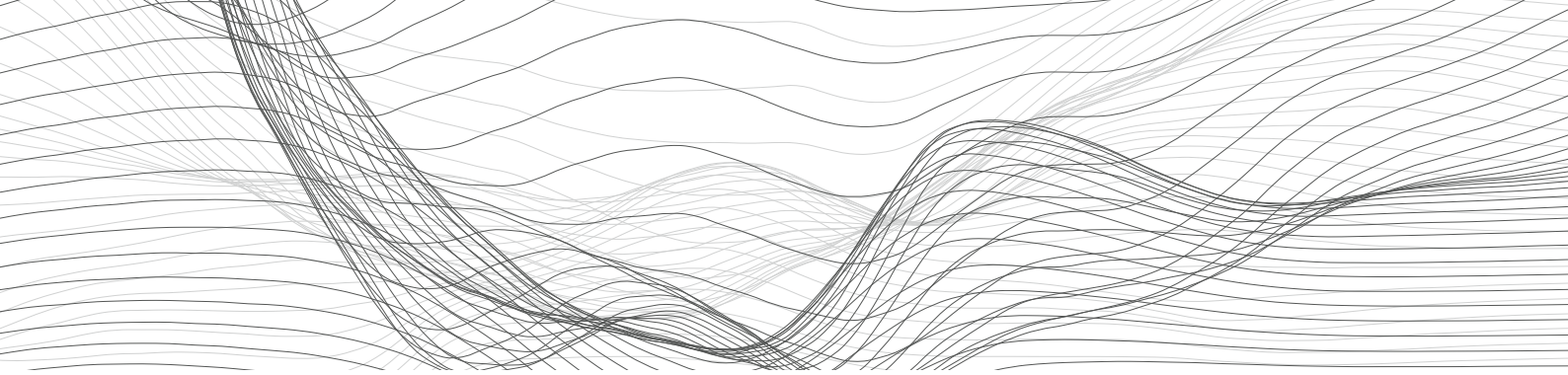

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Analysing households' consumption and saving patterns using tax data[a]

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Abstract

Private consumption, i.e., spending of households, is a key economic variable. While data on private consumption are widely available on a national, aggregate level, disaggregated data on household spending are scarce, particularly in the form of a panel. To fill this gap, we make use of Swiss tax data from the Canton of Bern from 2002 until 2016 to retrieve consumption estimates on a disaggregated level. Since consumption is not directly available from tax records, we show how to transform tax-specific data and information into economically interpretable measures. In particular, we impute consumption based on the simple budget constraint of a household. This approach yields a unique panel of income, wealth and consumption for each taxpayer in the Canton of Bern over time. After discussing and validating the obtained consumption estimates, we analyse consumption and saving patterns of households over the life cycle as well as across different subgroups and show how consumption inequality has evolved over time. We find the typical hump-shaped consumption profile over the life cycle and an increasing savings rate over the working age with a substantial fall with retirement and dissaving thereafter. Our results also suggest that consumption and saving behaviour vary across different household characteristics. Finally, we show that consumption and income inequality remained rather stable between 2002 and 2016. Over the life cycle, however, consumption and income inequality do change: they are rather low at a young age but increase thereafter.

JEL classification: D12, D14, D31, E21, G11

Keywords: Household finance, consumption measurement, tax data, wealth, income, savings

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1 Introduction

Consumer spending is a key variable for macro- and microeconomic analysis. The necessity of having high-quality consumption measures has been discussed, e.g., Browning, Crossley, and Weber (2003), Carroll, Crossley, and Sabelhaus (2015) and Pistaferri (2015). While aggregate data on private consumption expenditure are commonly available at a quarterly frequency from a country's national accounts, information on a disaggregated level is much harder to retrieve. However, to be able to account for heterogeneity in consumption patterns across households, such data are of high value. There are two main sources to obtain such detailed information on consumption: a) household surveys and b) administrative data, e.g., data from tax records.

For Switzerland, the main source of survey data on consumption is the Household Budget Survey (HABE) conducted by the Swiss Federal Statistics Office. While compared to administrative data, surveys may have advantages in terms of consistency of the covered entities (households), economical interpretation of the data, granularity with respect to the different consumption components and potentially geographical coverage, they also come with two major drawbacks. First, the sample size of surveys is usually rather small, which tends to substantially limit the scope and depth of detail of the analysis. Second, most of the time, survey data are cross-sectional rather than panel structure and therefore do not allow us to observe consumption patterns of the same entity over time.

The main focus of this paper is on the second source of information: administrative data, in particular tax records. The aim of the paper is to impute consumption from tax records and study consumption and saving patterns in Switzerland. Major advantages of using tax records are the panel structure, size, and representativeness of such samples, allowing for granular analysis. Our data show these advantages as well: it is a unique panel of income streams and wealth components and covers all individual taxpayers in the Swiss Canton of Bern between 2002 and 2016. The Canton of Bern is, measured by its population, the second largest canton of Switzerland and covers both urban and rural areas, similar to Switzerland as a whole.

Swiss tax data have already been used in other studies. For example, Brülhart, Gruber, Krapf, and Schmidheiny (2016), study the effects of wealth taxation on taxable wealth in Switzerland. They

use both aggregate data on wealth holdings by canton and individual-level data for the Canton of Bern. They find that reported wealth holdings in Switzerland are very responsive to wealth taxation. Brunner, Meier, and Naef (2020) also make use of tax data from the Canton of Bern and study the portfolio composition of wealth as well as the return on wealth along the distribution and sociodemographic characteristics. Martínez (2021) uses individual income and wealth tax data from eight Swiss cantons and investigates the distribution of income and wealth in depth. She also shows individual characteristics within the different income and wealth percentile groups and finds a pronounced age-wealth gradient.

While we will also present details on wealth and income across the distribution and for different subgroups, our paper adds to this literature by imputing consumption estimates out of these tax data and by analysing the resulting consumption and saving patterns descriptively. Retrieving consumption measures out of tax records is not straightforward. Income and wealth components in a tax declaration are defined in a tax-specific way. To obtain income and wealth measures that are useful for economic analysis, we have to account for these tax-specific characteristics and make assumptions where needed. Our method to impute consumption from administrative records is in line with existing research, e.g.,Fagereng and Halvorsen (2017), Koijen, Van Nieuwerburgh, and Vestman (2014), or Browning and Leth-Peterson (2003), who use the simple budget constraint — where consumption equals income minus savings — as the underlying imputation equation. Browning and Leth-Peterson (2003) validate consumption estimates with consumer expenditure survey data to check the reliability of the imputation. Browning, Crossley, and Winter (2014) review different methods of collecting data on household consumption expenditures, e.g., surveys and administrative data, and discuss advantages and difficulties of the different approaches. Kolsrud, Landais, and Spinnewijn (2017) compare their registry-based consumption measure to national accounts and find a close relationship for aggregate consumption. In addition, they find that the distributions of registry- and survey-based measures of consumption highly correlate with each other but differ in the tails. They conclude that this difference might reflect the difficulty of surveys to incentivise high-income households to accurately report their spending, and thus, registry-based measures might dominate survey-based measures when covering analysis at the top of the income distribution.

After having retrieved our imputed consumption estimates, we validate them with external sources, namely, consumption expenditures of the Swiss Household Budget Survey and national accounts data, and find that our consumption estimates are well in line with these two benchmarks. Thus, we use the resulting consumption estimates to analyse consumption and saving patterns of taxpayers over the life cycle as well as across different subgroups and look at how consumption inequality has evolved over time.

