percent of U.S. private net worth is devoted to future consumption, with the rest
destined for intergenerational transfer. White (1978) used aggregate data on the age
structure of the population, age earnings and age consumption profiles along with a
variety of parametric assumptions and concludes that the life cycle model can account
for only about a quarter of aggregate saving. Though their accounting frameworks
are somewhat different and though they use different data, and only cross section data
at that, Darby and White reach essentially the same conclusion as Kotlikoff and
Summers because the basic shapes of U.S. cross section age earnings and age
consumption profiles and the longitudinal profiles that can reasonably be inferred
from the cross section profiles are quite different from those of the textbook life cycle
model.

Calculations of Life Cycle and Transfer Wealth Using Flow Data

The analyses just described directly calculate life cycle wealth and indirectly infer
the stock of transfer wealth. Obviously it would be very useful to corroborate these
results with direct evidence on intergenerational transfers. Kotlikoff and Summers
Table 4

Intergenerational Transfers as a Source of Capital Accumulation, 1986

<table>
<thead>
<tr>
<th>Transfer Category</th>
<th>Annual Flow ($ billions)</th>
<th>Stock of Transfer Wealth ($ billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>(r - n = 0.01)</em></td>
</tr>
<tr>
<td>Support Given to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>32.69</td>
<td>1346.7</td>
</tr>
<tr>
<td>Parents</td>
<td>3.37</td>
<td>-104.3</td>
</tr>
<tr>
<td>Grandparents</td>
<td>0.07</td>
<td>-4.0</td>
</tr>
<tr>
<td>Grandchildren</td>
<td>5.05</td>
<td>416.2</td>
</tr>
<tr>
<td>Trusts</td>
<td>14.17</td>
<td>576.1</td>
</tr>
<tr>
<td>Life Insurance</td>
<td>7.84</td>
<td>258.3</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>63.19</strong></td>
<td><strong>2489.3</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intended Transfers</td>
<td>35.29</td>
<td>1441.5</td>
</tr>
<tr>
<td>College Payments</td>
<td>105.00</td>
<td>3708.1</td>
</tr>
<tr>
<td><strong>As a % of net worth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intended Transfers</td>
<td>0.53</td>
<td>20.8</td>
</tr>
<tr>
<td>College Expenses</td>
<td>0.29</td>
<td>12.0</td>
</tr>
<tr>
<td>Bequests</td>
<td>0.88</td>
<td>31.0</td>
</tr>
</tbody>
</table>

Source: Gale and Scholz (1994), p. 152

The first column of Table 4 presents our estimates that the gross flow of intended transfers in 1986 was about $63 billion, with the majority being support given from one household to another. The annual total of college payments was another $35 billion, and estimated bequests were another $105 billion. Our next task was to convert the annual flow of transfers into a stock of wealth. The equations behind this calculation appear in the second part of the Appendix. The conversion of a flow of transfers into a stock of transfer wealth requires obtaining values for a number of parameters: the flow of transfers in the current year (denoted by t), the growth rate of transfers (n), the interest rate (r), and the ages at which people receive transfers (I), give transfers (G), and die (D).

These parameters can be inferred from a variety of sources. For example, Kotlikoff and Summers (1981) estimate historical averages of a real rate of return of \( r = .045 \) and a real rate of GDP growth of \( .035 \). We set the growth rate of transfers at \( n = .01 \) and the interest rate at \( r = .01 \). The parameter I represents the ages at which people receive transfers, and we use data from the Survey of Consumer Finances to estimate these ages. The parameter G represents the ages at which people give transfers, and we use data from the Survey of Income and Program Participation to estimate these ages. The parameter D represents the ages at which people die, and we use data from the National Center for Health Statistics to estimate these ages.

