 | 99 - 99.9 | 99.9 - 100 |
|---|---|---|---|---|---|---|
| Average Return | (0.04) | 0.05 | 0.06 | 0.08 | 0.10 | 0.11 |
| Stand. Dev | 0.01 | 0.01 | 0.02 | 0.03 | 0.05 | 0.07 |

*Note.* Values in parenthesis indicate negative returns.
*Source.* Federal Reserve Board, 1998 - 2019 SCF.

[18] The lower average returns on public equity and real estate can be attributed to substantial declines during the Great Recession.

[19] It should be highlighted that households with greater wealth are likely to accrue higher returns from the same wealth components, possibly attributed to advanced education, skills, or information access. However, I abstract from within-class heterogeneity as it is beyond the scope of this exercise.

To summarise, while previous literature has predominantly focused on the parent-child link, Stylised Facts 1 to 3 from this section highlight that the impact of intergenerational transfers, via inheritances, can occur much earlier than previously understood. This is particularly important for understanding the wealth inequality since households receiving inheritances from grandparents in their early stages (typically when their parents are still alive) are also likely to inherit from their parents as they reach middle age. Moreover, while real estate constitutes the main component of the wealth portfolio for average households, the portfolios of wealthy families tend more towards public and private equities, which have persistently yielded higher returns than other assets.

The presence of return heterogeneity and the G-G link should have significant implications for the heterogeneity in bequests and may support the argument that inheritances increase wealth concentration. The effects of bequests can begin much earlier than previously understood, potentially shaping wealth outcomes later in life: inheritances are generally associated with very wealthy households. Hence, young heirs from affluent families are likely to begin their economic life with substantial wealth on hand, but are also likely to accumulate faster based on the nature of inherited wealth. Hence, the early inequality can be carried over to middle-age inequality to some extent.

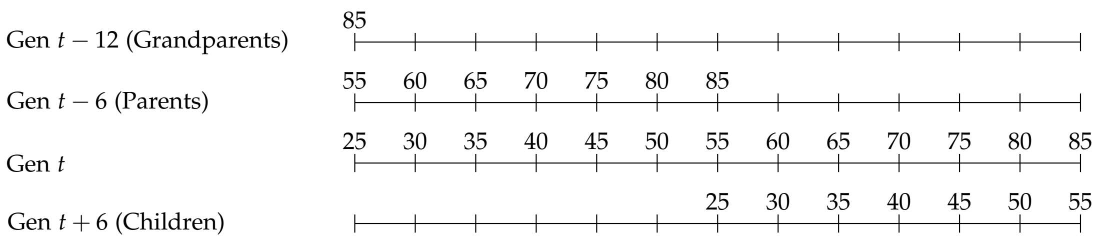
The empirical analysis in this section provides valuable insights into how rate-of-return heterogeneity and inheritances jointly influence individual wealth accumulation and shape the overall wealth distribution. To fully understand the implications of inheritances, it is essential to consider both their direct effect (from the transfer itself) and their indirect effect through rate-of-return heterogeneity, by which bequests influence agents in the model. Their combined impact can drive inequalities both within and across generations. Models that abstract from heterogeneities in bequests (in terms of timing and sources) and rate-of-return differences may not adequately capture the role inheritances play in wealth accumulation and inequality. This, in turn, can affect evaluations of policy interventions aimed at reducing wealth concentration. In the next section, I develop, calibrate, and simulate a general-equilibrium life-cycle model that incorporates these stylised facts to examine the aggregate and distributional implications of relaxing estate taxes.

# 3 Quantitative Life-Cycle Model

In this section, I develop a general equilibrium life-cycle model with bequests to examine the aggregate and distributional consequences of relaxing estate tax policy. The baseline model features heterogeneities in earnings and wealth returns. The economy is populated by overlapping generations of finitely-lived households facing age-dependent survival probabilities. Households derive utilities from consumption and bequests (net of taxes), which they begin planning from retirement. Intended bequests are luxury goods that not every household can afford. Importantly, if households live long enough to witness their grandchildren entering the economy, they derive utility from leaving bequests to grandchildren as well. Households may leave accidental bequests in case they pass away prematurely. Workers supply labour inelastically until they retire and households save by lending capital to firms.

*Model Demographics* One period in the model is equivalent to 5 years. Figure 2 illustrates the model demographics. Households enter the economy at age 25 ($j = 1$) as workers after which they consume, and accumulate wealth. Households supply labour inelastically until age 60 ($j = 8$) and retire from age 65 ($j = J_r = 9$). The maximum age is chosen to be 85 ($J = 13$) after which they pass away with certainty.

**Figure 2:** Model Demographics




At any age $j < J$, households face a conditional probability of reaching from age $j$ to $j+1$ denoted as $\gamma_j$ and hence $\gamma_J = 0$. The unconditional probability of reaching age $j$ is therefore denoted by $\gamma^j = \Pi_{m=1}^{j} \gamma_m$. As households give birth at age 30, children will enter the economy when parents are at age 55. For simplicity, I assume households survive with certainty until their children enter the economy, that is, $\gamma_j = 1$ for $j \leq 6$. This assumption is to ensure that all households have their parents alive when entering and no households die before their parents.

The total population alive at any given time $t$, is given by:

$$N_t = \sum_{j=1}^{J} N_{j,t}$$

$$N_{j+1,t+1} = \gamma_{j,t} N_{j,t}, \quad \forall j \in \{1, J\}$$

$$N_{1,t} = (1+f) N_{1,t-6}$$

where the last equation describes the total population of new households entering at $t = 1$ that is given by the population of their parents generation ($N_{1,t-6}$) multiplied by the fertility rate $f$. I assume that the population grows at a constant rate $n$ such that:

$$N_{1,t+1} = (1+n)N_{1,t}$$

Hence, in a steady-state where age-dependent survival probabilities and fertility rate are constant, the rate of total population growth is determined as,

$$n = (1+f)^{\frac{1}{6}} - 1$$

and the population composition becomes stationary. Normalising the total population to 1, we have:

$$\begin{aligned} N &= \sum_{j=1}^{J} N_j = 1 \\ N_{j+1} &= \frac{\gamma_j}{1+n} N_j, \quad \forall j \\ N_1 &= \bar{N}_1 = \left( \sum_{j=1}^{J} \frac{\gamma^{j-1}}{(1+n)^{j-1}} \right)^{-1} \end{aligned}$$

where $\bar{N}_1$ is the share of age-1 households in the stationary equilibrium.

*Earnings Process* Each household supplies one unit of labour inelastically in each period until they retire. The total labour productivity of worker $i$ at age $j$ is given by

$$\log e_j^i = z_j^i + \epsilon_j$$

where $\epsilon_j$ is the deterministic age-efficiency profile and $z_j^i$ denotes the stochastic earnings process that follows AR(1):

$$z_j^i = \rho_z z_{j-1}^i + \mu_j^i, \quad \mu_j^i \sim \mathcal{N}(0, \sigma_z^2)$$

Moreover, I assume the productivity of a household at entry (at $j = 1$) follows productivity of his/her parents at age 55 (at $j = 7$) to capture imperfect intergenerational transmission of earnings ability as in De Nardi and Yang (2016).

$$z_1 = \rho_h z_7$$

as there is a a 30-year age gap between parents and child by construction.

*Rate-of-return on Capital* I introduce rate-of-return heterogeneity into the model in which return and risk increase in the level of wealth as in Hubmer et al. (2021).[20] Hence the gross return in the model takes the form:

$$1 + \underline{r} + r^X(a) + \sigma^X(a) \cdot \eta$$

where $\underline{r}$ is an aggregate return component, $r^X(\cdot)$ and $\sigma^X(\cdot)$ are mean and standard deviations of excess returns and $\eta$ is an *i.i.d.* standard normal idiosyncratic shock. Hubmer et al. (2021) argue that this specification allows for a limited amount of return persistence: returns are persistent because wealth is, but conditional on the level of wealth, returns are uncorrelated over time. The above specification is still consistent with the firm's marginal product of capital being equal to aggregate $r$ since $\underline{r}$ will adjust to clear the capital market.

This also implies, within the model, that return on inherited wealth are heterogeneous due to heterogeneity in the size of the transfers. Households from wealthy families are likely to inherit larger amounts of wealth, and also enjoy higher returns on their inherited wealth. Therefore, parental background and early inheritance are likely to play a larger role in determining the wealth concentration in addition to the earnings ability transmission.

*Technology* The supply side of the economy is modelled as standard. A representative firm hires capital and labour from households and produce consumption goods in this economy using the constant returns-to-scale Cobb-Douglas production technology:

$$Y = AK^{\alpha}L^{1-\alpha}$$

where $A$ and $\alpha$ denote the level of productivity and capital share in the production respectively and capital depreciates at rate $\delta_k$ in each period.

[20] See Gabaix et al. (2016) and Xavier (2021) for other mechanism.

### 3.1 Government

The government collects taxes from labour earnings, capital income, and estates to finance its consumption and the interest payments on its debt. In addition to the tax on labour earnings, the government operates a balanced-budget social security program, which collects separate social security taxes from workers to provide benefits to retirees.

*Labour Income Tax* In the model, the progressive labour earnings tax is characterised by a two-parameter tax function of the form:

$$T_\ell(w \cdot e) = w \cdot e - (1 - \chi_e)(w \cdot e)^{1-\mu_e} \tag{1}$$

as in Benabou (2002) and Wu and Krueger (2021) where $\mu_e$ and $\chi_e$ are parameters governing the progressivity and the level of income tax respectively.

*Estate Tax* I assume the estate tax in the model is characterised by an exemption threshold $\chi_b$ and the tax rate $\tau_b$ such that only estates above the threshold are taxed at rate $\tau_b$ as in De Nardi and Yang (2016). Let $T_b(\cdot)$ be the estate tax function in the model,

$$T(b) = \max\{0, \tau_b(b - \chi_b)\} \tag{2}$$

where $b$ is the unspent wealth left by older households.[21]

*Social Security Tax* The government also collects separately social security taxes from workers to finance social security benefits to retirees. I assume a simplified social security system that pays a common retirement benefit to all retirees in the model.[22] Following Wu and Krueger (2021), the flat payroll tax in the model $\tau_{ss}$ is set to 7.65% based on the actual Social Security and Medicare tax rates on pre-tax income of employees. The amount of benefit is then computed based on,

$$s \int \cdot \mathbb{1}_{\{j \geq J_r\}} \, d\Phi = \tau_{ss} \int w \cdot e(j,z) \, d\Phi \tag{3}$$

*Capital Income Tax* Finally, the government also collects taxes on capital income earned by households at a constant rate $\tau_a$. I assume that the government in the model consumes a constant fraction of GDP and maintains a constant government debt-to-GDP ratio. Therefore, for any changes in government revenues induced by counterfactual estate tax reforms, the government will adjust its capital income tax rate to rebalance the government budget.

[21] In practice, the U.S. estate tax is also progressive. In this study, I follow a commonly used specification in the existing literature by targeting relevant moments using $\tau_b$ and $\chi_b$. The estimation of changes in actual estate tax progressivity is left for future research.

[22] This assumption is to avoid an additional continuous state variable (e.g., average indexed monthly earnings) to track agent's future retirement benefit.

### 3.2 Household's Problems

*Preference* The utility from consumption takes the standard CRRA form and the *warm-glow* bequest preference is taken from De Nardi and Yang (2016),

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma}, \qquad h(b) = \frac{\phi_1}{1-\sigma}\left[(b+\phi_2)^{1-\sigma} - 1\right]$$

where $\sigma$ is the risk-aversion coefficient, $\phi_1 > 0$ measures the bequest intensity and $\phi_2$ reflects the extent to which bequests are luxury goods. Treating bequests as luxury goods naturally segments households into two groups: bequesters and non-bequesters, so that with $\phi_2 > 0$, poor households will decide not to leave bequests at the final period. I introduce the G-G link by making following modification,

$$b = b_c^{\kappa_j} b_{gc}^{1-\kappa_j}, \quad \text{where} \quad \begin{cases} \kappa_j = 1 & \text{if} \quad j < J \\ \kappa_j < 1 & \text{if} \quad j = J \end{cases}$$

where $b_c$ and $b_{gc}$ denote the bequest to child and grandchild respectively. Note that the preference parameter $\kappa$ governs how the agent allocates the bequests between children and grandchildren, hence $\kappa = 1$ shuts down the G-G link.

Here, I make two simplifying assumptions. First, I assume in this setup whereby, only if households live long enough to witness their grandchildren entering the economy have active bequest motives. Given the model demographics, when agents pass away prematurely before reaching the maximum age $J$, their grandchildren has not entered the economy yet and therefore all bequests left should inherited by their children. However, if one lives long enough they are willing to leave a portion to their grandchildren hence $\kappa_J < 1$. This formulation allows some agents to receive inheritance earlier in their lives. Again, $\kappa_J = 1$ shuts down the G-G link as in the basic model. Second, I assume households begin their estate planning as they transition to retirement stage. Given the model demographics, households live with certainty until they children enter the economy at age 55 and they retire from age 65. While households face positive mortality rates between age 55 - 65, I consider this as part of accidental bequests.

The above specification allows households to become bequester-type regardless of parents' type (conditional on surviving long enough); that is, even without wealthy parents, if an agent is a "self-made" wealthy at retirement, he/she becomes bequester-type and is willing to leave bequests to their offspring. On the other hand, this also captures some persistency within wealthy families; an agent who receive substantial inheritances are more likely to become a bequester at retirement. Finally, this allows the composition of bequesters and non-bequesters to vary as changes in estate tax policy affect stationary distribution.