To describe and understand consumption and saving patterns, the life-cycle framework has been a work horse. For example, Attanasio and Weber (2010) and Browning and Crossley (2001) give a broad overview. Browning and Crossley (2001) use a wider definition of the life-cycle framework, where they argue that "buffer stock" savings and market imperfections (see, e.g., Deaton, 1991; Carroll, 1994) are still in line with the life-cycle framework.[1] They only rule out "rule of thumb" behaviour, where agents spend a fixed fraction of their income. Allowing for liquidity-constrained and impatient agents and "buffer stock" savings results in higher comovement of consumption and income than in the earlier versions of the permanent income model with more excessive consumption smoothing. In line with this literature, we also find a hump-shaped consumption-age profile and a saving rate that varies over the life cycle. Our results show an increasing saving rate over the working age with a substantial fall with retirement (and the associated decrease in disposable income) and dissaving thereafter. Similar to Ziegelmeyer, Porpiglia, Teppa, Le Blanc, and Zhu (2015), we find consumption and saving heterogeneity across different household characteristics, such as income, civil status and property ownership. Dynan, Skinner, and Zeldes (2004) document a strong positive relationship between saving rates and lifetime income and a weaker, but still positive, relationship between the marginal propensity to save and lifetime income (i.e., the rich saving more). Our results also point at this correlation. Finally, we analyse inequality in consumption. Similar to, Aguiar and Bils (2015) and Attanasio and Pistaferri (2014), we find evidence of comovement of income and consumption inequality. Overall, income and consumption inequality remained rather stable between 2003 and 2016. Over the life-cycle however, consumption and income inequality do change: they are rather low initially at a young age but increase thereafter.

Our paper is organised as follows: Section 2 gives an overview of the data. Section 3 explains

[1] In addition, see Carroll (Spring 2006), who reviews the link between uncertainty and consumption.

how to retrieve economically interpretable income and wealth measures from tax data. Section 4 shows how to impute consumption from tax data based on the idea of a household's budget constraint. Section 5 discusses and validates the resulting consumption estimates. Based on these data, Section 6 analyses consumption and saving patterns. Finally, Section 7 concludes the paper.

2 The dataset

Our data are retrieved from tax records of all individual taxpayers in the Canton of Bern between 2002 and 2016.[2] Tax records come at an annual frequency, with the due date being the 31st of December of the respective year for each taxpayer. Generally, all residents aged 18 and older must file an annual tax return.[3] Most of the information in Swiss tax records is self-reported. Nevertheless, the data are of good quality since the tax authority checks the data carefully.

The dataset is an unbalanced panel with 864,881 taxpayers (on average 565,589 per year) and a total of 8.5 million observations over the covered 15 years. On average, we observe 9.8 years per taxpayer. The data are reported at the level of taxpayers as well as per year and contain information on the following four categories:[4]

- *Demographics*: year of birth of taxpayer head and spouse (if existing), civil status, region of residence.
- *Tax type*: nonself-employed, self-employed, agricultural, major shareholder[5].
- *Income streams*: employment income, pension income, financial asset income, real estate income, inheritances, gifts. For taxpayers of self-employed and agricultural tax types, there are additional variables covering income from business activities.
- *Wealth components*: total value of financial asset portfolio[6], total administrative value of real estate wealth, total debt.

[2] An individual taxpayer is either an unmarried person or a married couple, each of them with or without kids.

[3] Resident foreign nationals taxed at the source by a wage withholding system, only file a tax return if their annual gross employment income exceeds CHF 120,000.

[4] The dataset is extremely rich, containing 127 variables. The large number of variables is due to the nature of tax declarations, which, e.g., requires citizens to give detailed information about their different income streams, wealth components, and deductible outlays.

[5] Major shareholders hold a stake of at least 10% of a joint stock company. They are assessed together with the legal person by the tax authority.

[6] The data do not contain pension wealth in the second and third pillars.

- *Details on real estate properties*: Administrative value of building, rental income, notional rental value, real estate property taxes, value-increasing and nonvalue-increasing investments, spending for maintenance, and voluntarily reported year of construction as well as the date and price of purchase.

For 2014, we have detailed information on each component of a taxpayer's financial asset wealth (the so-called financial asset register), including the taxable value as well as (self-reported) data on the type of asset (bank account, stock shares, bond shares, etc.). This information is only available for taxpayers who completed their tax declaration online (e.g., 43% of all taxpayers in 2014).[7] Appendix A.1 gives detailed information on the portfolio composition of these taxpayers.

Table 1 shows some characteristics for the full sample and for specific years. The median taxpayer head is 47 years old. Approximately one-third of tax records refer to married couples and approximately 20% claim deductions for children. Slightly less than one-third of all taxpayers own real estate. The majority of taxpayers are male because a married couple fills in a joint tax declaration, where the husband tends to head the tax liability. Comparing three specific years (2003, 2008, 2015), most of the reported characteristics vary slightly. Taxable income[8] and gross wealth have increased notably over time. The share of property owners has grown slightly over time, while the share of tax records that refer to a married couple has decreased.

[7] Conceptionally, the information is available for all taxpayers. However, since only the total financial wealth is relevant for determining the tax liability, these data were not systematically digitalised by the tax administration.

[8] Taxable income is defined as total income before any deductions; see also Table 2.