7Life-cycle wealth cannot be inferred by taking the difference between estimated intended transfer wealth and net worth, because some of that difference is due to intended bequests.
<table>
<thead>
<tr>
<th>Intertemporal Elasticity of Substitution ((\gamma))</th>
<th>Elasticity of Substitution between consumption and leisure ((\rho))</th>
<th>Elasticity of Substitution in Production ((\sigma))</th>
<th>Steady State Efficiency Gain from Consumption Tax (% Lifetime Wealth)</th>
<th>Steady State Change in Real Wage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.80</td>
<td>1.0</td>
<td>0.29%</td>
<td>6% 2% -13%</td>
</tr>
<tr>
<td>0.10</td>
<td>0.80</td>
<td>1.0</td>
<td>0.37</td>
<td>6 2 -8</td>
</tr>
<tr>
<td>0.50</td>
<td>0.80</td>
<td>1.0</td>
<td>0.28</td>
<td>6 3 -17</td>
</tr>
<tr>
<td>0.25</td>
<td>0.30</td>
<td>1.0</td>
<td>0.25</td>
<td>6 2 -12</td>
</tr>
<tr>
<td>0.25</td>
<td>1.50</td>
<td>1.0</td>
<td>0.36</td>
<td>5 2 -13</td>
</tr>
<tr>
<td>0.25</td>
<td>0.80</td>
<td>0.8</td>
<td>0.19</td>
<td>4 2 -16</td>
</tr>
<tr>
<td>0.25</td>
<td>0.80</td>
<td>1.25</td>
<td>0.45</td>
<td>8 2 -9</td>
</tr>
</tbody>
</table>

All policy experiments are relative to an income tax at an initial tax rate of 15%.
Source: Auerbach and Kotlikoff (1987, Table 5.4).

Figure 5.3. The impact on capital formation of tax reform.

Source: courtesy of Jim Poterba
Figure 5.4. The welfare effects of tax reform.

Source: courtesy of Jim Poterba
according to our latest data point (2008), it is now close to 15% (see Figure I).

If we take a longer run perspective, then the twentieth-century U-shaped pattern looks even more spectacular. The inheritance flow was relatively stable around 20–25% of national income throughout the 1820–1910 period (with a slight upward trend), before being divided by a factor of about 5–6 between 1910 and the 1950s, and then multiplied by a factor of about 3–4 between the 1950s and the 2000s.

These are truly enormous historical variations, but they appear to be well founded empirically. In particular, we find similar patterns with our two fully independent estimates of the inheritance flow. The gap between our “economic flow” (computed from national wealth estimates, mortality tables, and observed age-wealth profiles) and “fiscal flow” series (computed from observed bequest and gift tax data, inc. tax exempt assets) can be interpreted as a measure of tax evasion and other measurement errors. This gap appears to approximately constant over time and relatively small, so that our two series deliver fairly consistent long-run patterns (see Figure I).

If we use disposable income (national income minus taxes plus cash transfers) rather than national income as the denominator, then we find that the inheritance flow observed in the early twenty-first century is back to about 20%, that is, approximately the same level as that observed one century ago. This comes from the fact that disposable income was as high as 90–95% of national income in 2008.
agreed that such redistribution should take the form of moving wealth from the top quintile to the bottom three quintiles. In short, although Americans tend to be relatively more favorable toward economic inequality than members of other countries (Osberg & Smeeding, 2006), Americans’ consensus about the ideal distribution of wealth within the United States is...
**Figure 8** The rise of private versus the decline of public wealth in rich countries, 1970-2020

Interpretation: Public wealth is the sum of all financial and non-financial assets, net of debts, held by governments. Public wealth dropped from 60% of national income in 1970 to -106% in 2020 in the UK. **Sources and series:** wir2022.wid.world/methodology, Bauluz et al. (2021) and updates.
Private wealth / national income ratios 1870-2010

Authors' computations using country national accounts. Private wealth = non-financial assets + financial assets - financial liabilities (household & non-profit sectors)

Source: Piketty and Zucman '13
The changing nature of national wealth, US 1770-2010 (incl. slaves)

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Source: Piketty and Zucman '13
The changing nature of national wealth, UK 1700-2010

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Source: Piketty, Handbook chapter, 2014
The changing nature of national wealth, France 1700-2010

National wealth = agricultural land + housing + other domestic capital goods + net foreign assets

Source: Piketty, Handbook chapter, 2014
Figure S11.3. The share of inherited wealth in aggregate wealth, France 1850-2100 (2010-2100: g=1.7%, r=3.0%)