Next, I describe households' problem at each age $j = 1$ to $J = 13$. Since it is a finite-horizon life-cycle model, I start from retirees' problems then move to workers' problems. Following De Nardi and Yang (2016), the states of agents with living parents include the productivity and asset holdings of their parents. It is important to track family relations in this manner to ensure that bequests are specified for each dynasty. I assume that agents anticipate the size of bequests based on their parents' policy functions. In doing so, I separately describe households whose parents (or grandparents) are alive, distinguishing further between those whose parents are retired and those whose parents are working.[23]

*Retirees* The set of state variables for retirees are his age $j$, current asset holdings $a$ and idiosyncratic shock $\eta$. Let $V_r$ denotes the value functions, the recursive problem is given by:

$$V_r(j,a,\eta) = \max_{c,a'_c,a'_{gc}} \left\{u(c) + \beta\mathbb{E}\left[\gamma_j V_r(j+1,a',\eta') + (1-\gamma_j)\cdot h(b_c,b_{gc})\right]\right\}$$

subject to

$$\begin{aligned} c + a' &= s + (1+r^n)\cdot a \\ b_c &= a'_c - T_b(a'_c) \\ b_{gc} &= a'_{gc} - T_b(a'_{gc}) \end{aligned}$$

where $r^n = (1-\tau_a)(\underline{r} + r^X(a) + \sigma^X(a)\cdot\eta)$ denotes the net return on capital and $s$ is the social security benefit provided by the government. $b_c$ and $b_{gc}$ again denote bequests to child and grandchild respectively.[24] $T_b(\cdot)$ is the estate taxes given by (2).

*Workers without parents* Let $V_w$ be the value function of a working agent without parents,

$$V_w(j,a,z,\eta) = \begin{cases} \max_{c,a'}\left\{u(c) + \gamma_j\beta\mathbb{E}\left[V_r(j+1,a',\eta')\right]\right\} & \text{if} \quad j = J_r - 1 \\ \max_{c,a'}\left\{u(c) + \gamma_j\beta\mathbb{E}\left[V_w(j+1,a',z',\eta')\right]\right\} & \text{if} \quad j < J_r - 1 \end{cases}$$

subject to:

$$c + a' = (1-\tau_{ss})\cdot w\cdot e(j,z) - T_\ell(w\cdot e) + (1+r^n)\cdot a \tag{4}$$

where $T_\ell(w\cdot e)$ and $\tau_{ss}$ are progressive labour income tax and social security tax as in (1) and (3) respectively and the productivity $z$ is part of their state variables.

[23] This approach also significantly reduces computation costs.

[24] Note that for $J_r \leq j < J$, $a'_g = 0$ and hence $b_{gc} = 0$ as $\kappa_j = 1$.

*Workers with retired parents* Let $V_w^{pr}$ be the value function of a working agent with retired parents,

$$V_w^{pr}\left(j, a, z, \eta, S_p\right) = \max_{c,a'}\left\{u(c) + \gamma_j \beta \mathbb{E}\left[\gamma_{j+6} \cdot V_w^{pr}\left(j+1, a', z', \eta', S_p'\right) + (1-\gamma_{j+6}) \cdot V_w\left(j+1, a' + \frac{b_p}{1+f}, z', \eta'\right)\right]\right\}$$

subject to (4) where $S_p = \{a_p, \eta_p\}$ denotes the parent's state variables which includes parents' asset holding $a_p$, and their current realisation of the idiosyncratic shock $\eta_p$.[25] Therefore, with probability $(1-\gamma_{j+6})$ if parents do not survive, he/she will inherit the accidental bequest $b_p = a'(j+6, S_p)$ from parents[26] and proceed the next period with:

$$V_w(j, a, z, \eta) = \max_{c,a'}\left\{u(c) + \gamma_j \beta \mathbb{E}\left[V_w\left(j+1, a', z', \eta'\right)\right]\right\}$$

where parents' states, $S_p$ becomes redundant hence can be dropped without loss of generality.

*Workers with working parents* Let $V_w^{pw}$ be the value function of an agent with working parents,

$$V_w^{pw}\left(j, a, z, \eta, S_p\right) = \max_{c,a'}\left\{u(c) + \gamma_j \beta \mathbb{E}\left[\gamma_{j+6} \cdot V_w^{pr}\left(j+1, a', z', \eta', S_p'\right) + (1-\gamma_{j+6}) \cdot V_w\left(j+1, a' + \frac{b_p}{1+f}, z', \eta'\right)\right]\right\}$$

subject to (4) where parents' states $S_p = \{a_p, z_p, \eta_p\}$ in this case, also include $z_p$. This only applies to age-2 households with parents alive and age-1 households without grandparents at entry.[27]

*Age-1 with grandparents* Finally, at age $j = 1$ in case if an agent's grandparents are alive:

$$V_w^{pg}\left(j, a, z, \eta, S_p, S_g\right) = \max_{c,a'}\left\{u(c) + \gamma_j \beta \mathbb{E}\left[\gamma_{j+6} \cdot V_w^{pw}\left(j+1, a' + \frac{b_g}{(1+f)^2}, z', \eta', S_p'\right) + (1-\gamma_{j+6}) \cdot V_w\left(j+1, a' + \frac{b_g}{(1+f)^2} + \frac{b_p}{1+f}, z', \eta'\right)\right]\right\}$$

subject to (4) where $S_g = \{a_g, \eta_g\}$ denotes the grandparent's state variables. At entry, if the agent's grandparents are alive and are wealthy enough to afford the bequests, the agent will inherit bequests from grandparents with uncertainty.

[25]Note that parents' age is redundant as there is a constant age gap between parents and child by construction.

[26]As in De Nardi and Yang (2016), I assume that children have full information about their parents' state variables and infer the size of the bequests they are likely to receive according to their parents' policy function.

[27]Note that for age-1 households without grandparents, the next period value would be $V_w^{pw}$ instead of $V_w^{pr}$, as their parents would not have retired yet, if survived.

### 3.3 Stationary Equilibrium

I consider a stationary equilibrium of the model economy in which factor prices $(r^*, \underline{r}, w)$, demographic processes $(f, n, \gamma)$, and age-wealth distribution are constant over time.

**Definition:** Given government consumption $G$, government debt $D$, a tax system characterised by $(\tau_a, T_\ell(e), \tau_b, \chi_b)$ and a social security system characterised by $(\tau_{ss}, s)$, a stationary recursive competitive equilibrium with population growth is a collection of value functions $\{V_w^{pg}, V_w^{pw}, V_w^{pr}, V_w, V_r\}$ and relevant policy functions $\{c(x), a'(x)\}$, optimal input choices $\{K, L\}$ of firms, and equilibrium prices $(r^*, \underline{r}, w)$ with following properties:

i. Given prices $(r^*, \underline{r}, w)$ and government policies $(\tau_a, T_\ell(e), \tau_b, \chi_b, \tau_{ss}, s)$, the functions $V(x)$, $c(x)$ and $a'(x)$ solve the household's maximisation problem in state $x$.

ii. Given prices $(r^*, \underline{r}, w)$, the optimal choices of the representative firm satisfy:

$$r^* = A\alpha \left(\frac{K}{L}\right)^{\alpha-1} - \delta_k, \qquad w = A(1-\alpha)\left(\frac{K}{L}\right)^{1-\alpha}$$

iii. $\Phi$ is the invariant distribution of households over the state variables, $\Phi(X) = 1$

iv. Government policies satisfy the government budget constraints:

$$G + ((1-\tau_a)r^* - n)D = \tau_a r^* K + \int T(w \cdot e(j,z))\, d\Phi + \tau_b \int (1-\gamma_j) \max\left(a' - \chi_b, 0\right)\, d\Phi$$

$$\int s \cdot \mathbb{1}_{\{j \geq J_r\}}\, d\Phi = \tau_{ss} \int (w \cdot e(j,z))\, d\Phi$$

v. All markets clear:

- The labour market clears,

$$L = \int e(j,z)\, d\Phi$$

- The capital market clears,[28]

$$(1+n)(K+D) = \int a'(x)\, d\Phi$$

$$r^* \int a(x)\, d\Phi = \int \left(\underline{r} + r^X(a) + \sigma^X(a)\eta\right) \cdot a\, d\Phi$$

- The goods market clears,

$$\int c(x)\, d\Phi + (n+\delta)K + G = Y$$

[28]Non-trivial excess return schedule requires an additional equilibrium condition that the aggregate capital income equals to the aggregated individual capital income. The condition pins down the aggregate return component, $\underline{r}$.

## 4 Calibration

This section describes the parameter choices for the baseline model economy. The model is calibrated to match the characteristics of the U.S. economy in 1990-2000, a period where the estate tax policy was relatively stable. I choose a subset of parameters based on model-exogenous information and calibrate remaining parameters internally so that model moments closely match their data counterparts. Table 7 summarises the parameters that are externally calibrated. I report parameters at an annual frequency (unless stated otherwise) though they are converted to 5-year frequency in the computation.

**Table 7:** Externally Calibrated Parameters

| Parameter | | Value | Target/Data |
|---|---|---|---|
| Annual population growth rate | $n$ | 1.10% | |
| Age-dependent survival probability | $\gamma_j$ | $*$ | U.S. Life table (2001) |
| Capital share in production | $\alpha$ | 0.360 | |
| Risk aversion coefficient | $\sigma$ | 1.500 | |
| Productivity state | $z$ | $*$ | See text |
| Age-efficiency profile | $\epsilon_j$ | $*$ | SCF (2001) |
| 5-year labour productivity persistences | $\rho_z$ | 0.850 | De Nardi (2004) |
| 5-year labour productivity variance | $\sigma_z^2$ | 0.300 | De Nardi (2004) |
| Productivity transition probability | $Q_z$ | $*$ | See text |
| Productivity transmission probability | $Q_h$ | $*$ | See text |
| Excess return schedule | $r^X$ | $[5.1\%, 7.5\%]$ | SCF (2001-2019) |
| Std. deviation of excess return | $\sigma^X$ | $[0.023, 0.051]$ | SCF (2001-2019) |
| *i.i.d.* idiosyncratic shock | $\eta$ | $[-1, 0, 1]$ | |
| Government consumption-to-GDP | $G/Y$ | 18.0% | FRED (A822RE1Q156NBEA) |
| Government debt-to-GDP | $D/Y$ | 55.0% | FRED (DEBTTLUSA188A) |
| Labour income tax progressivity | $\mu_e$ | 0.1327 | Wu and Krueger (2021) |
| Labour income tax level | $\chi_e$ | 0.1575 | Wu and Krueger (2021) |
| Social security payroll tax rate | $\tau_{ss}$ | 0.0765 | Wu and Krueger (2021) |

*Note.* Unless stated otherwise, parameters are reported at an annual frequency.

First, I set the population growth rate to $n = 1.1\%$ and the age-dependent survival probabilities $\{\gamma_j\}$ are obtained from the U.S. Life Table (2001). The capital share is set to $\alpha = 0.36$ and the risk aversion coefficient is set to $\sigma = 1.5$.

Second, since labour supply is inelastic in the model, earnings process can be calibrated externally to match earnings distribution observed in the data. The labour productivity persistence $\rho_z$, variance $\sigma_z^2$ as well as the earnings transmission persistence $\rho_h$ are taken from De Nardi (2004). I calibrate model earnings process à la Castaneda et al. (2003) and Kindermann and Krueger (2021). Specifically, the stochastic component $z$ is approximated by a 4-state Markov Chain where I use Tauchen (1986) to obtain the first 3 states and $3 \times 3$ transition probabilities.

Then I calibrate remaining parameters (including the earnings transmission matrix, $Q_h$) to match earnings concentration observed in the data. In doing so, I differ from the usual *"superstar"* process in that, I only use information from the empirical earnings distribution, and I do not target wealth distribution. This yields 4 productivity states,

$$z = [0.3923,\ 1.000,\ 2.5492,\ 23.3975]$$

and the implied initial distribution at age-1 as,

$$\mu_1 = [34.48\%,\ 5.51\%,\ 59.62\%,\ 0.39\%]$$

I use the mean earnings for households age between 25 - 60 from the SCF 2001 for the model deterministic age-efficiency profile of labour productivity, $\epsilon_j$.[29] I then normalise the age-efficiency profile such that the average earnings (before tax) at age-1 is equal to unity.[30]

Third, the return heterogeneity in the model is characterised by a step function. For an individual $i$ with asset holding $a_i$,

$$1 + r_i = \begin{cases} 1 + \underline{r} & \text{if } a_i < \underline{a}_1 \\ 1 + \underline{r} + r_1^X + \sigma_1^X \cdot \eta & \text{if } \underline{a}_1 \leq a_i < \underline{a}_2 \\ 1 + \underline{r} + r_2^X + \sigma_2^X \cdot \eta & \text{if } \underline{a}_2 \leq a_i \end{cases}$$

where the *i.i.d.* standard normal idiosyncratic shock $\eta$ takes values of $[-1, 0, 1]$ with probabilities $[0.3085,\ 0.3829,\ 0.3085]$. There are 6 parameters to be calibrated: I set $\{r_1^X, r_2^X\} = \{0.051, 0.071\}$ and $\{\sigma_1^X, \sigma_2^X\} = \{0.023, 0.051\}$ respectively based on Table 4.1 while the remaining two threshold parameters $\{\underline{a}_1, \underline{a}_2\}$ are internally calibrated to match the concentration at the top of distribution.[31]

Next, the social security payroll tax rate, $\tau_{ss} = 7.65\%$ and the parameters governing the progressivity of labour earnings income, $\mu_e = 0.1327$ and $\chi_e = 0.1575$ are taken from Wu and Krueger (2021).[32] Lastly, I assume government consumes a constant fraction of output ($G/Y = 18\%$) in each period and outstanding government debt $B$ is set such that the government debt-to-GDP ratio is 55% in the initial equilibrium. Both are taken from the FRED.