Table 1: Sample characteristics

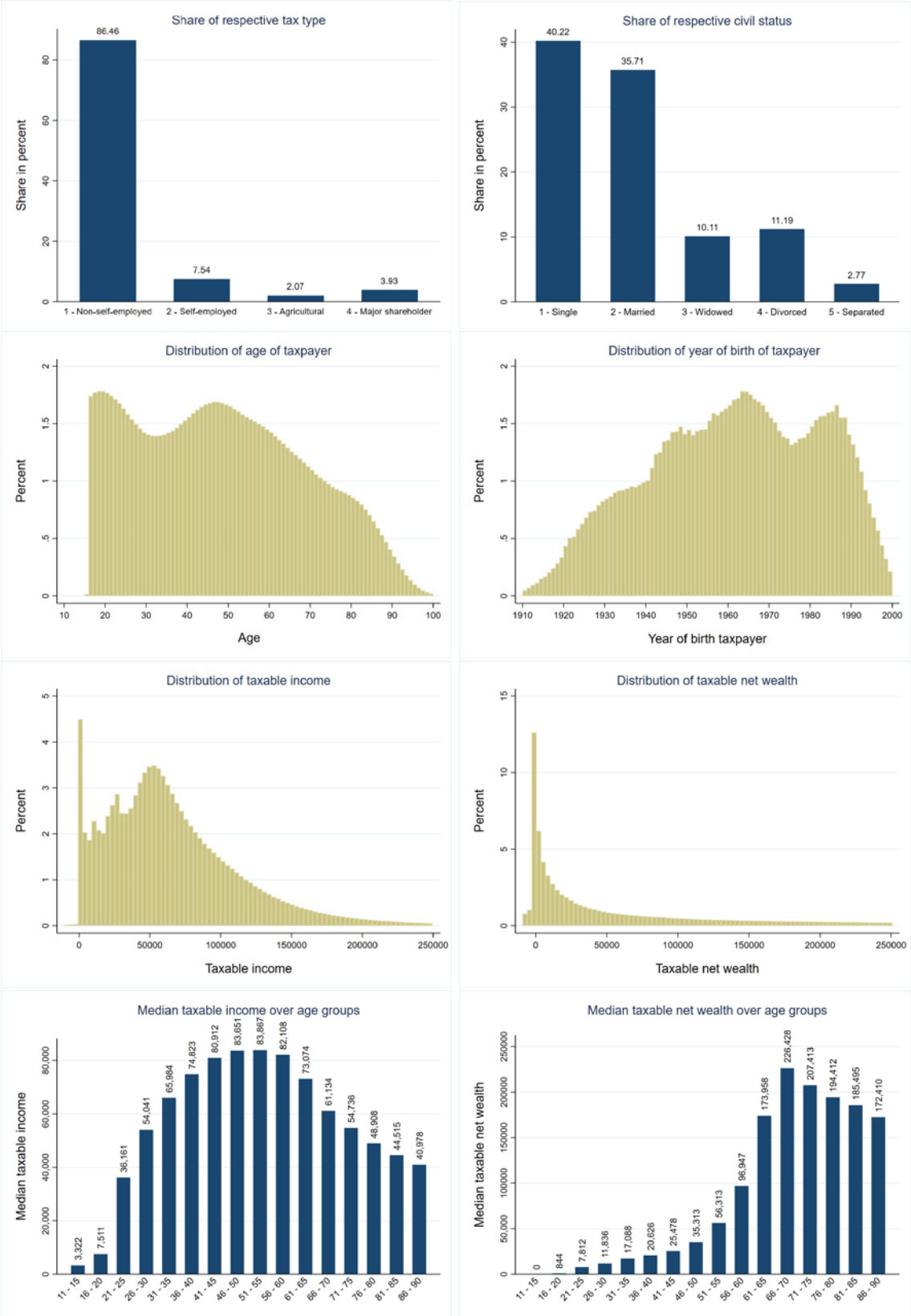
Variable	Full sample	2003	2008	2015
Year of birth (median)	1962	1957	1961	1966
Age (median)	47	46	47	49
Gender (0=M, 1=F; mean)	35.2%	34.3%	35.1%	35.8%
Share married	35.7%	37.8%	35.9%	34.1%
Share of taxpayers with deductions for children	19.8%	21.0%	19.9%	18.9%
Share of property owners	30.6%	29.8%	30.6%	31.3%
Taxable income (median)	57,718	54,608	57,892	60,371
Taxable gross wealth (median)	59,350	56,890	57,115	63,515
Taxable net wealth (median)	33,232	33,404	31,546	34,860
Number of taxpayers	864,881	540,154	561,512	589,884
Number of observations	8,483,827	540,154	561,512	589,884

Notes: The table shows medians and means (in case of shares) of the variables. The year of birth, age and gender relate to the taxpayer head (in the case of married couples, usually the husband). Values of income and wealth are denominated in CHF.

Figure 1 shows distributions of selected variables over all taxpayers, and for taxable income and taxable net wealth, the median over age groups.[9] The first and second charts show the distribution of tax types and civil status. 86% of all taxpayers in our sample are nonself-employed, approximately 8% self-employed, and 2% agricultural. Most of the taxpayers are single, followed by married ones. The third and fourth charts show the distribution of taxpayers by age and year of birth.[10] The bimodal nature of the age distribution and, in particular, the dent between the ages of 25 and 44 is related to the fact that married couples fill in a joint tax declaration. Therefore, the share of taxpayers across age groups decreases with the share of married taxpayers. Finally, the four remaining charts show the distributions of taxable income and taxable wealth. We notice an overrepresentation of income and wealth being either zero or very low. Values equal to zero are most likely due to taxpayers who are below the taxable threshold and therefore opted to report zero instead of their actual values. Median taxable income is CHF 57,718 and peaks at approximately 50 years of age. Median taxable net wealth lies at CHF 33,232 and peaks between 66 and 70 – right after the general retirement age of 65 for men and 64 for women in Switzerland.[11] For both taxable income and taxable wealth, we observe wide tails of the distribution.

[9] For better readability, the tails were restricted in some charts.
[10] Due to the panel structure of our sample, a taxpayer can appear more than once.
[11] Between 2001 and 2005, the age of retirement for women was 63.

Figure 1: Distributions of selected tax record variables



3 From tax variables to economically interpretable income and wealth measures

Even though our tax data already contain measures of income and wealth (as described in the previous section), we need to make further adjustments to our raw data to obtain income and wealth measures that are useful for economic analysis.

3.1 Disposable income

For income, our tax data contain the measure of taxable income. This measure, however, is a tax-specific definition of income and only contains tax-relevant income streams. Furthermore, for property owners, it also includes the so-called notional rental value. To retrieve an income measure that is economically interpretable, such as disposable income, we follow the calculation methods used for the national accounts. We adjust the measure of taxable income in several aspects, e.g., by subtracting the *notional rental value* and adding *(non)value-increasing investments into real estate properties* (since the latter were deducted for calculating taxable income) and by adding income streams that are either partially or not at all subject to taxation. Furthermore, we make some adjustments to flows of gifts and inheritances.[12] Table 2 provides an overview of how we calculate disposable income based on our tax data.

Table 3 gives an overview of the resulting median disposable income for the full sample and for specific years (2003, 2008, 2015). Median disposable income across all taxpayers and over all years amounts to 52,222. Disposable income has increased at the median over time. Figure 2 shows the distribution of disposable income over all taxpayers as well as the respective median per age group. As was the case for taxable income (Figure 1), we observe an overrepresentation of low values and zeros due to the reasons mentioned before. Disposable income increases with age, peaks at approximately the age of 50 and declines thereafter.

[12] More details can be found in Appendix A.2.

Table 2: Definition of disposable income using tax data

	Type of income in-/outflow
	Income from dependent employment, head/partner
+	Income from self-employment, head/partner
+	Income from agriculture, head/partner
+	Income from financial assets (e.g., dividends)
+	Pension income, head/partner
+	Social insurance benefits (incl. alimony), head/partner
+	Income from inheritance or ownership communities
+	Income from other types of communities
+	Net income from real estate property
+	Other types of income subject to taxation
=	*Taxable income*
+	Other types of income not subject to taxation
-	Notional rental value
+	(Non)value-increasing investments in real estate property
+	Gifts received
-	Gifts made
+	Inheritance
-	Taxes paid
=	*Disposable income*

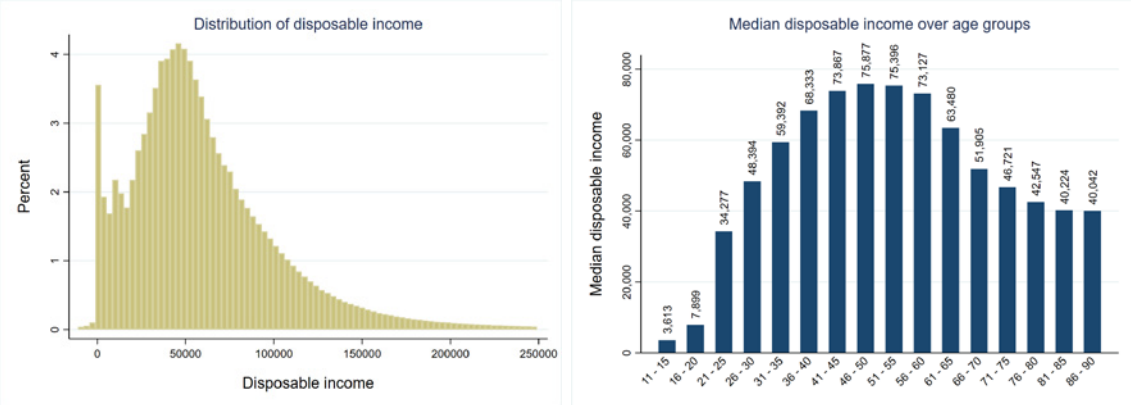
Notes: Subtotals are cumulative, e.g., all elements of taxable income are included in disposable income.