Source: Piketty, Handbook chapter, 2014
Figure S11.4. The share of inherited wealth in aggregate wealth, France 1850-2100 (2010-2100: g=1.7%, r=3.0%)

- ○ Capitalized inheritance (KS1) (Kotlikoff-Summers, r=3%, 30yrs)
- ♦ Partially capitalized inheritance (PPVR definition)
- □ Non-capitalized inheritance (Modigliani)

Source: Piketty, Handbook chapter, 2014
Figure 11.12. The inheritance flow in Europe 1900-2010

- France
- United Kingdom (Atkinson)
- Germany (Schinke)

Source: Piketty, Handbook chapter, 2014
Figure 11: National wealth in 1770-1810: Old vs. New world

- UK
- France
- US South
- US North

% national income

Figure 12: Capital shares in factor-price national income 1975-2010

USA Japan Germany France UK Canada Australia Italy

Source: Piketty and Zucman (2014)
Figure 10.5. Wealth inequality in the U.S., 1810-2010

The top 10% wealth holders own about 80% of total wealth in 1910, and 75% today. Sources and series: see piketty.pse.ens.fr/capital21c.

Source: Piketty (2014)
Until the mid 20th century, wealth inequality was higher in Europe than in the United States.

Sources and series: see piketty.pse.ens.fr/capital21c.

Source: Piketty (2014)
The rate of return to capital (after tax and capital losses) fell below the growth rate during the 20th century, and may again surpass it in the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c

Source: Piketty (2014)
Inherited wealth represents 80-90% of total wealth in France in the 19th century; this share fell to 40%-50% during the 20th century, and might return to 80%-90% during the 21st century. Sources and series: see piketty.pse.ens.fr/capital21c

Source: Piketty (2014)
Besides the income tax, the government can also level the playing field with the federal estate tax.

The **Federal Estate Tax** (also known as the **Death Tax**) applies when a deceased person leaves **more than $5 million** in wealth to his or her heirs. Wealth left to a spouse or charitable organizations is exempt from estate tax.

Only 1 person out of 1000 is wealthy enough to face the estate tax.

Average Americans do not have anything close to $5 million in wealth, so the estate tax does not affect them and they can pass on their property to their children tax-free.

Eliminating the estate tax would allow the very richest families to pass down all of their wealth to their children tax-free. Hence, children of rich people would also start off very rich themselves.

Increasing the estate tax is a way to level the playing field between the children of wealthy parents and children of middle-class parents.
The composition of capital income in the U.S., 1913-2013

Housing rents (net of mortgages)
Noncorporate business profits
Corporate profits
Profits & interest paid to pensions
Net interest

Source: Saez and Zucman (2014)
The composition of household wealth in the U.S., 1913-2013

- Housing (net of mortgages)
- Sole proprietorships & partnerships
- Equities
- Currency, deposits and bonds
- Pensions

Source: Saez and Zucman (2014)
Top 10% Wealth Shares: Comparing Estimates

- Capitalized Incomes (Saez-Zucman)
- SCF (Kennickell)
Top 1% Wealth Shares: Comparing Estimates

Source: Saez and Zucman (2014)
Composition of the bottom 90% wealth share

- Housing (net of mortgages)
- Business assets
- Equities & fixed claims (net of non-mortgage debt)
- Pensions

Source: Saez and Zucman (2014)
The top decile (the top 10% highest wealth holders) owns 80-90% of total wealth in 1810-1910, and 60-65% today.

Source: Piketty and Zucman ’14, handbook chapter
The top decile owns 80-90% of total wealth in 1810-1910, and 70% today.
The top 10% holds 80-90% of total wealth in 1810-1910, and 55-60% today.

Source: Piketty and Zucman ‘14, handbook chapter
The top 10% wealth holders own about 80% of total wealth in 1929, and 75% today.

Figure 3.5. Wealth inequality in the U.S., 1810-2010
Inherited wealth represents 80-90% of total wealth in France in the 19th century; this share fell to 40%-50% during the 20th century, and is back to about 60-70% in the early 21st century.