[29] I set $\epsilon_j = 0$ for $j \geq J_r$ due to mandatory retirement at age 65 (i.e. $j = 9$) in the model.

[30] The normalisation used in exercise is such that 1 unit in the model corresponds to 5-year average earnings of households at age 25, $\$53,488 \times 5 = \$267,440$ in 2019 US dollars based on SCF (2001). See Appendix C.1 for more information on the calibration of earnings process.

[31] See Appendix C.2 for more information on the choices of means and standard deviations of excess returns.

[32] Wu and Krueger (2021) estimate the two parameters, $\mu_e$ and $\chi_e$ for the U.S. by running the OLS regression: $\ln(e - T_\ell(e)) = \ln(1 - \chi_e) + (1 - \mu_e)\ln(e)$ where the tax liabilities $T_\ell(e)$ are defined as federal income taxes minus eligible amounts of the Earned Income Tax Credit (EITC) and food stamp benefits.

Table 8 below summarises the remaining parameters that are internally calibrated. Some parameters can be fixed directly by the equilibrium conditions. For instance, I assume the initial equilibrium annual real interest rate is $r = 7\%$ which requires capital to depreciate at $\delta_k = 3.85\%$ annually. The level of technology is normalised $A = 1.096$ such that the equilibrium wage rate per efficiency unit of labour is $w = 1$ following Kindermann and Krueger (2021). Given the exogenously chosen social security tax rate of $\tau_{ss} = 7.65\%$, the common social security benefits each retiree receive is equivalent to $32,190 in 2019 US dollars.

**Table 8:** Internally Calibrated Parameters

| Parameter | | Value | Target/Data |
|---|---|---|---|
| Time discount factor | $\beta$ | 0.9613 | $K/Y = 3.10$ |
| Bequest intensity | $\phi_1$ | 1.40 | $B/W = 0.01$ |
| Bequest luxury parameter | $\phi_2$ | 1.10 | Sources of transfers to under 30 |
| Bequest preference at age $J$ | $\kappa$ | 0.77 | Flow of transfers to under 30 |
| Technology level | $A$ | 1.096 | $w = 1$ |
| Capital depreciation rate | $\delta_k$ | 3.85% | $r^* = 7\%$ |
| Aggregate return component | $\underline{r}$ | 5.28% | $r^* \int a\, d\Phi = \int \left(\underline{r} + r^X(a) + \sigma^X(a)\eta\right) \cdot a\, d\Phi$ |
| 1st excess return threshold | $\underline{a}_1$ | \$ 7.4 M | Share of wealth held by 95th-99th percentiles |
| 2nd excess return threshold | $\underline{a}_2$ | \$ 39.7 M | Share of wealth held by top 1% |
| Social security benefit | $s$ | \$ 32,190 | Social security budget balance |
| Capital income tax rate | $\tau_a$ | 10.60% | Government budget balance |
| Estate tax rate | $\tau_b$ | 18% | Estate tax revenue (as % of GDP) |
| Estate tax exemption threshold | $\chi_b$ | \$ 6.4 M | % of estates that are subject to tax |

*Note.* Unless stated otherwise, parameters are reported at an annual frequency.

Remaining parameters are chosen jointly to match the target moments. First, the discount factor, $\beta$ and the bequest intensity parameter, $\phi_1$ are chosen to match the capital-labour ratio of 3.10 and bequest-wealth ratio of 1% respectively. The bequest luxury parameter, $\phi_2$ endogenously segments age-$J$ households into bequesters and non-bequesters and only bequesters leave bequests to grandchild, I choose $\phi_2$ to target the fraction of households who inherit from grandparents. The bequest preference at the final age, $\kappa_J$ is chosen to match the relative size of inheritance from grandparents.[33]

The exogenous wealth thresholds to earn excess returns, $\{\underline{a}_1, \underline{a}_2\}$ are set to $\underline{a}_1 = \$7.4$ million and $\underline{a}_2 = \$39.6$ million to match the shares held by 95th-99th percentiles and top 1%, respectively. The aggregate return component, $\underline{r}$ is found to be 5.28% in the baseline. Lastly, the main estate parameters, $\tau_b$ and $\chi_b$ are chosen to match the fraction of estate tax revenue to output (0.33%) and the fraction of estates that are subject to tax (2.0%) respectively, as in De Nardi and Yang (2016). In the baseline, $\tau_b = 0.18$ and $\chi_b = \$6.4$ million. Finally, the capital income tax rate of $\tau_a = 10.60\%$ balances the government budget.

[33]The model bequest parameters implies that for households at $j = J$, the intended bequest motive is active if the beginning-of-period wealth is greater than $384,140.

### 4.1 Calibration Results

Table 9 reports the distribution of labour earnings and wealth in both the data and the model along with their respective Gini coefficients. The baseline model produces cross-sectional distributions of both earnings and wealth that closely align with empirical counterparts. In particular, it generates a substantial concentration of wealth at the upper end of the wealth distribution.

**Table 9:** Earnings and Wealth Distributions in Benchmark Economy

| | Share of total sample (in %) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Quintiles | | | | | Top (%) | | | |
| | 1st | 2nd | 3rd | 4th | 5th | 90-95 | 95-99 | 99-100 | Gini |
| **Earnings** | | | | | | | | | |
| Data | 0 | 5 | 12 | 21 | 62 | 11 | 16 | 19 | 0.63 |
| Model | 0 | 5 | 12 | 20 | 63 | 10 | 16 | 19 | 0.62 |
| **Wealth** | | | | | | | | | |
| Data | 0 | 1 | 4 | 12 | 83 | 12 | 25 | 32 | 0.81 |
| Model | 0 | 0 | 3 | 12 | 85 | 12 | 28 | 32 | 0.83 |

Table 10 and Table 11 report a list of targeted moments and aggregate variables in the baseline model. The calibrated earnings process generates both parent-child earnings correlation and the earnings mean-to-median ratio that are close to the data. The model is also able to generate overall bequest characteristics. In the model, only 2.20% of estates are taxable and the ratio of government estate tax revenue to output is 0.37%. Moreover, it also matches both extensive and intensive margins of inheritances from grandparents.

**Table 10:** Targeted Moments and Empirical Counterparts

| Target | Source | Target/Data | | Model | |
|---|---|---|---|---|---|
| Capital-output ratio | · | 3.10 | | 3.10 | |
| Aggregate interest rate | · | 7.00 | | 7.00 | |
| Share held by 95-99th percentile | SCF (2001) | 0.25 | | 0.28 | |
| Share held by Top 1% | SCF (2001) | 0.32 | | 0.32 | |
| Parent-child earnings correlation | Solon (1992) | 0.40 | | 0.40 | |
| Earnings mean-median ratio | SCF (2001) | 1.71 | | 1.71 | |
| Bequest-to-wealth ratio | SCF (2001) | 1.10% | | 1.89% | |
| Estate tax revenues (as % of GDP) | Gale et al. (2001) | 0.33% | | 0.37% | |
| % of estates that are subject to tax | Gale et al. (2001) | 2.00% | | 2.20% | |
| | | From Grandparents | Parents | From Grandparents | Parents |
| Flow of Transfers to under 30 | SCF (1989 - 2019) | 52% | 48% | 52% | 48% |
| Sources of Transfers to under 30 | SCF (1989 - 2019) | 52% | 48% | 53% | 47% |

*Note.* Unless stated otherwise, parameters are reported at an annual frequency.

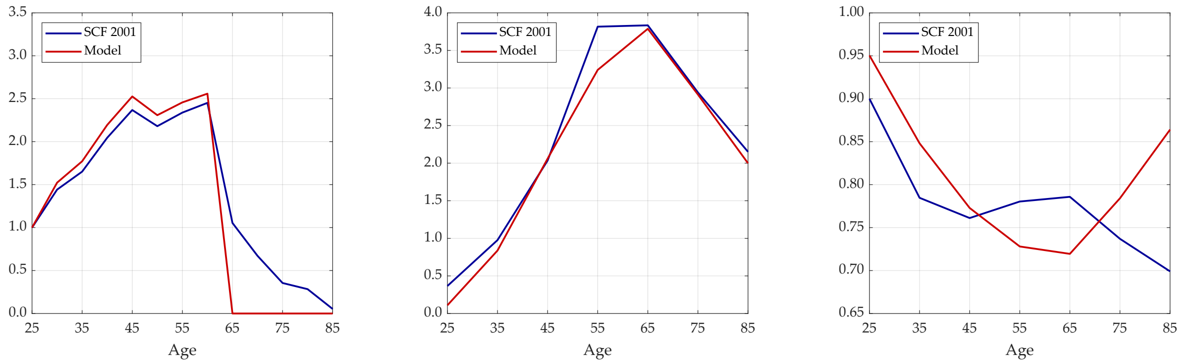
**Table 11:** Macroeconomic Variables

| Parameter | Value | Parameter | Value |
|---|---|---|---|
| Capital | 310.0% | Tax revenues | |
| Government debt | 55.0% | - Labour income | 18.32% |
| | | - Capital income | 4.27% |
| Consumption | 67.5% | - Estate | 0.37% |
| Investment | 14.5% | Pension System | |
| Government Consumption | 18.0% | Contribution rate (in %) | 7.65% |

*Note.* All variables in % of GDP if not indicated otherwise.

Figure 3 presents the life-cycle earnings and wealth profiles in the baseline economy. The calibrated earnings process reasonably replicates the mean earnings profile over the life cycle until retirement age.[34]

**Figure 3:** Life-cycle Earnings and Wealth Profile and Gini coefficient by Age




**(a)** Earnings (Targeted) **(b)** Wealth (Targeted) **(c)** Gini by Age (Untargeted)

The average wealth by age aligns well with empirical data for younger and middle-aged households; it accurately reflects the hump-shaped profile and the gradual depletion of wealth by older households observed in empirical data.[35] The model also accurately reproduces the pronounced wealth inequality observed in early life stages, gradual decrease in wealth inequality towards the middle-age, but it exaggerates inequality among retirees. A possible explanation is that, in reality, some households continue to work and earn labour income, as shown on the left panel whereas, in the model, they rely solely on uniform social security transfers and previously accumulated wealth. The bequest motive could also contribute to the elevated inequality observed among older households.

Having calibrated a model economy to the broad characteristics of the U.S. economy from 1990-2000, next section describes the counterfactual policy experiment and presents the main result of this paper.

[34]Any discrepancy post age 65 is attributed to the mandatory retirement in the model.
[35]Note that the average wealth at age 55 in SCF (2001) is somewhat higher than in SCF (1998) or SCF (2004). This discrepancy may be due to sampling error in the survey data.

## 5 Results

In this section, I investigate the aggregate and distributional effects of changes in estate tax policy, by adjusting the two estate tax parameters, namely the estate exemption threshold level, $\chi_b$ and the estate tax rate, $\tau_b$.

$$T(b) = \max\{0, \tau_b(b - \chi_b)\}$$

Implementing estate tax reforms can take the form of adjusting the exemption threshold, the tax rate, or both. Yet, they affect households in different ways. For example, a relaxation of estate taxation through raising the threshold implies (i) estates previously subjected to tax are now exempt if they fall below the new threshold, and (ii) such estates incur less tax if they exceed the new threshold. That is, changes in the exemption level affect both the magnitude of taxable estates and the tax burden. On the other hand, reducing the tax rate only lessens the tax load for those households which were already in the tax net.

*Counterfactual Policy Experiment* This involves implementing government revenue-neutral estate tax reforms. Specifically, I vary $\chi_b$ and/or $\tau_b$ and simulate the model until it converges to a new stationary distribution to analyse the long run impact of changes in estate tax policy on wealth distribution. In doing so, the capital income tax is adjusted to restore government budget balance.

Table 12 shows the policy changes considered in this section. During the period 1990-2000, the average estate exemption threshold was $1 million (in 2019 values), the highest tax bracket threshold was $6.2 million, and the average effective estate tax rate was 18 percent.[36] By 2019, the exemption threshold had increased to $11.4 million, and the highest tax bracket threshold had doubled to $12.4 million, leading to a decrease in the effective tax rate to 16 percent. Since I abstract from the progressivity of estate taxes and that the calibrated tax parameters are close to the highest tax bracket threshold, I consider a main counterfactual scenario involving a 2 percentage-point decrease in the estate tax rate and a doubling of exemption threshold.

**Table 12:** Counterfactual Policy Experiments

| | Data | | | Model | | |
|---|---|---|---|---|---|---|
| | 1990-2000 | 2019 | | Baseline | Counterfactuals | |
| Estate Exemption Threshold | $1.04 | $11.40 | $\chi_b$ | $6.4 | $12.9 | $26.1 |
| Highest Tax Bracket Threshold | $6.16 | $12.40 | | | | |
| Effective Estate Tax Rate | 18.2% | 15.8% | $\tau_b$ | 18% | 16% | 14% |

*Note.* All numbers with $ are in 2019 US millions.
*Source.* U.S. Internal Revenue Service.

[36] In practice, estate taxes are also progressive, hence the gap between the exemption threshold and the highest tax bracket threshold as shown in Table 12. During 1990-2000, the estate tax rates above the exemption level ranged from 18 percent to 55 percent.

Table 13 presents the aggregate and distributional effects of simultaneously relaxing estate tax policy in both dimensions. Panel *a* shows that these policy changes result in increased capital and output in the economy, which in turn, leads to raising wage $w$, and reducing the aggregate return component $\underline{r}$. Capital-output ratio increases and the bequest-to-wealth ratio increases as expected. Additionally, due to the decreased fraction of taxable estates and the resulting reduction in estate tax revenue caused by the increased exemption level, the capital income tax must increase to re-establish the government budget.