Table 3: Disposable income

Variable	Full sample	2003	2008	2015
Disposable income (median)	52,222	49,489	52,152	54,289

Notes: Values are denominated in CHF.

Figure 2: Distribution of disposable income



3.2 Gross and net wealth

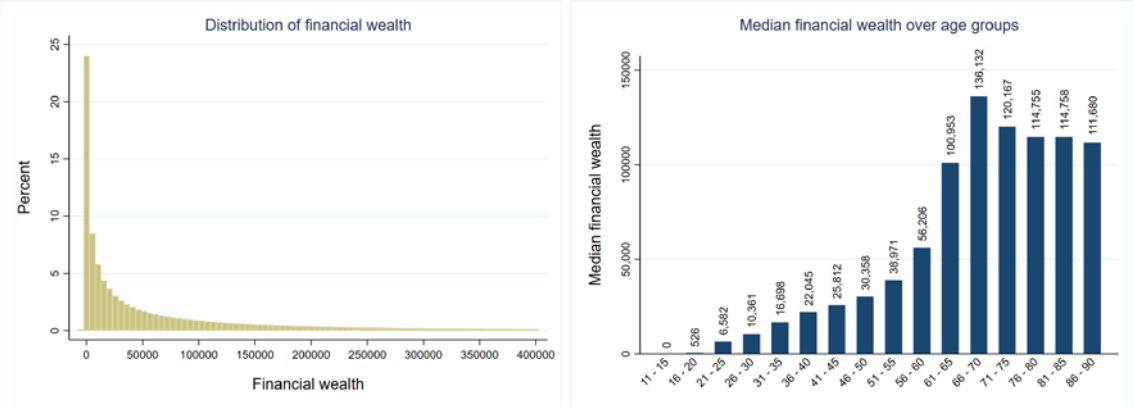
For wealth, our tax data contain the measures of taxable gross wealth and taxable net wealth. However, since these variables tend to capture only tax-specific information, we calculate our own

Table 4: Definition of gross and net wealth

	Wealth component
	Financial wealth
	Taxable financial assets
	+ Taxable stakes of inheritance or ownership communities
	+ Taxable stakes of other types of communities
+	Real estate wealth
	Taxable value of real estate properties
	+ Value correction for properties outside of the Canton of Bern
	+ Difference between market value and taxable value
=	*Gross wealth*
−	Tax-deductible debt
=	*Net wealth*

Notes: Subtotals are cumulative, i.e., all elements of gross wealth are included in net wealth.

Figure 3: Distribution of financial wealth



measures of wealth according to Table 4. These measures are better suited for economic analysis.

We define a taxpayer's financial wealth as the sum of his taxable financial assets (bank accounts, holdings of stocks and bonds, etc.) plus wealth held in inheritance, ownership or other types of communities.[13] The distribution of financial wealth over all taxpayers as well as the median per age group are shown in Figure 3. Median financial wealth amounts to CHF 27,942 (see Table 5). However, there is a high fraction of taxpayers who own very limited financial wealth. Over the life cycle, financial wealth tends to peak at the age of 66 to 70 years, immediately after the general retirement age of men in Switzerland.

[13]Note that we do not know the composition of wealth held in communities. In principle, this could also entail real estate wealth.

Regarding real estate wealth, the tax data only contain the so-called administrative value (AV) of each property.[14] While this AV is useful in the context of taxation, the financial situation of a taxpayer is more accurately assessed by looking at market values of the respective real estate properties. In theory, the AV of a property should equal 77% of its market value (MV). Obviously, the MV of a property is volatile and changes over time. However, a general reassessment of all properties and the respective AVs in the Canton of Bern is carried out only on an irregular basis (roughly every 20 years; the latest one was carried out in 1999).[15] Between such general reassessments, changing conditions in the housing market may cause the ratio of a property's AV to its MV — henceforth called the correction factor (CF) — to deviate from the target of 77%.

For 2012, our data include this CF for each property.[16] Based on the CF, we can calculate the MV W^h of property h of taxpayer i for 2012, $W^h_{i,h,2012}$, based on the corresponding AV, $AV_{i,h,2012}$, and the CF, $CF_{i,h,2012}$:

$$W^h_{i,h,2012} = \frac{1}{0.77} * CF_{i,h,2012} * AV_{i,h,2012}. \tag{1}$$

For all other years, we calculate the MVs by first retro- and extrapolating the CF of the year 2012 based on a house price index of the Canton of Bern and then by applying it to the AV of the respective year:

$$W^h_{i,h,t} = \frac{1}{0.77} * \underbrace{CF_{i,h,2012} * \frac{P^h_t}{P^h_{2012}}}_{\equiv CF_{i,h,t}} * AV_{i,h,t}. \tag{2}$$

The house price index is a hedonic transaction price index from Wüest Partner for privately owned apartments and single-family homes.[17]

A taxpayer's real estate wealth for a particular year then simply corresponds to the sum over

[14] In Switzerland, the AV of a property is estimated by the tax authority.

[15] Between general reassessments, the AVs of properties are usually only revalued if significant value-enhancing investments by the owner have been conducted. For newly built houses, the AV is set to match the current median AV to-MV ratio of the properties of the respective municipality. For properties outside of the Canton of Bern, the AV is set to match the mean AV-MV-ratio of all properties in the Canton of Bern.

[16] There are properties that were built after 2012 or taxpayers who sold their property before 2012. Obviously, there is no CF available for these respective properties in 2012, and we therefore impute the CF for 2012 by the median of the CF of all properties in the respective municipality. For properties outside of the Canton of Bern, we impute the CF by the mean of the CF of all properties in the Canton of Bern.

[17] Data Source: Wüest Partner (2018). Grossräumiger Transaktionspreisindex, Einfamilienhäuser und Eigentumswohnungen. Extracted on the 29th of September 2018 from `https://www.wuestpartner.com/online_services_classic/immobilienindizes/grossraeumiger-transaktionspreisindex/index.phtml`.

Figure 4: Distribution of real estate wealth

the MVs of all properties H of the respective taxpayer i:[18]

$$W_{i,t}^{h} = \sum_{h=1}^{H} W_{i,h,t}^{h}. \tag{3}$$

The resulting distribution of real estate wealth across all taxpayers who own real estate properties and the corresponding median real estate wealth per age group are shown in Figure 4. Median real estate wealth amounts to 568,310 (see also Table 5). Real estate wealth is roughly symmetrically distributed around this median. Furthermore, real estate wealth increases with age up to approximately 40 years, remains fairly stable until 70 and declines thereafter.

Finally, the sum of financial wealth and real estate wealth yields gross wealth, and net wealth is defined as gross wealth minus a taxpayer's tax-deductible debt.[19] Figure 5 shows the distribution of gross and net wealth across all taxpayers, as well as the corresponding median per age group. Table 5 shows median gross and net wealth for the full sample as well as for specific years. The median gross wealth amounts to 56,219, and the median net wealth amounts to 39,577. Most of the taxpayers own a small amount of wealth, while the upper tails of the distributions are wide. Median gross and net wealth increase up to the general retirement age of men in Switzerland and

[18]There are some taxpayers for which a property is missing in the detailed data file on each property. In this case, the sum of the AVs over each property does not equal the total taxable AV of the taxpayer. For most of these missing properties, the AV is very low, or these properties are empty and there is neither a notional rental value nor a rental income. For only 5% of taxpayers, this difference is larger than CHF 5,357. For these missing properties, we impute the CF by the weighted average of the CFs of all other properties of the respective taxpayer (using the respective administrative values as weights).