Source: Piketty and Zucman '14, handbook chapter
The inheritance flow follows a U-shaped curve in France as well as in the U.K. and Germany. It is possible that gifts are underestimated in the U.K. at the end of the period.

Source: Piketty and Zucman ’14, handbook chapter
The inheritance share in aggregate wealth accumulation follows a U-shaped curve in France and Germany (and to a more limited extent in the U.K. and Germany. It is possible that gifts are under-estimated in the U.K. at the end of the period.

Source: Piketty and Zucman '14, handbook chapter
This figure depicts the share of total household wealth relative to national income. Source: Piketty, Saez, and Zucman (2018).
Average tax rates by income group in 2018
(% of pre-tax income)

Source: Saez and Zucman 2019
Adding old Warren wealth tax (2% above $50m, 3% above $1b) with 15% avoidance/evasion rate (Saez-Zucman)

- Estate taxes
- Individual income taxes
- Payroll taxes
- Corporate & property taxes
- Consumption taxes

Source: Saez and Zucman BPEA2019
Adding old Warren wealth tax (2% above $50m, 3% above $1b) with 89% avoidance/evasion rate (Summers-Sarin)
## Long-Term Wealth Taxation and Top Wealth Holders

<table>
<thead>
<tr>
<th>Top Wealth Holder</th>
<th>Source</th>
<th>Current 2018 wealth ($ billions)</th>
<th>With Warren wealth tax (3% above $1b since 1982)</th>
<th>With Sanders wealth tax (5% above $1b up to 8% above $10b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jeff Bezos</td>
<td>Amazon (founder)</td>
<td>160.0</td>
<td>86.8</td>
<td>43.0</td>
</tr>
<tr>
<td>2. Bill Gates</td>
<td>Microsoft (founder)</td>
<td>97.0</td>
<td>36.4</td>
<td>9.9</td>
</tr>
<tr>
<td>3. Warren Buffett</td>
<td>Berkshire Hathaway</td>
<td>88.3</td>
<td>29.6</td>
<td>8.2</td>
</tr>
<tr>
<td>4. Mark Zuckerberg</td>
<td>Facebook (founder)</td>
<td>61.0</td>
<td>44.2</td>
<td>28.6</td>
</tr>
<tr>
<td>5. Larry Ellison</td>
<td>Oracle (founder)</td>
<td>58.4</td>
<td>23.5</td>
<td>8.5</td>
</tr>
<tr>
<td>6. Larry Page</td>
<td>Google (founder)</td>
<td>53.8</td>
<td>35.3</td>
<td>19.5</td>
</tr>
<tr>
<td>7. David Koch</td>
<td>Koch industries</td>
<td>53.5</td>
<td>18.9</td>
<td>8.0</td>
</tr>
<tr>
<td>8. Charles Koch</td>
<td>Koch industries</td>
<td>53.5</td>
<td>18.9</td>
<td>8.0</td>
</tr>
<tr>
<td>9. Sergey Brin</td>
<td>Google (founder)</td>
<td>52.4</td>
<td>34.4</td>
<td>19.0</td>
</tr>
<tr>
<td>10. M. Bloomberg</td>
<td>Bloomberg LP (f.)</td>
<td>51.8</td>
<td>24.2</td>
<td>11.3</td>
</tr>
<tr>
<td>11. Jim Walton</td>
<td>Walmart (heir)</td>
<td>45.2</td>
<td>15.1</td>
<td>5.0</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total top 15</td>
<td></td>
<td>942.5</td>
<td>433.9</td>
<td>195.7</td>
</tr>
</tbody>
</table>

Source: Saez and Zucman BPEA2019
Forbes 400 wealth share (% of US wealth)

Actual share of wealth owned by the Forbes 400

With Warren wealth tax
(3% rate above $1bn)

With Sanders wealth tax
(5% above $1bn graduated to 8% above $10bn)

Source: Saez and Zucman BPEA2019
Wealth Share of the top 400 wealthiest Americans (top 0.00025%)

October 1st, 2021
The figure depicts the share of total household wealth owned by bottom 90% and top 0.1% obtained by capitalizing income tax returns (Piketty, Saez and Zucman 2018, updated to 2019). The unit of analysis is the family.
Wealth of the top 400 wealthiest Americans (top 0.00025%) (% of US GDP)

October 1st, 2021
Wealth During the Pandemic

After a very short dip in early 2020, wealth per adult (defined as the value of all assets owned minus debts) boomed during the pandemic. As shown in the graph below, this wealth growth was higher for the rich than for the middle class.