**Table 13:** Aggregate and Distributional Effects of Relaxing Both $\chi_b$ and $\tau_b$

| *a.* | Aggregate Effects | | | | | | | | | Government Revenue | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\tau_b$ | $\chi_b$ | $\tau_a$ | $K$ | $Y$ | $K/Y$ | $B/W$ | $r^*$ | $\underline{r}$ | Frac. | Estate | Labour | Capital |
| * | 0.18 | \$ 6.4 | 10.60 | 7.656 | 2.470 | 3.100 | 1.89% | 7.00 | 5.28 | 2.20% | 0.37% | 18.32% | 4.27% |
| | 0.16 | \$12.9 | 10.94 | 7.748 | 2.480 | 3.124 | 1.93% | 6.93 | 5.18 | 0.31% | 0.21% | 18.35% | 4.36% |
| | 0.14 | \$26.1 | 10.90 | 7.840 | 2.491 | 3.148 | 1.95% | 6.87 | 5.00 | 0.10% | 0.16% | 18.37% | 4.29% |

| *b.* | Distributional Effects | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Percentile (%) | | | |
| | $\tau_b$ | $\chi_b$ | Gini | Top 20% | 90-95 | 95-99 | 99-99.9 | 99.9-100 |
| * | 0.18 | \$ 6.4 | 0.8328 | 85.1 | 12.1 | 28.1 | 19.5 | 12.6 |
| | 0.16 | \$12.9 | 0.8390 | 85.8 | 11.8 | 28.2 | 19.4 | 13.9 |
| | 0.14 | \$26.1 | 0.8477 | 86.7 | 11.3 | 28.1 | 20.7 | 14.7 |

*Note.* Rows marked with an asterisk indicate the baseline. The second row presents steady-state results when the exemption threshold ($\chi_b$) is increased to \$12.9 million and the estate tax rate ($\tau_b$) is reduced to 16%. The third row presents steady-state results when the exemption threshold is further increased to \$26.1 million and the estate tax rate is reduced to 14%. Government revenues are shown as a percentage of GDP. Frac. indicates the fraction of estates subject to estate taxes.

In terms of the wealth distribution, it unambiguously amplifies the wealth concentration in the economy. The share held by the top 1 percent group increases by 1.2 percentage points (from 32.1 percent to 33.3 percent). In the data, the share held by the top 1 percent increased by 5 percentage points (See Table 3.3). This suggests that the model explains one-fourth of the observed increase in wealth concentration in the data. Aggregate Gini slightly increases from 0.833 to 0.839. As an additional exercise, I consider the scenario when the estate tax policy is further relaxed to an estate tax rate of 14 percent and an exemption level of \$26.1 million, the share held by the top 1 percent increases by an additional 2 percentage points, causing the aggregate Gini to increase to 0.848.

This finding is in stark contrast to De Nardi and Yang (2016) who found that the share held by the top 1 percent increased by 1.7 percentage points following the complete abolition of the estate tax (i.e., relaxing the estate tax rate from 21 percent to 0). The differences arise because the main driving forces are different in the two models. De Nardi and Yang (2016) use an earnings process that targets both earnings and wealth distribution, whereas in my model, earnings heterogeneity alone cannot generate such a high concentration of wealth. Hence, when return heterogeneity is employed to generate wealth inequality, the role of inheritance in wealth accumulation becomes crucial. The main result in this paper is also broadly consistent with Nekoei and Seim (2023) in that, inheritances increase wealth inequality in the long run since the different depletion rates, arising from return heterogeneity, widen the inequality in inherited wealth over time.

For a more comprehensive understanding of how each tax parameter affects the economy differently, I revisit the counterfactual experiment by relaxing one component while keeping the other fixed at the benchmark.

*Estate Tax Exemption Threshold* Table 14 below present the steady-state results of counterfactual scenarios in which only the exemption threshold is increased—from \$6.4 million to \$12.9 million and then further to \$26.1 million, respectively—while the estate tax rate remains unchanged at the benchmark rate of 18%.

Panel *a* presents the aggregate effects of increasing the exemption level. It substantially reduces the fraction of taxable estates. This allows relatively wealthier households to pass on more wealth to their offspring, thereby increasing the bequest-to-wealth ratio slightly. This leads to higher capital and output in the economy, which in turn increase wages and put downward pressure on return to capital. While increased wage slightly raises government revenue from labour income, reduced government revenue from estate tax implies that the capital income tax has to rise to re-establish the government budget.

**Table 14:** Aggregate and Distributional Effects of Changing $\chi_b$

*a.* Aggregate Effects

| | $\tau_b$ | $\chi_b$ | $\tau_a$ | $K$ | $Y$ | $K/Y$ | $B/W$ | $r^*$ | $\underline{r}$ | Frac. | Government Revenue: Estate | Labour | Capital |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * | 0.18 | \$ 6.4 | 10.60 | 7.656 | 2.470 | 3.100 | 1.89% | 7.00 | 5.28 | 2.20% | 0.37% | 18.32% | 4.27% |
| | 0.18 | \$12.9 | 11.08 | 7.702 | 2.475 | 3.112 | 1.92% | 6.97 | 5.25 | 0.31% | 0.20% | 18.33% | 4.43% |
| | 0.18 | \$26.1 | 11.10 | 7.764 | 2.482 | 3.128 | 1.94% | 6.92 | 5.10 | 0.08% | 0.16% | 18.35% | 4.41% |

*b.* Distributional Effects

| | $\tau_b$ | $\chi_b$ | Gini | Top 20% | Percentile (%): 90-95 | 95-99 | 99-99.9 | 99.9-100 |
|---|---|---|---|---|---|---|---|---|
| * | 0.18 | \$ 6.4 | 0.8328 | 85.1 | 12.1 | 28.1 | 19.5 | 12.6 |
| | 0.18 | \$12.9 | 0.8348 | 85.4 | 12.0 | 28.9 | 19.7 | 12.1 |
| | 0.18 | \$26.1 | 0.8425 | 86.2 | 11.7 | 28.8 | 21.3 | 12.2 |

*Note.* Rows marked with an asterisk indicate the baseline. The second and third rows present the steady-state results of counterfactual scenarios in which only the exemption threshold ($\chi_b$) is increased—from \$6.4 million to \$12.9 million and then further to \$26.1 million, respectively—while the estate tax rate ($\tau_b$) remains unchanged at the benchmark rate of 18%. Government revenues are shown as a percentage of GDP. Frac. indicates the fraction of estates subject to estate taxes.

Panel *b* presents the distributional effects of increasing the exemption level. It is worth-noting that the aggregate inequality as measured by the Gini coefficient increases only slightly from 0.833 to 0.835 since the distributional effect is heterogeneous across different wealth groups. The share held by households in the 95th-99th percentiles increases, while the share held by the top 1 percent decreases. Relaxing the exemption level increases the share of wealth held by the marginal household group, who directly benefit from being fully exempt from taxes following the tax reform. On the other hand, households with wealth exceeding the new threshold even before the tax reform lose their share. Despite the reduced tax burden that may allow them to pass more wealth tax-free when the new policy is introduced, it is not sufficient for their heirs to accumulate wealth to the same extent as their ancestors in the long run due to the reduced interest rate and increased capital income tax.

*Estate Tax Rate* Next, Table 15 present steady-state results for counterfactual scenarios in which only the estate tax rate is decreased—from 18% to 16% and then further to 14%, respectively—while the exemption threshold remains unchanged at the benchmark level of $6.4 million.

**Table 15:** Aggregate and Distributional Effects of Changing $\tau_b$

| *a.* | Aggregate Effects | | | | | | | | | Government Revenue | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\tau_b$ | $\chi_b$ | $\tau_a$ | $K$ | $Y$ | $K/Y$ | $B/W$ | $r^*$ | $\underline{r}$ | Frac. | Estate | Labour | Capital |
| * | 0.18 | $ 6.4 | 10.60 | 7.656 | 2.470 | 3.100 | 1.89% | 7.00 | 5.28 | 2.20% | 0.37% | 18.32% | 4.27% |
| | 0.16 | $ 6.4 | 10.52 | 7.714 | 2.476 | 3.115 | 1.91% | 6.96 | 5.19 | 2.19% | 0.36% | 18.34% | 4.21% |
| | 0.14 | $ 6.4 | 10.48 | 7.761 | 2.482 | 3.127 | 1.92% | 6.92 | 5.11 | 2.20% | 0.34% | 18.35% | 4.17% |

| *b.* Distributional Effects | | | | | Percentile (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | $\tau_b$ | $\chi_b$ | Gini | Top 20% | 90-95 | 95-99 | 99-99.9 | 99.9-100 |
| * | 0.18 | $ 6.4 | 0.8328 | 85.1 | 12.1 | 28.1 | 19.5 | 12.6 |
| | 0.16 | $ 6.4 | 0.8376 | 85.6 | 11.8 | 27.6 | 19.2 | 14.3 |
| | 0.14 | $ 6.4 | 0.8422 | 86.0 | 11.6 | 27.2 | 19.1 | 15.9 |

*Note.* Rows marked with an asterisk indicate the baseline. The second and third rows present steady-state results for counterfactual scenarios in which only the estate tax rate ($\tau_b$) is decreased—from 18% to 16% and then further to 14%, respectively—while the exemption threshold ($\chi_b$) remains unchanged at the benchmark level of $6.4 million. Government revenues are shown as a percentage of GDP. Frac. indicates the fraction of estates subject to estate taxes.

Panel *a* presents the aggregate effects of relaxing the estate tax rate. Similar to the exemption level, this policy change leads to more capital and output in the economy, subsequently increasing equilibrium wages and reducing the interest rate. However, it does not affect the fraction of taxable estates since this policy change only targets households who were already subject to the estate tax. As a result, government estate tax revenue remains unaffected. In fact, the government accrues more taxes from wealthy households who benefit from the reduced estate tax rate and increase their wealth. Therefore, the capital income tax rate is reduced to balance the government budget.

Similarly, relaxing the estate tax rate has a relatively small effect on the aggregate Gini, increasing it from 0.833 to 0.838, but it introduces subtle changes in the distribution at the top and very top. Moreover, the impact is greater than that of the exemption level, as it affects households in the opposite manner. The share held by the top 1% (or more precisely, the top 0.1%) increases, while the shares of all other groups decline, including those of households in the 95th-99.9th percentiles. This occurs because, for these groups, the reduction in the return to capital outweighs the benefits of the reduced capital income and estate tax rates in the long run.

In summary, relaxing estate tax policy in either form leads to higher capital and output in the economy but at the cost of increased wealth concentration. However, these different estate tax instruments have distinct effects on the economy. For example, raising the exemption threshold increases capital income tax, while lowering the tax rate decreases capital income tax to rebalance the government budget. Regarding wealth distribution, both tax parameters impact the household groups that benefit directly from the policy changes. Increasing the exemption level raises the wealth share of the 95th–99th percentile group, as they benefit from full tax exemption, whereas reducing the estate tax rate increases the share held by the top 1 percent, who were already subject to the tax. When both parameters are relaxed simultaneously, the offsetting effects from each adjustment neutralise each other: the wealth share of the 95th–99th percentiles remains stable, while the wealth of the top 1 percent increases.

*Inheritances & Return Heterogeneity* How does inheritance interact with the return heterogeneity in the model? Recall that the return heterogeneity is modelled in a simplified way; both return and risk increase in the level of wealth, returns are persistent because wealth is. Specifically, households earn the first excess return if their wealth exceeds $7.4 million and earn the second excess return if their wealth exceeds $40 million.

In the model, agents enter the economy at age 25 with zero wealth, at which point they begin to supply labour to earn wages, pay taxes, consume and save. Table 16 shows that there is a very small but certainly positive mass of households that earn excess returns at age 30. However, the calibrated earnings process and the tax system in the model imply that it is impossible, in the absence of inheritances, for these newly entered households to accumulate sufficient wealth in just one model period to earn excess returns.[37]

[37]The calibrated earnings process implies that agents can earn at most $3.5 million (5-year) at entry by drawing the highest productivity state. They are subject to progressive labour income tax, social security payroll tax, and taxes on capital income if invested.

**Table 16:** Fraction of Age 30 Households Attaining Excess Returns

| | | | % Age 30 Households access to | |
|---|---|---|---|---|
| | $\chi_b$ | $\tau_b$ | 1st Excess Return ($a \geq \$7.4$) | 2nd Excess Return ($a \geq \$40$) |
| Baseline | \$ 6.4 | 0.18 | 0.076 | 0.0042 |
| $\Delta$ both | \$12.9 | 0.16 | 0.093 | 0.0053 |
| | \$26.1 | 0.14 | 0.102 | 0.0050 |
| $\Delta\chi_b$ | \$ 12.9 | 0.18 | 0.095 | 0.0041 |
| | \$ 26.1 | 0.18 | 0.105 | 0.0042 |
| $\Delta\tau_b$ | \$ 6.4 | 0.16 | 0.077 | 0.0053 |
| | \$ 6.4 | 0.14 | 0.078 | 0.0063 |

In the baseline, 0.076% and 0.0042% of age 30 households earn first and second excess returns respectively. Therefore, heirs from wealthy families start their lives at the top of the distribution and are likely to stay there, accumulating wealth faster than others by securing excess returns from the very beginning. Given the current demographic structure, there exist three possibilities: First, agents may inherit accidental bequests if his parents pass away prematurely. Second, they may receive bequests from affluent grandparents even if the parents survive. Lastly, some may inherit from both parents and grandparents.