[19]Note that for some types of debt, such as mortgage debt, actual debt may differ from tax-deductible debt due to indirect amortization, which is not covered in our tax data.

Figure 5: Distribution of gross and net wealth

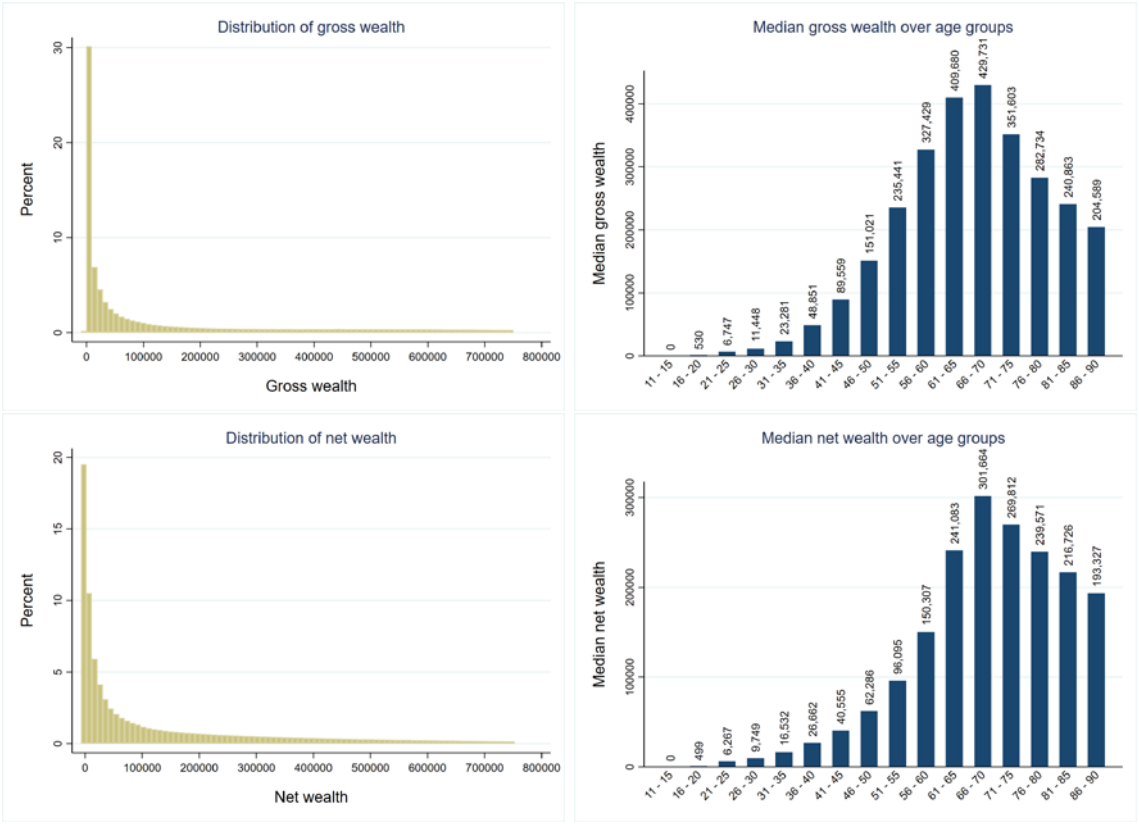


Table 5: Gross and net wealth

Variable	Full sample	2003	2008	2015
Financial wealth (median)	27,942	25,583	26,056	31,835
Real estate wealth (median)	0	0	0	0
Property owners only	568,310	429,467	547,019	718,382
Gross wealth (median)	56,219	53,361	54,168	60,761
Net wealth (median)	39,577	31,510	37,788	49,071

Notes: Values of wealth are denominated in CHF.

decrease thereafter.

4 How to impute consumption from tax data

In contrast to survey-based data on consumption, where consumption is a variable typically directly asked for, tax data do not include a measure of consumption. This section describes how we impute consumption from tax data. In line with, e.g., Fagereng and Halvorsen (2017) or Koijen, Van Nieuwerburgh, and Vestman (2014), we use the simple budget constraint of a household, where consumption equals disposable income minus savings, as the underlying imputation equation. While, as shown in the previous section, obtaining a measure of disposable income based on tax data is more or less straightforward, retrieving a measure of savings is more demanding and requires distinguishing between changes in valuation of assets and net acquisitions of assets. This section also covers this issue.

4.1 The household budget constraint

Our framework to impute consumption spending uses a similar method as described in Fagereng and Halvorsen (2017) and combines information on income with changes in wealth. We rely on the household's simple budget constraint, which states that a household's net wealth today equals his previous period's net wealth plus the return on the latter plus savings:

$$W_t - D_t = (1 + r_t) * W_{t-1} - D_{t-1} + Y_t - C_t, \tag{4}$$

where W_t is gross wealth in year t, D_t is the corresponding (in our case tax-deductible) debt and r_t stands for the return on wealth. Y_t is income, and C_t is consumption in year t.

The return on the previous period's net wealth can be decomposed further into realised capital gains (dividends, interest payments, rental income, etc.) and unrealised capital gains (valuation changes). In what follows, we will work with disposable income as our income measure. Since realised capital gains are included in disposable income, we rewrite equation (4) in terms of disposable income and $r^{vc}_{i,t}$, which denotes valuation changes. Furthermore, we need to account for a tax-related issue: pension wealth is not included in the tax records and, in turn, in our measure of financial wealth. Therefore, we need to additionally add extractions from and subtract voluntary contributions to the second and third pension pillars. After rearranging terms, our imputation equation for

consumption at time t for each taxpayer i is:

$$C_{i,t} = Y_{i,t}^{disp} + \Delta D_{i,t} - \underbrace{(\Delta W_{i,t} - r_{i,t}^{vc} * W_{i,t-1})}_{\equiv NA_{i,t}} + PE_{i,t} - PC_{i,t}. \tag{5}$$

Consumption of a taxpayer, $C_{i,t}$, equals the sum of disposable income $Y_{i,t}$ and the change in net borrowing $\Delta D_{i,t}$ that is not used for net acquisitions of wealth $NA_{i,t}$, plus second and third pillar pension extractions $PE_{i,t}$, minus second and third pillar voluntary pension contributions $PC_{i,t}$. The size of net acquisitions is defined by changes in gross wealth that are not caused by valuation gains or losses. This distinction is important, as these valuation gains or losses do not represent an increase in wealth due to active savings (i.e., forgone consumption).[20] Baker, Kueng, Meyer, and Pagel (2018) discuss sources of possible measurement errors in imputed consumption.

Equation (5) can be separated further by distinguishing between net acquisitions of financial wealth $NA_{i,t}^{f}$ and net acquisitions of real estate wealth $NA_{i,t}^{h}$, such that

$$C_{i,t} = Y_{i,t}^{disp} + \Delta D_{i,t} - NA_{i,t}^{f} - NA_{i,t}^{h} + PE_{i,t} - PC_{i,t}. \tag{6}$$

While the calculation of disposable income was outlined in section 3.1 and data on pension contributions and extractions as well as changes in debt are directly obtained from the tax records, the following subsections show how we calculate net acquisitions of financial wealth and real estate wealth based on our tax data.