Interested in further investigating wealth during the pandemic? Click on this link to interact with a fully customizable version of this graph.

Wealth graph options  Reset

<table>
<thead>
<tr>
<th>Group</th>
<th>Growth (%)</th>
<th>Gain ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 0.01%</td>
<td>39.6%</td>
<td>$150M</td>
</tr>
<tr>
<td>Top 0.1%</td>
<td>36.7%</td>
<td>$27M</td>
</tr>
<tr>
<td>Top 1%</td>
<td>33.3%</td>
<td>$4.7M</td>
</tr>
<tr>
<td>Top 10%</td>
<td>29.4%</td>
<td>$850k</td>
</tr>
<tr>
<td>Middle 40%</td>
<td>25.8%</td>
<td>$74k</td>
</tr>
<tr>
<td>Bottom 50%</td>
<td>288.3%</td>
<td>$5.9k</td>
</tr>
<tr>
<td>Total</td>
<td>29%</td>
<td>$120k</td>
</tr>
</tbody>
</table>
Correcting Estate Multiplier Estimates


2. Noise smoothing


4. From individuals to family tax units
This figure depicts the share of total household wealth owned by the top 0.1% of families (tax units) and bottom 90% from capitalized incomes (Saez and Zucman, 2016) and survey data SCF+Forbes 400.
This figure depicts the share of total household wealth owned by the top 0.1% of families (tax units) from various data sources.
This figure depicts the share of total household wealth owned by the top 0.1% of families (tax units) from various data sources.
This figure depicts the share of total household wealth owned by the top 0.1% of families (tax units) and bottom 90% from capitalized incomes (Saez and Zucman, 2016) and survey data SCF+Forbes 400.
inheritance share was rising fast in the late 19th and early 20th centuries. The shocks caused by the 1930s and the Second World War led to a downturn, but much less pronounced than in Europe, so the US inheritance share became higher than in Europe by the mid-20th century. In recent decades, the inheritance share seems to have increased substantially in the USA.

However, there is significant uncertainty about the exact levels and trends, due in particular to the limitations of US estate tax data (which covers only a small fraction of all decedents, so it cannot be used to produce aggregate series). We should also emphasize that there are significant variations within Europe. For simplicity, we define ‘Europe’ in Figure 1 as the average of France, Germany and the UK. We will see later that France and Germany follow a particularly marked U-shaped pattern, while the UK pattern is in some ways closer to the US evolution.

In brief, our general conclusion is that there are substantial variations in the inheritance share over time and across countries, and that one should be careful not to interpret averages over one or two decades as steady-state outcomes. Wealth accumulation takes time: it spans over several generations, so it is important to take a very-long-run perspective on these issues. Modigliani’s conclusions—with a large majority of wealth coming from lifecycle savings—might have been right for the immediate postwar period (though somewhat exaggerated). But the Kotlikoff–Summers estimates—with inheritance accounting for a significant majority of wealth—appear to be closer to what we generally observe in the long run, in both the 19th and early 20th centuries, and in the late 20th and early 21st centuries.

Regarding the very long run, we stress that there are many different possible steady-state levels for the inheritance share. As we will see, there are several forces that tend to imply that low-growth societies also have higher inheritance shares. But other effects can go in the opposite direction. Depending on the evolution of demographic parameters,
Average tax rates: labor vs. capital in the United States

Source: Saez and Zucman (2019)
**Figure 1.1** Global income and wealth inequality, 2021

**Interpretation:** The global 50% captures 8% of total income measured at Purchasing Power Parity (PPP). The global bottom 50% owns 2% of wealth (at Purchasing Power Parity). The global top 10% owns 76% of total Household wealth and captures 52% of total income in 2021. Note that top wealth holders are not necessarily top income holders. Income is measured after the operation of pension and unemployment systems and before taxes and transfers. **Sources and series:** wir2022.wid.world/methodology
capitalized interests. The reform should only play on the supplemental contributions made after age 70 and above the tax exemption. Therefore, the reform should not affect the probability to terminate the account.