Relaxing the estate tax slightly increases the proportion of age 30 households attaining excess returns. Increasing the thresholds raises the fraction of households attaining the first excess return at age 30, whereas decreasing the estate rate increases the fraction of households attaining the second excess return at age 30. This explains why the two tax reforms affect households at the top 0.1 percent and 95th-99.9th percentiles differently in the experiments.

*G-G Link* Finally, I investigate the extent to which the G-G link has any implications in the model by shutting down the G-G link, setting $\kappa = 1$ holding all else constant. That is, starting from the benchmark economy, I shut down the G-G link and simulate the model until it converges to a new stationary distribution.

Table 17 presents the aggregate and distributional effects in the long run when households are allowed to pass on wealth only to their direct children in the model. Eliminating the G-G link weakens wealth concentration, with the share held by the top 1 percent decreasing by 0.8 percentage points, and the share held by the 95th-99th percentiles dropping by 0.4 percentage points. This highlights the significance of the G-G link in wealth accumulation, particularly for those at the top of the distribution. Since these households are unable to accumulate as much wealth, both capital and output in the economy decrease and the aggregate return component, $\underline{r}$, increases from 5.28 percent to 5.40 percent to achieve equilibrium.

**Table 17:** Steady-state with and without G-G Link

| *a.* | Aggregate Effects | | | | | | | | Government Revenue | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\kappa$ | $\tau_a$ | $K$ | $Y$ | $K/Y$ | $B/W$ | $r^*$ | $\underline{r}$ | Frac. | Estate | Labour | Capital |
| $*$ | 0.77 | 10.60 | 7.656 | 2.470 | 3.100 | 1.89% | 7.00 | 5.28 | 2.20% | 0.37% | 18.32% | 4.27% |
| | 1.00 | 10.75 | 7.623 | 2.466 | 3.091 | 1.90% | 7.02 | 5.40 | 2.14% | 0.35% | 18.31% | 4.35% |

| *b.* Distributional Effects | | | | Percentile (%) | | | |
|---|---|---|---|---|---|---|---|
| | $\kappa$ | Gini | Top 20% | 90-95 | 95-99 | 99-99.9 | 99.9-100 |
| $*$ | 0.77 | 0.8329 | 85.1 | 11.8 | 28.1 | 19.5 | 12.6 |
| | 1.00 | 0.8285 | 84.7 | 12.3 | 27.7 | 19.2 | 12.1 |

*Note.* Rows marked with an asterisk indicate the baseline. The second row presents steady-state results for an alternative scenario in which bequests to grandchildren are not permitted. This is achieved by setting the bequest preference parameter ($\kappa_J = 1$), while all other factors, including estate tax policy, remain unchanged. Government revenues are shown as a percentage of GDP. Frac. indicates the fraction of estates subject to estate taxes.

Eliminating the G-G link weakens wealth concentration, with the share held by the top 1 percent decreasing by 0.8 percentage points, and the share held by the 95-99 percentile dropping by 0.4 percentage points. This highlights the significance of the G-G link in wealth accumulation, particularly for those at the top of the distribution. Since these households are unable to accumulate as much wealth, both capital and output in the economy decrease and the aggregate return component, $\underline{r}$, increases from 5.28 percent to 5.40 percent to achieve equilibrium.

Table 18 compares Gini coefficients by age with and without the G-G link.[38] On average, it amplifies wealth inequality across all age groups, and this discrepancy tends to increase with age. This highlights that inequality induced by the G-G link persists throughout the life-cycle.

**Table 18:** Gini coefficient by age in model with and without G-G Link

| Age | Data | With G-G Link | Model<br>Without G-G Link | Δ |
|---|---|---|---|---|
| 25 | 0.976 | n/a | n/a | n/a |
| 30 | 0.760 | 0.898 | 0.895 | 0.0034 |
| 35 | 0.795 | 0.850 | 0.849 | 0.0003 |
| 40 | 0.763 | 0.836 | 0.836 | 0.0005 |
| 45 | 0.756 | 0.795 | 0.793 | 0.0017 |
| 50 | 0.777 | 0.748 | 0.744 | 0.0038 |
| 55 | 0.764 | 0.734 | 0.727 | 0.0065 |
| 60 | 0.797 | 0.721 | 0.710 | 0.0112 |
| 65 | 0.755 | 0.707 | 0.697 | 0.0103 |
| 70 | 0.785 | 0.734 | 0.722 | 0.0121 |
| 75 | 0.710 | 0.767 | 0.753 | 0.0139 |
| 80 | 0.776 | 0.809 | 0.792 | 0.0172 |
| 85 | 0.685 | 0.864 | 0.840 | 0.0246 |
| Aggregate | 0.805 | 0.833 | 0.829 | 0.004 |

[38] The data Gini for age 25 is calculated using date from households aged between 23 and 27 in SCF. The model Gini is computed based on households' beginning-of-period wealth. As households begin with zero wealth, Gini at age 25 in the model is effectively zero.

There is a noticeable difference in inequality within age 30 households compared to age 35 and 40. The discrepancy starts to get larger in middle-age at 50-55 as households receive second inheritances from parents. From retirement onward, the gap continues to widen due to mandatory retirement, uniform social security benefits, and return heterogeneity: households who accumulated sufficient wealth continue to earn excess returns while others rely on common social security benefits.

Table 19 explains the noticeable difference in inequality within age 30 households compared to age 35 and 40. It is clear that shutting down the G-G link reduces slightly the fraction of households attaining excess returns at age 30 compared to the model with the G-G link. In particular, it reduces share of households attaining the second excess return more than the share attaining the first excess return.[39] While applying the same estate tax reforms increase these fractions, they do not increase as much compared to the model with the G-G link.

**Table 19:** Fraction of Age 30 Households Attaining Excess Returns

| | | | With G-G Link | | Without G-G Link | |
|---|---|---|---|---|---|---|
| | | | % Age 30 Households access to | | % Age 30 Households access to | |
| | $\chi_b$ | $\tau_b$ | 1st Excess Return ($a \geq \$7.4$) | 2nd Excess Return ($a \geq \$40$) | 1st Excess Return ($a \geq \$7.4$) | 2nd Excess Return ($a \geq \$40$) |
| Benchmark | \$ 6.4 | 0.18 | 0.076 | 0.0042 | 0.066 | 0.0027 |
| Δ both | \$ 12.9 | 0.16 | 0.093 | 0.0053 | 0.084 | 0.0029 |
| | \$ 26.1 | 0.14 | 0.102 | 0.0050 | 0.088 | 0.0033 |

*Note.* All numbers with \$ are in 2019 US millions.

Finally, Table 20 compares the distributional effects of changes in estate taxes with and without the G-G link. Following the same estate tax reforms, the increase in the aggregate Gini coefficient (compared to their respective benchmarks) is relatively consistent between the two scenarios. However, the increase in wealth concentration is more pronounced in the model with the G-G link.

**Table 20:** Distributional Effects in model with and without G-G Link

| Distributional Effects | | | With G-G Link | | | | Without G-G Link | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\chi_b$ | $\tau_b$ | Gini | 95-99 | 99-99.9 | 99.9-100 | Gini | 95-99 | 99-99.9 | 99.9-100 |
| Benchmark | \$ 6.4 | 0.18 | 0.833 | 28.1 | 19.5 | 12.6 | 0.829 | 27.7 | 19.2 | 12.1 |
| | \$ 12.9 | 0.16 | 0.839 (+0.006) | 28.2 (+0.10) | 19.4 (−0.10) | 13.9 (+1.31) | 0.835 (+0.006) | 28.5 (+0.77) | 19.3 (+0.15) | 12.6 (+0.43) |
| | \$ 26.1 | 0.14 | 0.848 (+0.015) | 28.1 (+0.00) | 20.7 (+1.28) | 14.7 (+2.09) | 0.844 (+0.015) | 28.2 (+0.46) | 20.5 (+1.33) | 13.7 (+1.55) |

*Note.* Values in parentheses represent changes relative to the benchmark.

[39] It is worth-noting that they are still positive due to accidental bequests from parents.

For instance, when applying estate tax reforms that mimic the actual changes between 2000 and 2019, the share held by the top 1 percent increases by 1.2 percentage points when the G-G link is active, while it increases by 0.6 percentage points when the G-G link is absent. Further relaxation of estate taxes also results in a more substantial increase in the top 1 percent's wealth holding when the G-G link is active (3.28 percentage points vs. 2.88 percentage points). I conclude that the G-G link tends to amplify the qualitative effects of estate tax reforms, though the quantitative magnitude remains modest.

This is not surprising because when the G-G link is active, wealthy households at the final period can split their wealth between children and grandchildren, in which case separate estate taxes apply to each transfer. Hence, when estate taxes are relaxed, such relaxation applies separately to inheritances given to children and grandchildren, amplifying the effects of estate tax reforms.

## 6 Concluding Remarks

In this paper, I investigate the long-term aggregate and distributional implications of the recent relaxation in estate taxes in the U.S. Empirical evidence suggests that, for younger households, the link between households and their grandparents is particularly strong, with the size of inheritances from grandparents being significant and even larger than those from parents. As well, wealthy households tend to have portfolios that lean more towards assets with high returns. Motivated by these facts, I develop a general equilibrium life-cycle model that features heterogeneities in earnings, rates-of-returns and bequests.

Counterfactual experiments demonstrate that relaxing estate taxes increases wealth concentration. In the model, inheritances play a significant role in shaping wealth concentration. Households from wealthy families not only inherit substantial wealth but also benefit from higher returns on the inherited wealth. This allows them to accumulate wealth more rapidly than others from the beginning. Furthermore, I find that shutting the G-G link leads to lower capital and output and weakens wealth concentration at the top of the distribution.These findings highlight the importance of investigating the potential significance of the G-G link in shaping wealth accumulation dynamics and its broader implications, emphasising the need for further research in this area.

While the presented model fits key characteristics of the U.S. quite well, there are several dimensions in which it can be further improved and expanded. Firstly, the estate tax is represented in the model using a simple piece-wise linear function. Given that detailed estate tax schedules are readily available, incorporating the actual progressive estate tax schedules, would significantly enhance the precision and depth of the quantitative analysis presented in this study.

Second, I abstract from labour supply distortions resulting from inheritances and estate tax reforms. Furthermore, I introduced return heterogeneity such that households who inherit larger wealth are entitled to earn a higher return on inherited wealth. While this specification captures the strong relationship between household's overall wealth and return characteristics in a simplified way, endogenising these aspects could be potentially important and valuable extensions to the existing literature. Furthermore, I assume there is only one period of overlap between grandparents and children in the model due to computational limitations, whereas the relationship remains quite strong until age 40 in the data. Hence, the present model may fail to fully capture the effects arising from this channel. It would be necessary to have multiple periods of overlap between grandparents and child to explore this link more precisely.

Moreover, the current paper highlights the importance of return heterogeneity and how it amplifies the effects of bequests from parents and grandparents. In the model, returns are scale heterogeneous, meaning that a larger stock of wealth generates a higher return. While this specification captures the fact that wealthier households, on average, earn higher returns, it would be interesting to investigate type heterogeneity as in Cagetti and De Nardi (2006, 2009). For instance, larger transfers received from grandparents at younger ages, when individuals are more likely to be borrowing constrained, may more effectively help those with entrepreneurial ability to earn higher returns through business ventures. As well, it would also be interesting to study the relative importance of the G-G link and return heterogeneity by turning each feature on and off in shaping wealth distribution and estate tax reforms.

Finally, the current study focuses on steady-state analysis and only examines the aggregate and distributional effects of estate tax reforms. It would be interesting to study transition dynamics and welfare implications. Moreover, the current counterfactual, revenue-neutral estate tax reforms involve the government adjusting capital income taxes to rebalance the government budget. It would also be interesting to study the optimal estate tax reforms by analysing how the results change if the government were to adjust labour income taxes and/or modify their consumption or public debt to balance the budget. All of these topics are left for future research.

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# A Estate Tax Policy in the United States

In fact, estate tax policy in the U.S. has undergone various reforms and changes over the years depending on the political party in power, with reforms often amended by succeeding administrations.[40] The estate tax policy was steadily relaxed until 2009, accompanied by plans to repeal in 2010 then revert back to 2002 provisions in 2011. The plans were, then reversed under the Obama Administration: the 2010 Act maintained the exemption level at $5 million with a top tax rate of 35 percent, which then increased to 40 percent under the 2012 Act, with a scheduled return to $3.5 million in 2018. However, the Tax Cuts and Jobs Act of 2017, enacted during the Trump Administration, temporarily doubled the exemption amount to $11 million from 2018 with a schedule of reverting back to 2017 provisions in 2026. Recently, the Biden Administration's proposal includes a return to 2009 estate exemption levels along with an increased maximum tax rate of 45 percent from 2026. Nonetheless, this issue has garnered significant attention in recent years regardless of political ideology, as the country is expected to experience one of the largest transfers of wealth in its history in the coming years.