4.2 Net acquisitions of financial wealth

The validity of our consumption imputation procedure relies on distinguishing between net acquisitions of financial wealth, i.e., (dis-)investments into financial assets on the one hand and valuation gains or losses in existing financial wealth on the other hand. While changes in wealth can be caused by either or both causes, we only observe the *total* change in wealth in our tax data. To obtain a measure of net acquisitions of financial wealth, we need to estimate or calibrate $r_{i,t}^{vc,f}$, i.e.,

[20] Our consumption measure is relatively comprehensive in the sense that it also includes, e.g., private health insurance premia or donations. In comparison, for example, the Household Budget Survey (HABE) from the Swiss Federal Statistics Office does not consider spending for private health insurance as consumption.

annual valuation changes in existing financial wealth. To do so, we proceed in the following way: For bank accounts, loans, qualitative holdings and 'others', we assume no valuation changes to be present. For stock and bond holdings, we assume a representative portfolio for each of these two asset classes and approximate the respective valuation changes by the annual performance of this representative portfolio.[21] Any changes in stocks or bond holdings that go beyond the performance of the representative portfolio are then interpreted as net acquisitions:

$$NA^f_{i,t} = \Delta W^f_{i,t} - r^{vc,f}_{i,t} * W^f_{i,t-1}, \tag{7}$$

$$\text{with } r^{vc,f}_{i,t} = \begin{cases} \frac{W^{Stocks}_{i,t-1}}{W^f_{i,t-1}} * \Delta RP^{Stocks}_t + \frac{W^{Bonds}_{i,t-1}}{W^f_{i,t-1}} * \Delta RP^{Bonds}_t & \text{if } W^f_{i,t-1} > 0 \\ 0 & \text{otherwise.} \end{cases} \tag{8}$$

$\frac{W^{Stocks}_{i,t-1}}{W^f_{i,t-1}}$ and $\frac{W^{Bonds}_{i,t-1}}{W^f_{i,t-1}}$ denote the shares of stocks and bonds in the portfolio of the respective taxpayer, and $\Delta RP^{Stocks}_{i,t}$ and $\Delta RP^{Bonds}_{i,t}$ denote the annual gains or losses of the representative stock and bond portfolios.

The representative stock and bond portfolios are characterised in terms of shares of domestic and foreign assets. These shares are obtained from the official Swiss financial accounts, which suggests that Swiss households hold approximately 7/10 of stocks and 1/3 of bonds domestically.

The performance of domestic assets is approximated by the Swiss Market Index (SMI) for stocks and the Swiss Bond Index (SBI) for bonds. The performance of foreign assets is approximated by the MSCI World Index for stocks and the Bloomberg Barclays US Aggregate Bond Index (BBAgg) for bonds, both converted to Swiss francs using the USDCHF nominal exchange rate. Based on the respective weights, the annual performance of the representative stock and bond portfolios are then calculated as follows:

[21] A simpler approach to proxy net acquisitions of financial wealth would be to set it equal to the total change in financial wealth, i.e., ignoring potential valuation changes in stocks and bonds. This is done, e.g., by Kreiner, Lassen, and Leth-Petersen (2014). A more sophisticated approach than the one applied in this paper would be to regress each taxpayer's portfolio over time on several market performance indices to obtain taxpayer-specific portfolio weights. The net acquisition would then be given by the regression residuals. However, since we only have on average 9.8 observations per taxpayer, our dataset is not rich enough to estimate taxpayer-specific portfolio weights.

$$\begin{aligned}\Delta RP_t^{Stocks} &= \frac{7}{10} * \Delta SMI_t + \frac{3}{10} * \Delta(MSCIWorld_t * USDCHF),\\ \Delta RP_t^{Bonds} &= \frac{1}{3} * \Delta SBI_t + \frac{2}{3} * \Delta(BBAgg_t * USDCHF).\end{aligned} \tag{9}$$

Based on these returns of the representative portfolios, we then calculate for each taxpayer the respective net acquisitions of financial wealth. To this end, we need to know the amount of stocks and bonds each taxpayer holds, i.e., $\frac{W_{i,t}^{Stocks}}{W_{i,t}^{f}}$ and $\frac{W_{i,t}^{Bonds}}{W_{i,t}^{f}}$. We retrieve this information from the data on the taxpayers' composition of financial assets. This composition is available for 2014 until 2018 but only for taxpayers who completed their tax records online (approximately 43% in 2014, see Section 2). We thus impute the composition of financial assets for the remaining taxpayers and years by picking the year 2014 and using a (kernel-based) nearest-neighbour matching approach; see, for example van Buren (2012). In brief, this procedure is based on an algorithm that searches for taxpayers with (predefined) characteristics as similar as possible to the taxpayer who should be matched and then uses the matched pairs' relative composition of financial assets for imputation.[22] The algorithm matches each to-be-matched taxpayer with the five most similar taxpayers within the subsample where the composition of financial assets is known. The portfolio composition of the matched partners is then weighted according to their degree of similarity using an Epanechnikov kernel function.[23] The set of characteristics the matching process is based on should reflect relevant determinants of differences in the composition of financial assets, such as financial situation, liquidity needs and risk aversion. We proxy a) the financial situation by the taxpayer's income[24] and financial wealth, b) the liquidity needs by the taxpayer's year of birth, civil status, tax type (nonself-employed, self employed, etc.) as well as dummies for owning a house and having made tax deductions for children, and c) the risk aversion by the taxpayer's gender and his return on financial assets. For all years other than 2014, we assume that the taxpayer's portfolio composition remains unchanged.[25]

[22] If a taxpayer is not part of the sample in 2014, his available tax record closest to 2014 enters the matching process.

[23] Using matching methods to impute missing values is not uncommon; see, for examplevan Buren (2012). The method applied here is an extension to predictive mean matching (PMM). It is fully nonparametric and allows not only to impute one variable but also several mutually dependent variables (dependence in the sense that relatively more stock holdings imply smaller shares in other asset types). The applied method differs from PMM in the sense that the values of the five matched partners are weighted instead of choosing one of them randomly.

[24] Since the focus lies on regular income streams, we take disposable income excluding gifts, inheritance and taxes paid.

[25] Additional data on financial asset registers for 2015–2018 indicate that the *relative* composition of taxpayers' financial assets indeed remains quite constant over time.

26

Compared to other possible imputation strategies, the described method has relevant advantages. For example, it is superior to simple linear fitting in the sense that it is able to address potentially complex nonlinearities and interactions in the relationship of the relative portfolio structure and the described determinants. Furthermore, using the kernel-weighting extension reduces the risk of biases due to outliers.

4.3 Net acquisitions of real estate wealth

Changes in real estate wealth can be determined by several sources: purchases or sales of real estate properties, value-increasing investments, and valuation changes.[27] Analogous to net acquisitions of financial wealth, net acquisitions of real estate wealth are defined by the change in real estate wealth minus valuation changes:[28]

$$NA^h_{i,t} = \Delta W^h_{i,t} - r^{vc,h}_{i,t} * W^h_{i,t-1}. \tag{10}$$

We calibrate the change in valuation of existing real estate properties, $r^{vc,h}_{i,t}$, to equal the change in the house price index of the Canton of Bern, introduced in Section 3.2. This allows us to calculate net acquisitions of real estate wealth $NA^h_{i,t}$ in the following way:

$$NA^h_{i,t} = \sum_{h=1}^{H} \frac{1}{0.77} * CF_{i,h,t} * \Delta AV^h_{i,h,t}, \tag{11}$$

where $\Delta AV^h_{i,t}$ is the change in the AV of real estate property owned by taxpayer i in year t and $CF_{i,h,t}$ is the year- and property-specific correction factor defined in equation (2).