Second, individuals could anticipate the reform by opening an account just before its implementation. In this case, the assignment in the treated or control group would no longer be considered as exogenous, and the estimation would be biased. This latter point, however, should not be a concern in our analysis. The 1992 reform was applied to Assurance-vie accounts opened after 11/20/1991, i.e. 40 days before the law was voted, in order to avoid this kind of behavior.

Formally, we can test the presence of selection bias using the following intuition. If the treatment selection based on the 1992 reform is not exogenous, we should expect the number of accounts opened after the reform to be much less important than those opened before the reform. In contrast, online Appendix Fig. 8 exhibits no difference in the number of accounts coming from both groups.\footnote{In addition, online Appendix Fig. 9 shows that the density distributions are similar between groups. Online Appendix Fig. 10 depicts survival rates by age of account owner in 2003 and treatment status over the 2003–2013 period. It shows that attrition is slightly more pronounced in the treated group but the differences remain limited.}

Finally, a difference-in-differences design is usually implementable when a sharp and unexpected change affects one out of two groups that would evolve similarly in absence of the change. That is not the case in our framework. The policy change was implemented in 1992, implying that individuals from the treatment group are aware of the tax scheme they face before and after age 70 throughout the studied period (2003–2013). In a classical life-cycle model with bequest motives, forward-looking individuals should therefore plan ahead and adjust both their contributions made before and after age 70, invalidating the use of a difference-in-differences approach. However, Fig. 4 shows that they don’t. The evolutions of contributions and account balances before age 70 are similar between groups. These findings are therefore not consistent with forward-looking individuals’ decisions and could be better explained by the presence of myopia in a peculiar model with people aware and responsive to current tax rates but not to future expected tax rates. In this particular context, a difference-in-differences design makes sense. Indeed, myopic individuals unable to respond to future expected tax changes should behave exactly as individuals unaware of future tax changes.

Formally, we can quantify the impact of the inheritance tax change on Assurance-vie accumulation using regression specifications of the form:

\[
\log(y_{agt} + 1) = \alpha + \log(1 - \tau_{ga}) + \beta_g + \gamma_a + \nu_t + \epsilon_{ia} 
\]

where the dependent variable is either contributions or account balances (in log)\footnote{Note that we add one euro to each individual-level contribution/account balance in order to include zeros in the analysis. Indeed, dropping them could bias downward the results. The jump in taxation after age 70 decreases the incentives of individuals from the treated group to make contributions after age 70, while it is not the case for the control group. Dropping zero contributions could artificially increase the average level of contributions made by the treated group after age 70.} of individual $i$ of age $a$ from group $g$ at time $t$. $\alpha$, $\beta_g$, $\gamma_a$, and $\nu_t$ are respectively individual, group, age, and year fixed effects. The treatment group is defined as individuals with accounts opened up to two years after 11/20/1991, and the control group is defined as individuals with accounts opened up to two years before 11/20/1991. $\tau_{ga}$ is the top marginal tax rate faced by individuals from group $g$ at age $a$. Consistent with the reform of the preferential tax scheme, it is equal to 40% for individuals from the treated group aged more than 70 years old and 20% otherwise. $\delta$ represents the difference-in-differences elasticity estimate. In Eq. (5), group fixed effects are substituted by individual fixed effects to fully exploit the longitudinal dimension of our data set.

\section{Results} \label{section:results}

\subsection{Regression estimates} Table 9 summarizes the graphical evidence described above by presenting elasticity estimates. All estimates are derived from Eqs. (4) and (5) using as dependent variable either contributions (Panel A) or account balances (Panel B).