**Table A1:** Evolution of Federal Estate Tax Policy in the U.S.

| Year | Tax Rate Range | Exemption Threshold | Exemption Threshold (2019 USD) | Highest Bracket Threshold | Highest Bracket Threshold (2019 USD) | Effective Estate Tax Rate |
|---|---|---|---|---|---|---|
| 1989 | (18 - 55) | 0.600 | 1.197 | 3.600 | 7.185 | 0.180 |
| 1992 | (18 - 55) | 0.600 | 1.074 | 3.600 | 6.445 | 0.177 |
| 1995 | (18 - 55) | 0.600 | 1.002 | 3.600 | 6.013 | 0.179 |
| 1998 | (18 - 55) | 0.625 | 0.982 | 3.625 | 5.695 | 0.190 |
| 2001 | (18 - 55) | 0.675 | 0.977 | 3.675 | 5.318 | 0.181 |
| 2004 | (18 - 48) | 1.500 | 2.035 | 3.500 | 4.748 | 0.205 |
| 2007 | (18 - 45) | 2.000 | 4.180 | 4.000 | 4.943 | 0.199 |
| 2009 | (18 - 45) | 3.500 | 5.694 | 5.500 | 6.568 | 0.186 |
| 2011 | (18 - 35) | 5.000 | 5.876 | 5.500 | 6.263 | 0.142 |
| 2013 | (18 - 40) | 5.250 | 5.769 | 6.250 | 6.868 | 0.171 |
| 2016 | (18 - 40) | 5.450 | 5.805 | 6.450 | 6.870 | 0.173 |
| 2019 | (18 - 40) | 11.400 | 11.400 | 12.400 | 12.400 | 0.158 |

*Note.* Values in parenthesis indicate negative returns.
*Source.* Federal Reserve Board, 1998 - 2019 SCF.

[40] Major legislation include Economic Growth and Tax Relief Reconciliation Act of 2001 and Jobs and Growth Tax Relief Reconciliation Act of 2003 during the Bush Administration, Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 and American Taxpayer Relief Act of 2012 during the Obama Administration and Tax Cuts and Jobs Act 2017 during the Trump Administration.

## A.1 Inheritance/Estate Tax at the State Level

While they are often used interchangeably in the literature, inheritance tax and estate tax are different in practice. The estate tax applies to the decedent's estate, while the inheritance tax applies to the beneficiaries who inherit the assets. As of 2022, there are 12 states[41] and the District of Columbia that impose estate taxes at the state level and 6 states[42] impose inheritance taxes at the state level. Maryland is unique in having both of these taxes, and the specific rules and exemptions can vary depending on the relationship between the decedent and the beneficiary.

[41] These include Connecticut, Hawaii, Illinois, Maine, Maryland, Massachusetts, Minnesota, New York, Oregon, Rhode Island, Vermont and Washington.

[42] These include Iowa, Kentucky, Maryland, Nebraska, New Jersey and Pennsylvania.

# B Survey of Consumer Finances

## B.1 Data and Methodology

I utilise a total of 11 SCF survey datasets spanning from 1989 to 2019. Wealth is defined as the net worth of households, as in Kuhn et al. (2020) and Bricker et al. (2020). Regarding demographics, I categorise households into seven age groups. The youngest group comprises households 30 years or younger, while the oldest group includes households 81 years or older. The five intermediate groups are divided according to 10-year age intervals. In terms of intergenerational transfers, I analyse responses to the following questions in Section X: 'Inheritances and Charity'. These questions are included in each SCF dataset, as shown in Table B1 below.

**Table B1:** List of Questions in Section X, SCF

| SCF Code | Questions |
|---|---|
| x5801 | Have you ever received an inheritance, or been given substantial assets? |
| x5803 | Was that an inheritance, a trust or something else? |
| x5804 | What was its approximate value at the time it was received? |
| x5805 | In what year was it received? |
| x5806 | From whom was it received? |
| x5818 | How much altogether were any others you have received? |
| x5819 | Do you expect to receive a substantial inheritance in the future? |

*Source.* Federal Reserve Board, 1998 - 2019 SCF.

The SCF thoroughly records intergenerational transfer status for up to three past transfers including the sources and the timing of transfers, while any additional transfers are aggregated into a single entry (i.e., see SCF code x5818 above).[43] For each reported past transfer, I utilise the reported approximate values at the time of receipt, along with the year of receipt and the year of the survey, to adjust all past transfers to 2019 U.S. dollars using the Bureau of Labour Statistics (BLS) Consumer Price Index for Urban Consumers (CPI-U-RS).

[43]For robustness, I compared two different calculations: (i) excluding this entry from the calculation, and (ii) including this entry, assuming the same year of receipt and sources of transfers as their third transfer. The results were quite similar.

### B.2 More Stylised Facts from the SCF (1989 - 2019)

This section presents more stylised facts based on the empirical analysis of the U.S. household wealth using the SCF data. First, Table B2 presents the evolution of U.S. wealth inequality according to the SCF data from 1989 to 2019. Wealth has become increasingly concentrated over the past three decades: only the wealthiest 5 percent saw their shares of wealth increase from 54 percent to 65 percent while all other groups saw their shares decline. This has led the aggregate Gini coefficient rising from 0.79 in 1989 to 0.86 in 2019.

**Table B2:** Evolution of Wealth Inequality in the U.S.

| Year | Gini | HH in Wealth Quintiles | | | | | The Wealth-Rich | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | 4th | 5th | 90-95% | 95-99% | Top 1% |
| 1989 | 0.790 | -0.2 | 1.2 | 5.2 | 13.0 | 80.7 | 12.9 | 24.3 | 29.9 |
| 1992 | 0.786 | -0.2 | 1.5 | 5.4 | 13.2 | 80.1 | 12.6 | 24.3 | 30.1 |
| 1995 | 0.791 | -0.2 | 1.6 | 5.5 | 12.5 | 80.6 | 11.8 | 21.2 | 34.8 |
| 1998 | 0.800 | -0.3 | 1.4 | 5.1 | 12.4 | 81.4 | 11.4 | 23.3 | 33.8 |
| 2001 | 0.805 | -0.1 | 1.2 | 4.5 | 11.8 | 82.5 | 12.2 | 25.1 | 32.2 |
| 2004 | 0.809 | -0.2 | 1.1 | 4.4 | 11.8 | 82.9 | 12.0 | 24.2 | 33.2 |
| 2007 | 0.816 | -0.2 | 1.1 | 4.5 | 11.2 | 83.4 | 11.1 | 26.7 | 33.6 |
| 2010 | 0.846 | -0.7 | 0.7 | 3.3 | 9.9 | 86.7 | 13.5 | 26.8 | 34.1 |
| 2013 | 0.850 | -0.7 | 0.6 | 3.2 | 9.8 | 87.0 | 12.1 | 27.3 | 35.5 |
| 2016 | 0.860 | -0.5 | 0.6 | 2.9 | 8.6 | 88.3 | 11.9 | 26.5 | 38.5 |
| 2019 | 0.852 | -0.5 | 0.8 | 3.4 | 9.0 | 87.4 | 11.5 | 27.7 | 37.2 |

*Source.* Federal Reserve Board, 1998 - 2019 SCF.

Furthermore, I observe that inequality has become even more severe post-Great Recession. This can partially be explained by wealth portfolio heterogeneity, which will be discussed later. For the majority of U.S. households, real estate is the single most important asset in their portfolios, whereas wealthier households hold a relatively small fraction of their wealth in the form of real estate, and their portfolios are mostly comprised of public and private equities. Therefore, the burst of the housing market during the Great Recession negatively affected bottom and middle-class households more severely, while wealthy households were less impacted and recovered quickly as the financial sector rebounded after the Great Recession.

Table B3 below presents the evolution of wealth inequality—as measured by the Gini coefficient—across different age groups over the sample period.[44] The increasing trends in inequality apply to all age groups. The results also suggest that inequality tends to decrease with age. The youngest group exhibits the highest inequality in all SCF datasets, while the oldest group, on average, has the lowest Gini coefficient.

**Table B3:** Gini Coefficients by Age

| Year | Under 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 + |
|---|---|---|---|---|---|---|---|
| 1989 | 0.882 | 0.758 | 0.741 | 0.737 | 0.769 | 0.753 | 0.748 |
| 1992 | 0.853 | 0.761 | 0.757 | 0.749 | 0.739 | 0.712 | 0.742 |
| 1995 | 0.835 | 0.740 | 0.753 | 0.764 | 0.761 | 0.713 | 0.785 |
| 1998 | 0.961 | 0.773 | 0.762 | 0.772 | 0.765 | 0.739 | 0.678 |
| 2001 | 0.900 | 0.785 | 0.761 | 0.780 | 0.786 | 0.737 | 0.699 |
| 2004 | 0.917 | 0.809 | 0.773 | 0.764 | 0.774 | 0.770 | 0.691 |
| 2007 | 0.971 | 0.774 | 0.779 | 0.781 | 0.784 | 0.786 | 0.736 |
| 2010 | 1.012 | 0.896 | 0.846 | 0.809 | 0.781 | 0.766 | 0.744 |
| 2013 | 1.118 | 0.875 | 0.846 | 0.815 | 0.801 | 0.800 | 0.758 |
| 2016 | 1.144 | 0.880 | 0.820 | 0.847 | 0.818 | 0.797 | 0.763 |
| 2019 | 1.061 | 0.877 | 0.839 | 0.828 | 0.815 | 0.787 | 0.778 |
| Total | 0.969 | 0.812 | 0.789 | 0.786 | 0.781 | 0.760 | 0.738 |

*Source.* Federal Reserve Board, 1998 - 2019 SCF.

A simple comparison between the Gini coefficients in 1989 and 2019 shows that the inequality in the under-30 age group increased the most, by 0.179 over the past three decades. Moreover, the increase in inequality tends to decrease with age, with the oldest group experiencing the smallest increase, by 0.03.

[44] Note that the Gini coefficient for the under-30 age group goes above 1, as some households hold negative wealth.

Table B4 presents the evolution of mean wealth holdings (adjusted to 2019 US dollars in thousands) by different age groups. In general, the average wealth holdings for all age groups increased, peaking in 2007, possibly due to the bubbles in the housing and financial markets during the lead-up to the Global Financial Crisis, then decreased in 2010, and have reverted since 2013.

**Table B4:** Mean Wealth Holdings by Age

| Year | Under 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 + |
|---|---|---|---|---|---|---|---|
| 1989 | 81.2 | 197.7 | 459.7 | 554.7 | 670.9 | 486.0 | 481.3 |
| 1992 | 52.4 | 158.9 | 394.8 | 596.7 | 533.1 | 470.8 | 343.3 |
| 1995 | 54.7 | 152.2 | 397.9 | 644.5 | 606.3 | 464.7 | 488.1 |
| 1998 | 53.5 | 222.6 | 460.4 | 751.0 | 837.5 | 591.2 | 443.2 |
| 2001 | 97.8 | 261.1 | 544.2 | 1,020.5 | 1,025.3 | 786.6 | 575.2 |
| 2004 | 70.4 | 279.8 | 570.9 | 979.0 | 1,126.6 | 856.6 | 659.4 |
| 2007 | 105.6 | 272.6 | 621.3 | 1,058.5 | 1,294.1 | 967.7 | 776.7 |
| 2010 | 43.4 | 168.8 | 529.1 | 855.6 | 1,109.2 | 821.7 | 760.3 |
| 2013 | 53.7 | 229.8 | 498.6 | 774.1 | 1,063.1 | 905.6 | 610.7 |
| 2016 | 67.5 | 207.7 | 511.3 | 1,130.1 | 1,164.2 | 1186.1 | 1,078.5 |
| 2019 | 53.0 | 223.9 | 714.8 | 1,096.1 | 1,226.3 | 1032.3 | 935.4 |
| Total | 66.7 | 215.9 | 518.5 | 860.1 | 968.8 | 779.0 | 650.2 |

*Note.* All values are expressed in 2019 US thousands.
*Source.* Federal Reserve Board, 1998 - 2019 SCF.

The hump-shaped average life-cycle wealth profile is consistent with the life-cycle hypothesis, indicating that households begin with relatively low wealth holdings in the early stages and start to accumulate wealth, which peaks near retirement and then starts to decrease. Nevertheless, the results suggest that households do not decumulate as quickly as expected. For instance, the average wealth holdings by the oldest group are higher than those by households in their 40s. The reasons behind the slow decumulation could be due to precautionary saving motives for uncertain lifetime or medical expenses (Davies, 1981; De Nardi et al., 2010), bequest motives (Hurd, 1987; Carroll, 1998), or both.

Table B5 shows the evolution of wealth shares held by different age groups. As expected, the youngest age group holds a negligible share of the aggregate wealth, and the shares held tend to increase first with age and then decrease after retirement. This pattern is consistent with the hump-shaped life-cycle profile, where households' wealth holdings typically peak near retirement before starting to decumulate post-retirement.

**Table B5:** Share of Wealth held by Different Age Group

| Year | Under 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 + |
|---|---|---|---|---|---|---|---|
| 1989 | 3.86 | 12.22 | 21.22 | 20.96 | 24.41 | 13.30 | 4.02 |
| 1992 | 2.58 | 11.15 | 22.69 | 23.69 | 21.87 | 13.91 | 4.12 |
| 1995 | 2.51 | 9.58 | 23.75 | 23.44 | 21.78 | 13.92 | 5.01 |
| 1998 | 1.90 | 10.46 | 22.65 | 26.90 | 20.95 | 12.40 | 4.75 |
| 2001 | 2.68 | 8.80 | 22.19 | 27.95 | 19.90 | 14.14 | 4.33 |
| 2004 | 1.74 | 8.82 | 20.24 | 28.91 | 21.17 | 13.81 | 5.30 |
| 2007 | 2.23 | 7.27 | 19.57 | 28.49 | 24.03 | 11.57 | 6.85 |
| 2010 | 1.02 | 5.17 | 18.37 | 29.24 | 26.32 | 13.25 | 6.65 |
| 2013 | 1.25 | 6.80 | 15.99 | 26.58 | 29.09 | 14.26 | 6.03 |
| 2016 | 1.22 | 4.79 | 12.26 | 30.38 | 27.25 | 15.81 | 8.30 |
| 2019 | 0.98 | 5.24 | 15.44 | 26.88 | 29.13 | 16.71 | 5.62 |
| Total | 2.00 | 8.21 | 19.49 | 26.67 | 24.17 | 13.92 | 5.54 |

*Source.* Federal Reserve Board, 1998 - 2019 SCF.