[26] There is a small number of cases (roughly 1%) for which the matching process fails, i.e., the algorithm cannot find a corresponding taxpayer whose detailed portfolio is available and is sufficiently similar. For these taxpayers, the composition of their financial wealth remains latent for all other years, too.

[27] Additionally, in the context of tax data, there might also be changes in the value of a property due to an extraordinary reassessment of the AV not being linked to value-increasing investments.

[28] As in the case of financial wealth, income linked to real estate properties, such as rental income, is captured by disposable income.

5 Consumption estimates

Based on the measure of disposable income calculated in Section 3.1 and net acquisitions of financial wealth and real estate wealth calculated in the previous section, we can now impute consumption according to equation (6).

Table 6 shows the number of taxpayers and observations of the resulting consumption sample as well as for the full sample. The consumption sample is smaller than the full sample for two reasons. First, consumption can only be calculated if a taxpayer filled in a tax record in the preceding year, as our approach relies on a taxpayer's change in wealth. Second, for a small number of cases, the matching process failed when calculating net acquisitions of financial wealth.

Table 6: Sample size of full sample and consumption sample

	Full Sample	Consumption sample
Number of taxpayers	864,881	796,738
Number of observations	8,483,827	7,427,388

Due to the nature of our data, our imputation may yield implausible or biased consumption estimates in some cases. In particular, we observe imputed consumption values that are negative and/or a variation in consumption that is implausibly high over time.[29] In the first step, we therefore try to identify outliers in our imputed consumption values. In the second step, we aim to identify a) clusters of taxpayers with specific characteristics and b) events that both may lead to biased consumption estimates. One may want to exclude such clusters and events before analysing consumption patterns.

[29]This observation has also been the case in several other studies that imputed consumption, e.g., Fagereng and Halvorsen (2017) or Koijen, Van Nieuwerburgh, and Vestman (2014).

5.1 Cleaning of outliers

To account for outliers, we follow the existing literature and exclude observations that are linked to the tails of the distribution of a benchmark variable.[30] This procedure identifies outliers in imputed consumption regardless of the respective taxpayer's characteristics. Our outlier cleaning procedure uses the deviation of the respective consumption value from the taxpayer's median consumption as the benchmark variable and entails two steps:

1. We assume that a taxpayer's median consumption represents his habit level of consumption and exclude all taxpayers with negative median consumption (since they are not plausible).

2. For the remaining taxpayers, we calculate the percentage deviation of consumption at time t from the taxpayer's median consumption $\widetilde{C}_i$:

$$C_{i,t}^{\Delta} \equiv (C_{i,t} - \widetilde{C}_i)/\widetilde{C}_i. \tag{12}$$

   We then exclude those consumption values for which $C_{i,t}^{\Delta}$ exceeds the 10- to 95-percentile of the distribution of C^{Δ} over all taxpayers in the respective year.[31]

Table 7 documents how the cleaning of outliers affects our sample, in particular the demographic, income and wealth variables. In total, we lose roughly 25,000 taxpayers and 1.2 million observations. As the third and fourth columns reveal, this is mainly driven by the second step of our outlier cleaning procedure, i.e., consumption estimates that deviate too strongly from the median consumption. The taxpayers that fall out of the sample due to outlier cleaning can mostly be characterised as taxpayers that were in the sample only for a few years.[32] With outlier cleaning, the average age of the taxpayers' heads increases marginally by one year (see Table 7). The

[30] In the context of consumption data, e.g., Fagereng and Halvorsen (2017) remove consumption observations if the corresponding financial active saving is in the top or bottom 1% of the respective year-specific distribution. Koijen, Van Nieuwerburgh, and Vestman (2014) exclude consumption observations if the corresponding change in net wealth is outside the 2.5- to 97.5-percentile and Kniesner and Ziliak (2002) remove observations if consumption either increased by more than 300% or decreased by more than 75%. All the aforementioned references additionally exclude any negative consumption estimates; Kniesner and Ziliak (2002) require in addition that consumption must be at least USD 1,000.

[31] Following Kniesner and Ziliak (2002), the reason for our choice of asymmetric tails is to allow for higher increases in consumption than decreases. Intuitively, a sudden jump in consumption, e.g., due to an expensive purchase, is more realistic than a strong decrease in consumption since one always has to consume for a living. The choice of a tail of 10% rules out any negative consumption values.

[32] They entail on average 4 observations of consumption per taxpayer.

Table 7: Sample characteristics before and after outlier cleaning

	Full sample	Consumption sample		
		Before outlier cleaning	Excl. median consumption ≤ 0	After outlier cleaning
Year of birth (median)	1962	1962	1962	1961
Age (median)	47	48	48	49
Gender (0=M, 1=F; mean)	35.2%	34.6%	34.5%	34.7%
Share married	35.7%	36.8%	37.0%	37.7%
Share of taxpayers reporting children	19.8%	20.0%	20.1%	20.7%
Share of property owners	30.6%	31.5%	31.6%	30.3%
Taxable income (median)	57,718	59,188	59,481	60,621
Taxable gross wealth (median)	59,350	66,658	67,632	61,427
Taxable net wealth (median)	33,232	36,652	37,053	35,235
Disposable income (median)	52,222	53,377	53,639	54,489
Financial wealth (median)	27,942	30,528	30,789	29,173
Real estate wealth (median)	0	0	0	0
Property owners only	568,310	573,810	572,842	560,589
Gross wealth (median)	56,219	63,472	64,396	57,677
Net wealth (median)	39,577	45,080	45,679	42,670
Consumption (median)	49,285	49,285	49,660	52,617
Number of taxpayers	864,881	796,738	775,610	771,587
Number of observations	8,483,827	7,427,388	7,343,336	6,241,850

Notes: The table shows medians and means (in case of shares) of the variables over all years at the respective sample stage. The year of birth and gender both relate to the taxpayer head (in the case of married couples, usually the husband). Values of income, wealth and consumption are denominated in CHF.

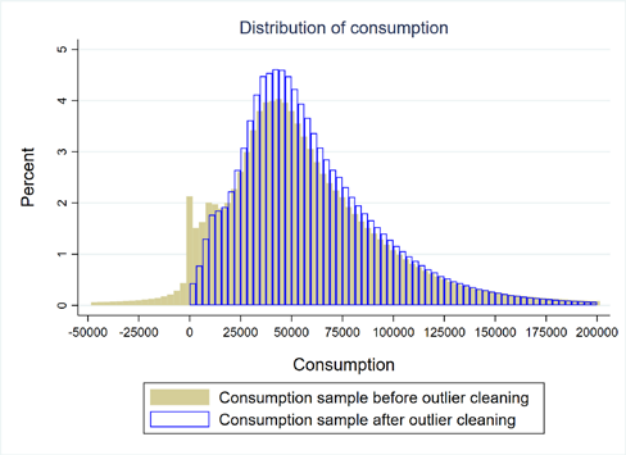
outlier cleaning increases the share of taxpayers who are married couples, which in turn decreases the share of female taxpayers (as for married couples, the husband tends to be the taxpayer head). Additionally, and in line with a slightly higher median age, is the increase in income, wealth and the share of property owners.