Column 2 reports the elasticity estimates from Eq. (4), while column 1 omits year fixed effects. The estimated elasticities are essentially the same in both specifications: around 0.32 for contributions and 0.38 for account balances. Time is indeed irrelevant in our
Finally, we can obtain reduced-form estimates of timing responses by fitting the following regression model:

\[ c_a = E[\log(y_{ia} + 1) | \text{age} = a] = \sum_{j=0}^{J} \beta_j \cdot (\text{age}_a)^j + \gamma_1 \cdot 1_{a \leq \text{age}_{\text{excl}} < a} + \gamma_2 \cdot 1_{a < \text{age}_{\text{excl}} \leq a} + \epsilon_a \]

where the dependent variable is the average log of (individual-level contribution + 1) made by individuals of age \( a \). \( 1_{a \leq \text{age}_{\text{excl}} < a} \) and \( 1_{a < \text{age}_{\text{excl}} \leq a} \) are respectively dummies for age \( a \) being in the excluding range below or above the notch.

The coefficient we are interested in is \( \gamma_2 \) (medium-term timing responses). It corresponds to the difference of average contributions (in log) between the empirical and the counterfactual functions in the excluded range above the notch. Note that we add one euro to each individual-level contribution in order to include zero contributions in the analysis, because dropping them could bias the results downward. The jump in taxation around age 70 is likely to increase the proportion of zero contributions just after age 70 and decrease it just before age 70. Dropping zero contributions would therefore artificially increase the average log of contributions just after age 70 and would underestimate the magnitude of the timing responses.

Our methodology differs slightly from traditional bunching estimation techniques for at least two reasons. First, our approach is based on an inter-temporal setting. The taxation occurs only at death but depends on the age at which contributions were made. Therefore, the relevant dependent variable is the amount of contributions made instead of the number of individuals or accounts by age.\(^{30}\) Second, the difference between the empirical and the counterfactual functions above the notch (\( \gamma_2 \)) corresponds to the magnitude of medium-term timing responses, i.e. what proportion of contributions have been retimed after age 70. Finally, the size of the hole determines the length of the horizon over which there is retiming. Usually, the estimation of medium-term responses is difficult to convincingly identify because tax change and time effects are not dissociable. The originality of our estimation comes from the fact that the tax change is associated with age. By pooling together different cohorts of individuals over a long period of time, we can then properly isolate medium-term timing responses from time-varying or age-varying factors.

### 3.1.2. Results

Fig. 3 reports empirical and counterfactual contributions (in log) by quarterly age around the notch. Specifically, Fig. 3 is split into two panels. Panel A makes reference to wealthy individuals with accounts under the supervision of portfolio manager ("wealthy individuals"). Panel B corresponds to individuals with standard accounts ("standard individuals").\(^{31}\) Each panel shows the estimate of \( b \), i.e. excess mass divided by the average contributions at the notch, with its standard error shown in parentheses.

Our main findings are the following. First, we observe bunching concentrated just during the last quarter before 70 years old in both panels. The size of the bunching differs significantly depending on the level of wealth. Panel A depicts important bunching corresponding to 0.83 times the height of the counterfactual contribution at age 70 for the wealthy. Panel B shows moderate bunching corresponding to 0.16 times the height of the counterfactual contributions for the standard individuals. Second, both notches are associated with a slight but wide hole above the cutoff. Finally, the horizon of timing responses is 3 years for wealthy individuals and 1.5 years for standard individuals.

Table 8 presents reduced-form estimates of timing responses and inter-temporal shifting elasticity with respect to the net-of-tax rate.\(^{32}\) The elasticities corresponding to medium-term timing

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\(^{29}\) As a sensitivity analysis, we have also added two euros (instead of one euro) to each contribution and the results are unchanged (see online Appendix Table 14).

\(^{30}\) The increase in taxation at age 70 should only affect the amount of contributions made. As Assurance-vie transmission and taxation will occur only at death, individuals having opened an account before age 70 will keep this account until death. Therefore, the distribution of the number of accounts by age remains smoothed and exhibits no discontinuity at age 70 (online Appendix Fig. 6).

\(^{31}\) Online Appendix Fig. 7 reports the evolution of account balances and different types of contributions (discretionary, automatic, and account-opening contributions) by quarterly age.

\(^{32}\) Note that our bunching approach allows to identify reduced-form rather than structural responses. Our estimated responses are therefore a combination of the structural behavioral responses and other factors such as preference for bequest and consumption and liquidity constraints.