Note, however, that the shares held by different age groups are also related to the population distribution. For example, the average share of wealth held by the oldest group over the sample period is only 5.50 percent, despite their relatively high mean wealth holdings. This discrepancy is due to them accounting for less than 5 percent of the total population.[45] The results also show evidence that the baby boom generation (those born between 1946 and 1964) holds a significant share of national wealth. For instance, although households in their 50s and 60s constitute about 23 percent of the total population, they hold nearly half of the aggregate wealth.

[45] See Appendix B.2 for the evolution of population distribution.

Table B6 presents the sources and sizes of early inheritances (under age 30). This includes households who are over 30 at the time of the survey but had received inheritances before turning 30.

**Table B6:** Sources and Size of Early Inheritances

| | Sources of Inheritances | | | Size of Inheritances | | |
|---|---|---|---|---|---|---|
| Year | Grandparents | Parents | Others | Grandparents | Parents | Others |
| 1989 | 0.44 | 0.35 | 0.21 | 0.79 | 0.11 | 0.10 |
| 1992 | 0.48 | 0.32 | 0.19 | 0.39 | 0.39 | 0.23 |
| 1995 | 0.37 | 0.40 | 0.23 | 0.27 | 0.57 | 0.16 |
| 1998 | 0.36 | 0.49 | 0.15 | 0.62 | 0.28 | 0.10 |
| 2001 | 0.52 | 0.41 | 0.07 | 0.70 | 0.29 | 0.01 |
| 2004 | 0.45 | 0.39 | 0.16 | 0.86 | 0.08 | 0.06 |
| 2007 | 0.45 | 0.42 | 0.13 | 0.05 | 0.93 | 0.02 |
| 2010 | 0.48 | 0.35 | 0.16 | 0.22 | 0.77 | 0.01 |
| 2013 | 0.41 | 0.44 | 0.15 | 0.20 | 0.65 | 0.16 |
| 2016 | 0.40 | 0.48 | 0.12 | 0.65 | 0.34 | 0.01 |
| 2019 | 0.49 | 0.41 | 0.11 | 0.62 | 0.35 | 0.03 |
| Average | 0.44 | 0.40 | 0.15 | 0.49 | 0.43 | 0.08 |
| | 0.52 | 0.48 | | 0.53 | 0.47 | |

*Source.* Federal Reserve Board, 1998 - 2019 SCF.

## B.3 Return on Wealth

Another important exercise I consider in this chapter is documenting evidence of return heterogeneity stemming from portfolio heterogeneity. To address this, I use the SCF datasets to compute portfolio-weighted average rates of return on wealth for different wealth groups. In doing so, I generally follow the methodologies employed by existing studies.[46]

Let $a_{i,j,t}$ and $d_{i,k,t}$ denote the value of asset $j$ and the value of debt $k$ held by each wealth group $i$ at the beginning of period $t$. Given $J$ assets and $K$ debt categories, each wealth group $i$'s net worth is given by

$$w_{i,t} = \sum_{j=1}^{J} a_{i,j,t} - \sum_{k=1}^{K} d_{i,k,t} \tag{5}$$

First, for each SCF dataset, households are grouped into 6 wealth bins: 0-50, 50-90, 90-95, 95-99, 99-99.9 and 99.9-100 percentiles. Next, I define Households' assets into 6 categories as shown in Table B7 such that (5) holds: (i) interest-earnings asset, (ii) public equity (iii) other financial assets (iv) real estates, (v) private businesses and (vi) other non-financial assets. For debts, I follow pre-defined categories by the SCF: (i) debt secured by primary residences, (ii) debt secured by other real estates (iii) other lines of credit, (iv) credit card debt (v) instalment loans (including education loans and vehicle loans) and (vi) other debt.

**Table B7:** Classification of Assets and Debt Components

| Total Assets | Total Debt |
|---|---|
| Financial Assets | Debt secured by primary residences |
| Interest-earning assets | Debt secured by other real estates |
| Public equity | Other lines of credit |
| Other financial assets | Credit card debt |
| Non-financial assets | Installment loans |
| Real estates | Education loans |
| Private Businesses | Vehicle loans |
| Other non-financial assets | Other debt |

If we let $r^A_{i,j,t}$ and $r^D_{i,j,t}$ denote the average return on asset $j$ and debt $k$ earned (or paid) by the wealth group $i$ respectively. Then the return on net worth $r_{i,t}$ is then computed as the weighted average of the returns on individual wealth components,

$$r_{i,t} = \sum_{j=1}^{J} \omega^A_{i,j,t} \times r^A_{i,j,t} - \sum_{k=1}^{K} \omega^D_{i,k,t} \times r^D_{i,k,t} \tag{6}$$

where the weights $\omega^A_{i,j,t}$ and $\omega^D_{i,k,t}$ of any wealth group $i$ in (6), are given by the share of net worth invested in an asset or debt category. Therefore, for each SCF dataset and for each

[46] It is worth noting that, this methodology requires two consecutive SCF datasets for each episode due to its non-panel structure. For example, the SCF 2016 and 2019 are utilised to compute the average return over the 2017-2019 episode. Consequently, I use eight sets of SCF data, to calculate average returns spanning from 1999-2001 to 2017-2019.

wealth group, I aggregate the values of each asset and each debt and divide by the aggregated value of net worth.[47]

The return on any asset $j$ (or any debt $k$) is defined as the sum of yield component and capital gain component.

$$r_{i,j,t} = y^*_{i,j,t} + g_{i,j,t} \tag{7}$$

where the yield component $y^*_{i,j,t}$ in (7) is computed as,

$$y^*_{i,j,t} = \left(1 + \frac{y_{i,j,t}}{a_{i,j,t} + 0.5\left(a_{i,j,t+3} - a_{i,j,t} - \tilde{y}_{i,j,t}\right)}\right)^{\frac{1}{3}} - 1$$

following Fagereng et al. (2016) and Kartashova and Zhou (2021). Here, $a_{i,j,t}$ and $a_{i,j,t+3}$ are the reported market values of an asset (or debt) in two consecutive surveys and $y_{i,j,t}$ in the numerator is the total flow income (payment) generated over 3 years. The denominator takes into account potential net flows invested between $t$ and $t+3$. Note that $y_{i,j,t}$ and $\tilde{y}_{i,j,t}$ are specific to the asset type.

**Interest-earning assets.** This includes all types of transaction account (liquid assets), certificate of deposit, directly and indirectly held bonds, cash value of whole life insurance and other interest-earning assets invested through annuities and trusts. The income flow generated from these assets is the total interest income reported by households. In the SCF 2019, households report annual interest income earned for 2018. Following Kartashova and Zhou (2021), I use growth rates of interest income from the Bureau of Economic Analysis (BEA) to obtain annual interest income earned in 2017 and 2019 and sum all to obtain $y_{i,j,t}$ over 2017-2019. As in Fagereng et al. (2020) and Kartashova and Zhou (2021), all interest incomes are capitalised into $a_{i,j,t+3}$ and no capital gains for interest-earning assets hence, $\tilde{y} = y_{i,j,t}$.

**Public equities.** Public equities are directly and indirectly held stocks including stocks invested through annuities and trusts. The income flow generated from public equities is the total dividend income reported by households. Similar to the interest incomes, I use the growth rates of dividend income from the BEA to obtain total flow dividend income over 2017-2019. I use Wilshire 5000 Total Market Index to obtain the capital gains component of public equities. Following Kartashova and Zhou (2021), I assume dividend income and capital gains are capitalised into $a_{i,j,t+3}$, hence $\tilde{y}_{i,j,t} = y_{i,j,t} + g_{i,j,t}a_{i,j,t}$.

**Other financial assets.** Other financial assets is computed as the total financial assets minus the interest-earning assets and public equity. I assume no income is generated from these assets.

[47] Then the portfolio shares of each wealth group for a given time period, is simply the average of the values obtained from two consecutive SCF surveys.

**Real estate.** This category includes primary residence, other residential properties, and net equity in non-residential real estates. Since the yield on primary residence is unobserved, I use aggregate counterparts to compute the yield on primary residences. I divide imputed rental of owner-occupied housing by the market value of owner-occupied real estates to compute the annual yield on primary residences. Following Kartashova and Zhou (2021), I subtract the annual depreciation rate of 2.3% (estimated by the BEA) and the average effective property tax rate 1.03%. For non-primary residential properties, I use the annual rent income reported in SCF by households. Since the rent income collected by the SCF include rent income plus other incomes from trusts or royalties, I condition on households who own non-primary residential properties (but not the commercial properties and/or any other miscellaneous assets such as royalties) to isolate the rent income. As before, I use growth rates of rent income to obtain $y_{i,j,t}$. For this asset, $\tilde{y}_{i,j,t} = (g_{i,j,t} - 3\delta^R)a_{i,j,t}$ where $\delta^R = 3.64\%$ is the annual depreciation of residential rental properties. As before, I further subtract the average effective property tax rate of 1.03%. Finally, I use the commercial property return index (CPRI) from the Green Street as the return on non-residential real estate as in Kartashova and Zhou (2021).

**Private Business.** This includes the share of net equity in the non-publicly traded businesses owned reported by households. This can be sub-divided into two: corporate equities (S and C corporations) and non-corporate equities (proprietorship and partnerships). I follow Moskowitz and Vissing-Jørgensen (2002) and Kartashova (2014) to compute the yield component. From the reported net business income, I adjust for corporate taxes (30% for C corporations and 0% for S-corporations and non-corporate businesses) and retained earnings (40% for C-corporations and 20% for S-Corporations and non-corporate businesses). In order to account for labour incomes of entrepreneurs who actively manage the business but report no salary, I regress the wage rate of households (who actively manage and report salary) on households' age, gender, education, working hours and size of business to impute the labour income of these households. As before, I use growth rates of corporate profit and non-corporate profit to obtain $y_{i,j,t}$ over 2017-2019 and I assume $\tilde{y}_{i,j,t} = g_{i,j,t}$ to compute the return on each type of business.

**Other non-financial assets.** Other non-financial assets is computed as the total non-financial assets minus the private businesses and real estates. I assume constant return at 2% as in Kartashova and Zhou (2021) over the sample period.

**Debt.** The income flow (i.e. payments) generated from each debt category is computed as the reported annual interest rate multiplied by the total amount owed. If households report multiple loans within each debt component, I used geometric average of the interest rates reported. Once the interest payments are obtained, I use growth rates of mortgages (if secured by residential properties) and consumer credits (for other types of debt) to obtain $y_{i,j,t}$ and set $\tilde{y}_{i,j,t} = y_{i,j,t}$ to compute the return on each debt category.

For the capital gains component $g_{i,j,t}$ in (7), I infer their changes based on the growth rates of their aggregate counterparts. Following external data series are used to compute capital gains component when calibrating the excess return schedules.

**Table B8:** List of External Data Series

| Data Series (FRED code) | Source |
|---|---|
| **Financial assets** | |
| Personal interest income (PII) | BEA |
| Personal dividend income (PDI) | BEA |
| Wilshire 5000 Total Market Index (WILL5000IND) | Wilshire Associates |
| **Non-financial assets** | |
| Imputed Rental of Owner-occupied housing (A2013C1A027NBEA) | BEA |
| Personal rental income (RENTIN) | BEA |
| Corporate Profits After Tax (without IVA and CCAdj) (CP) | BEA |
| Net profit of nonfarm proprietorships and partnerships (B1207C1A027NBEA) | BEA |
| Commercial Property Return Index (CPRI) | Green Street |
| Households and Nonprofit Organisations; | |
| Owner-Occupied Real Estate (inc. vacant land and mobile homes) (HOOREVLMHMV) | Financial Accounts |
| Real Estate at Market Value (HNOREMV) | Financial Accounts |
| Corporate Equities; Asset, Market value Levels (HNOCEA) | Financial Accounts |
| Proprietors' Equity in Noncorporate Business (ENBABSHNO) | Financial Accounts |
| **Debts** | |
| Households and Nonprofit Organisations; | |
| One-to-Four-Family Residential Mortgages (HMLBSHNO) | Financial Accounts |
| Consumer Credit (CCLBSHNO) | Financial Accounts |

**Table B9:** Heterogeneity in Returns across Different Wealth Groups and Episodes

| | Percentile (%) | | | | | |
|---|---|---|---|---|---|---|
| | 0-50 | 50-90 | 90-95 | 95-99 | 99-99.9 | 99.9-100 |
| 1991 - 2001 | 0.07 | 0.08 | 0.10 | 0.09 | 0.09 | 0.08 |
| | (0.01) | (0.01) | (0.02) | (0.03) | (0.04) | (0.06) |
| 2002 - 2004 | 0.08 | 0.08 | 0.07 | 0.08 | 0.10 | 0.11 |
| | (0.00) | (0.01) | (0.01) | (0.02) | (0.03) | (0.04) |
| 2005 - 2007 | 0.00 | 0.07 | 0.09 | 0.13 | 0.16 | 0.18 |
| | (0.01) | (0.01) | (0.02) | (0.04) | (0.07) | (0.10) |
| 2008 - 2010 | -0.48 | -0.08 | -0.05 | -0.04 | -0.04 | -0.03 |
| | (0.01) | (0.01) | (0.02) | (0.03) | (0.05) | (0.08) |
| 2011 - 2013 | -0.10 | 0.05 | 0.07 | 0.10 | 0.13 | 0.15 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.02) | (0.03) |
| 2014 - 2016 | 0.12 | 0.08 | 0.09 | 0.11 | 0.11 | 0.14 |
| | (0.01) | (0.01) | (0.01) | (0.03) | (0.04) | (0.06) |
| 2017 - 2019 | 0.04 | 0.07 | 0.09 | 0.11 | 0.12 | 0.13 |
| | (0.01) | (0.02) | (0.03) | (0.06) | (0.09) | (0.14) |
| Average | -0.04 | 0.05 | 0.06 | 0.08 | 0.10 | 0.11 |
| | (0.01) | (0.01) | (0.02) | (0.03) | (0.05) | (0.07) |

*Note.* Values in parentheses indicate standard deviations.

# C Calibration

## C.1 Earnings Process

In the model, households in working stage supply one unit of labour inelastically and earn labour income which is given by:

$$\log e(j,z) = z + \epsilon_j$$

where $z$ is the idiosyncratic stochastic component that follows an AR(1) process and $\epsilon_j$ is the deterministic age-efficiency profile.

I calibrate model earnings process à la Kindermann and Krueger (2021). Specifically, the stochastic component $z$ is approximated by a 4-state Markov Chain where I use Tauchen (1986) to obtain the first 3 states and $3 \times 3$ transition probabilities for the lowest 3 states. Then I calibrate remaining parameters to match earnings concentration observed in the data. In doing so, I differ from the usual *"super star"* process in that, I only use information from the empirical earnings distribution and I do not target wealth distribution.

Since the model features (imperfect) transmission of productivity from parents to child as in De Nardi and Yang (2016), the stationary initial distribution of age-1 households $\mu_1$ is obtained from:

$$\mu_1 = Q_h' \cdot (Q_z')^7 \mu_1$$

where $Q_z$ is the productivity transition matrix and $Q_h$ is the productivity transmission matrix that captures transmission of productivity from age 55 parents to age 25 children at entry. I make the following zero restrictions to reduce parameter space.

- Equal probabilities from $z_1$ and $z_2$ to the highest state, $z_4$.
- No direct transition is possible from the highest to the lowest ($\pi_{z,41} = 0$).
- If parents are at any of first 3 states, child cannot draw $z_4$ at entry.
- If parents are at the highest at age 55, child cannot be at the lowest at entry.

The following transition matrix. $Q_z$ and the transmission matrix, $Q_h$ show the zero restrictions imposed and probability parameters to be calibrated.

$$Q_z = \begin{bmatrix} \pi_{z,11}(1-\tilde{\pi}_{z,14}) & \pi_{z,12}(1-\tilde{\pi}_{z,14}) & \pi_{z,13}(1-\tilde{\pi}_{z,14}) & \tilde{\pi}_{z,\cdot 4} \\ \vdots & \ddots & \vdots & \tilde{\pi}_{z,\cdot 4} \\ \pi_{z,31}(1-\tilde{\pi}_{z,34}) & \cdots & \pi_{z,33}(1-\tilde{\pi}_{z,34}) & \tilde{\pi}_{z,34} \\ 0 & * & \tilde{\pi}_{z,43} & \tilde{\pi}_{z,44} \end{bmatrix}$$

$$Q_h = \begin{bmatrix} \tilde{\pi}_{h,11} & \tilde{\pi}_{h,12} & * & 0 \\ \tilde{\pi}_{h,21} & \tilde{\pi}_{h,22} & * & 0 \\ \tilde{\pi}_{h,31} & \tilde{\pi}_{h,32} & * & 0 \\ 0 & * & \tilde{\pi}_{h,34} & \tilde{\pi}_{h,44} \end{bmatrix}$$

where $\pi$ (without tilde) are pre-allocated from Tauchen (1986) and $\tilde{\pi}$ are to be calibrated. In total, there are 13 parameters (including $\tilde{z}_4$) to be calibrated. I use the following,

- 10 points on the Earnings Lorenz Curve (from SCF 2001)
- Earnings Gini coefficient (from SCF 2001)
- Earnings mean-median ratio (from SCF 2001)
- Earnings correlation between parents and child (from De Nardi and Yang (2016))

Finding a set of parameters that minimises the sum of squared residual gives:

$$z = \begin{bmatrix} 0.3923 & 1.0000 & 2.5492 & 23.3975 \end{bmatrix}$$

and the implied stationary initial distribution at age-1 is,[48]

$$\mu_1 = [34.48\%,\ 5.51\%,\ 59.62\%,\ 0.39\%]$$

Resulting matrix $Q_z$ suggests that productivity is reasonably persistent over 5-year period and earnings mean-to-median ratio equals its target at 1.71. $Q_h$ implies earnings correlation between parents and child in the model equals its target at 0.4.

$$Q_z = \begin{bmatrix} 0.7230 & 0.2636 & 0.0105 & 0.0029 \\ 0.1959 & 0.6053 & 0.1959 & 0.0029 \\ 0.0103 & 0.2584 & 0.7086 & 0.0228 \\ 0.0000 & 0.1283 & 0.2201 & 0.6516 \end{bmatrix}, \quad Q_h = \begin{bmatrix} 0.6481 & 0.0424 & 0.3095 & 0.0000 \\ 0.3962 & 0.0273 & 0.5765 & 0.0000 \\ 0.0380 & 0.0905 & 0.8715 & 0.0000 \\ 0.0000 & 0.1892 & 0.6614 & 0.1495 \end{bmatrix}$$

I use mean earnings for households age between 25 to 60 from the SCF (2001) as the deterministic age-efficiency profile. Since the mandatory retirement in the model starts is 65, I set $\epsilon_j = 0$ for $j \geq J_r$. I then normalise the age-efficiency profile such that the average earnings (before tax) at age-1 households equal to 1. Therefore, 1 unit in the model corresponds to 5-year average earnings of households at age 25, $\$53,488 \times 5 = \$267,440$ in 2019 US dollars based on SCF (2001).

[48]Note also that, $\mu_{j+1} = Q_z' \cdot \mu_j$ for $j \to j = J_r - 1$ are now stationary given $\mu_1$.

### C.2 Return Heterogeneity

I assume return heterogeneity is characterised by a step function. For individual $i$ with asset holding $a_i$,

$$1 + r_i = \begin{cases} 1 + \underline{r} & \text{if } a_i < \underline{a}_1 \\ 1 + \underline{r} + r_1^X + \sigma_1^X \cdot \eta & \text{if } \underline{a}_1 \leq a_i < \underline{a}_2 \\ 1 + \underline{r} + r_2^X + \sigma_2^X \cdot \eta & \text{if } \underline{a}_2 \leq a_i \end{cases}$$

where the *i.i.d.* standard normal idiosyncratic shock $\eta$ takes the values of $[-1, 0, 1]$ with probabilities $[0.3085,\ 0.3829,\ 0.3085]$.

There are 6 parameters to be calibrated, $\{r_1^X, r_2^X, \sigma_1^X, \sigma_2^X, \underline{a}_1, \underline{a}_2\}$. To reduce the dimension of parameter space for internal calibration, I fix the first 4 parameters, excess returns and standard deviations based on Table 6.

**Table C10:** Heterogeneity in Returns across Different Wealth Group

| Wealth Percentile | 0 - 50 | 50 - 90 | 90 - 95 | 95 - 99 | 99 - 99.9 | 99.9 - 100 |
|---|---|---|---|---|---|---|
| Average Return | -0.04 | 0.05 | 0.06 | 0.08 | 0.10 | 0.11 |
| Std. Dev | (0.01) | (0.01) | (0.02) | (0.03) | (0.05) | (0.07) |
| Average Return | 0.022 | | 0.073 | | 0.097 | |
| Std. Dev | (0.000) | | (0.023) | | (0.051) | |
| $r =$ | $\underline{r}$ | | $\underline{r} + 0.051 + 0.023\eta$ | | $\underline{r} + 0.075 + 0.051\eta$ | |

First, I further reduce the wealth bins into 3, by taking weighted average of the two groups. Then, treating the low group's return as $\underline{r}$, compute the excess returns that the middle and high group earn relative to the lowest group by taking the difference. Consequently, I set $\{r_1^X, r_2^X\} = \{0.051, 0.071\}$ and $\{\sigma_1^X, \sigma_2^X\} = \{0.023, 0.051\}$ respectively.

Remaining two threshold parameters $\{\underline{a}_1, \underline{a}_2\}$ are internally calibrated to match the concentration at the top of distribution.

# D Computation Details

The stationary equilibrium for the baseline economy is computed using constant real interest rate and capital income tax rate. I start first by guessing the capital income tax rate and compute the optimal policy and value functions for the last period $j = J$, then solve the household problems at earlier ages using the method of endogenous grid and backward induction.

In order to simulate the economy to achieve convergence, one needs to construct a transition matrix of the aggregate economy which in principle, should incorporate transitions of age, asset, productivity, idiosyncratic shocks as well as how agents' parents states evolve. Constructing a single massive transition matrix to find stationary distribution using eigenvalues methods is very computationally costly and slow. Instead, I construct age-dependent transition matrices $\Pi_{j,j+1}$ such that:

$$\mu_{j+1} = \Pi_{j,j+1}\mu_j$$

using the households' policy functions, Markov Chain transition matrix and probabilities for *i.i.d.* standard normal idiosyncratic shocks. For instance, retirees' states include $(a, \eta)$ so that

$$\dim\left(\Pi_{j,j+1}\right) = (na \times n\eta) \times (na \times n\eta), \qquad \text{for all } j > J_r = 9$$

where $\Pi_{j,j+1}$ is constructed using retiree's policy and probabilities for idiosyncratic shocks:

$$\begin{aligned}\text{Prob}(a', \eta' | a, \eta) &= \text{Prob}(a' | a, \eta) \times \text{Prob}(\eta') \\ &= \mathbb{1}(a' = g(a, \eta, j)) \cdot \frac{\gamma_j}{1+n} \times \text{Prob}(\eta')\end{aligned}$$

This way I can ensure:

$$\sum \mu_{j+1} = \frac{\gamma_j}{1+n} \sum \mu_j$$

For workers (without parents alive) the individual states are $(a, z, \eta)$ hence,

$$\dim\left(\Pi_{j,j+1}\right) = \begin{cases} (na \times nz \times n\eta) \times (na \times nz \times n\eta), & \text{for } j < 8 \\ (na \times nz \times n\eta) \times (na \times n\eta), & \text{for } j = 8 \end{cases}$$

where $\text{Prob}(z_{t+1}|z_t)$ is now given by the Markov transition matrix.

For younger workers whose parents are still alive, two matrices are needed. Young workers with retired parents may transition to:

$$(a, z, \eta, a_p, \eta_p) \rightarrow \begin{cases} (a, z, \eta, a_p, \eta_p) & \text{if parents survive} \\ (a, z, \eta) & \text{if parents pass away} \end{cases}$$

For those whose retired parents survive to the next period, transition matrix is constructed using their parents' policy as,

$$\text{Prob}(a_p'|a_p,\eta_p) = \mathbb{1}(a_p' = g(a_p,\eta_p,j+6))$$

whereas the indicator function used to construct the second case transition matrix accounts for bequests they may inherit.

Similar procedures to get transition matrices for age-2 and age-1. For age-2, we have:

$$(a,z,\eta,a_p,z_p,\eta_p) \rightarrow \begin{cases} (a,z,\eta,a_p,\eta_p) & \text{if parents survive and retiree} \\ (a,z,\eta) & \text{if parents pass away} \end{cases}$$

For age-1 households, we have two types depending on whether grandparent is alive or not. Fortunately, as agents start with zero wealth (hence $\eta$ is irrelevant) both $(a,\eta)$ can be dropped.

$$(z,a_p,z_p,\eta_p) \rightarrow \begin{cases} (a,z,\eta,a_p,\eta_p) & \text{if parents survive} \\ (a,z,\eta) & \text{if parents pass away} \end{cases}$$

$$(z,a_p,z_p,\eta_p,a_g,\eta_g) \rightarrow \begin{cases} (a,z,\eta,a_p,\eta_p) & \text{if parents survive} \\ (a,z,\eta) & \text{if parents pass away} \end{cases}$$

Finally, the initial distribution for age-1 $(z,a_p,z_p,\eta_p)$ and $(z,a_p,z_p,\eta_p,a_g,\eta_g)$ are obtained using the *transmission* matrices from age-7 to age-1.

$$\mu_1^p = \Pi^p \mu_7$$
$$\mu_1^{pg} = \Pi^{pg} \mu_7^p$$

It is worth noting that, I discretised the asset grid into 70 points ranging from 0 to 8000.[49] I discretised the model first 65 points based on

$$a_i = \bar{a} \cdot \frac{(1+g_{na})^{i-1} - 1}{(1+g_{na})^{na-1} - 1}$$

where I set $\bar{a} = 1600$, $na = 65$ and $g_{na} = 0.15$, and the remaining 5 points are discretised and equally spaced from 1600 to 8000. Hence, the distance between two successive grid points becomes significantly larger in the upper region. although I described using an indicator function when assigning probabilities in transition matrices, in fact, I assign positive probabilities to the nearest two grid points, using the distance as weights to ensure a smooth transition and prevent the wealthiest from being stuck at a certain state.

[49] The normalisation used in exercise is such that 1 unit in the model corresponds to 5-year average earnings of households at age 25, $\$53,488 \times 5 = \$267,440$ in 2019 US dollars based on SCF (2001). Hence, I set $a_{max} = 8000$ to ensure agents in the model can become as wealthy as in the data.

Once all the transition matrices are obtained, I then simulate the economy until a stationary distribution of households over the state space is achieved. The stationary distribution is then obtained when the age distribution, productivity distribution and average wealth across the households are all stabilised. Using the stationary distribution, I check whether the government budget is balanced and update the capital income tax accordingly. The procedure described above is repeated until the government budget is balanced.