To assess the effectiveness of our outlier cleaning procedure in terms of reducing implausible consumption values, Table 8 and Figure 6 provide some insights. As seen in Figure 6, our approach eliminates all negative consumption values (as the outlier tails in the distribution of $C_{i,t}^{\Delta}$ were chosen accordingly). The chart also shows that the fraction of very low consumption values decreases and the corresponding hump in the distribution becomes less pronounced. Similar to the findings of Battistin, Blundell, and Lewbel (2009), a QQ plot analysis and the Kolmogorov–Smirnov test

Table 8: Consumption characteristics before and after outlier cleaning

Indicators	Consumption sample		
	Before outlier cleaning	Excl. median consumption ≤ 0	After outlier cleaning
Number of observations with any consumption estimate	7,427,388	7,343,336	6,241,850
Number of observations with consumption estimate < 0	393,996	354,530	0
Coefficient of variation p99	13.91	13.41	0.641
Coefficient of variation p95	3.424	3.352	0.518
Coefficient of variation p90	1.967	1.929	0.454
Coefficient of variation p50	0.472	0.473	0.260
Average number of observations per taxpayer	9.322	9.468	8.090

Figure 6: Effect of outlier cleaning on consumption estimates



suggest that our resulting consumption estimates are lognormally distributed. Table 8 further shows that our approach reduces the variation in consumption per taxpayer significantly: The top percentiles of the coefficient of variation of consumption decline substantially.[33]

5.2 Validation of consumption estimates using external sources

To validate our method of imputing consumption from tax data, we compare the resulting consumption estimates with two external sources: a) survey data on consumption from the official Swiss Household Budget Survey (disaggregated/microlevel data) and b) official Swiss national accounts (aggregated/macrolevel data).

The first source for our comparison is the Household Budget Survey (HABE). This survey

[33]The coefficient of variation is defined as the standard deviation divided by the mean of a series. In our case, this coefficient is calculated on the level of taxpayer.

is conducted by the Federal Statistical Office and contains approximately 3,000 observations per year. Before comparing, we have to account for three important differences between the tax data and the HABE. First, the datasets differ in nature: while the tax dataset can be characterised as an unbalanced panel of the full population of the Canton of Bern, the HABE corresponds to a pooled cross-section representative subsample of Switzerland. Thus, we base our comparison on pooled observations over those years that are available for both datasets (i.e., 2006-2014), and we only include observations from the Canton of Bern for the HABE. Second, while in the tax data, observations represent taxpayers, in the HABE, they represent households. For this reason, we restrict the comparison to married taxpayers/households above the age of 30.[34]

Third, definitions of income and consumption differ between our analysis and the household survey equivalents. Namely, in the household survey, sporadic income, such as gifts or inheritance, was not incorporated into disposable income, and insurance premia were not incorporated into consumption and were deducted from disposable income. To account for these differences, we constructed household survey measures for disposable income and consumption that are comparable to our definition based on the tax data.

Table 9 shows the comparison between our tax data and the HABE equivalents. The results reveal that for both disposable income and consumption, our estimates are, at the median, very close to the results from the household survey. Additionally, when comparing the entire distribution of the two variables, shown in Figure 7, we observe that our data seem to map the data in the household survey very well, with the advantage of being based on a much larger sample and therefore showing a much smoother density function (proxied by histogram bins) and allowing for a more granular analysis.

The second source of comparison is the official Swiss national account data on private consumption, computed by the Federal Statistical Office. We conduct the comparison between our tax data and the national accounts by looking at cumulative annual growth of private consumption in the national accounts (in per capita terms) and compare it with cumulative median consumption

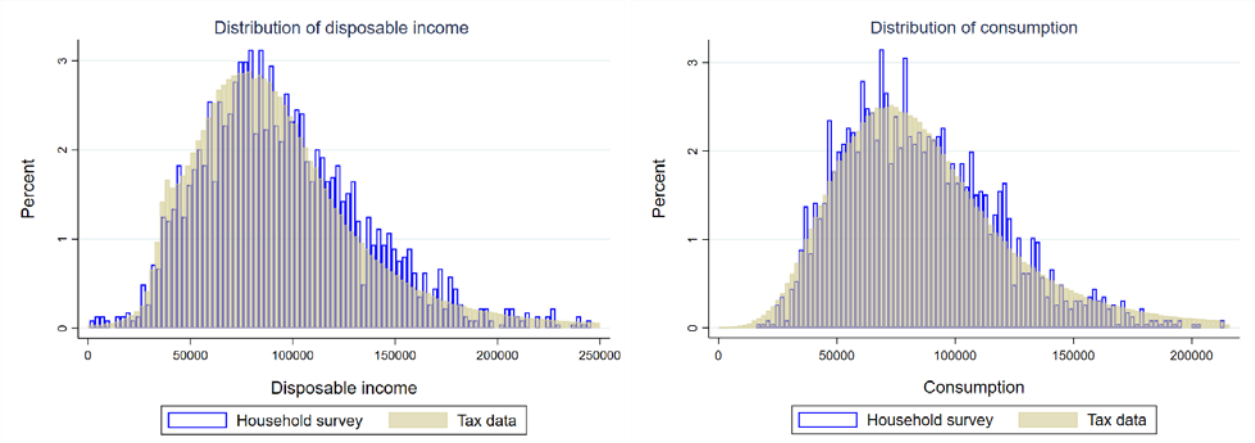
[34]The threshold regarding the age of 30 comes from the fact that young taxpayers with low income, in particular students, may receive financial support from their parents, which they do not state in their tax records. Furthermore, they may have amounts of income and wealth below the taxable threshold and might state a value of zero instead of accurate amounts. In both cases, our resulting consumption estimates are biased. Therefore, we only consider taxpayers above the age of 30 for the comparison.

Table 9: Comparison between tax data and household survey

	Tax data definition	HABE definition	Tax data		Household survey	
			Mean	Median	Mean	Median
	Net income from dependent employment	Gross Income from dependant employment	69,976	71,623	77,436	73,499
+	Net income from self-employment	Gross Income from self-employment	6,520	0	14,990	0
+	Net income from agriculture					
-		Social contribution			12,199	10,822
=	Total net employment income	Total net employment income	76,496	78,216	80,227	79,915
+	Pension income	Income from AHV/IV and 2nd pillar	20,953	0	21,257	0
+	Social insurance benefits	Social insurance benefits	1,134	0	4,575	0
+	Income from financial assets (e.g., dividends)	Investment income	6,442	473	5,346	390
+	Tied individual pensions (pillar 3a)					
+	Pensions from life insurance incl. life annuities					
+	Net income from real estate property					
-	Notional rental value					
+	(Non)value-increasing real estate investments					
+	Other types of income subject to taxation		407	0		
+	Other types of income not subject to taxation		1,295	0		
+	Received aliments	Monetary transfers from other households	97	0	1,077	0
-	Paid aliments made	Monetary transfers to other households	NA	NA	2,121	0
+	Inheritance	Sporadic income	4,744	0	2,360	1,024
+	Income from inheritance or ownership communities					
+	Income from other types of communities					
+	Gifts received					
-	Gifts made					
-	Taxes	Taxes	14,276	10,593	15,662	11,627
=	Disposable income		97,293	86,301	97,060	88,896
	Consumption		90,996	81,798	85,656	80,371
	Year of birth		1954	1955	1955	1956
	Number of observations		1,473,298	1,473,298	2,268	2,268

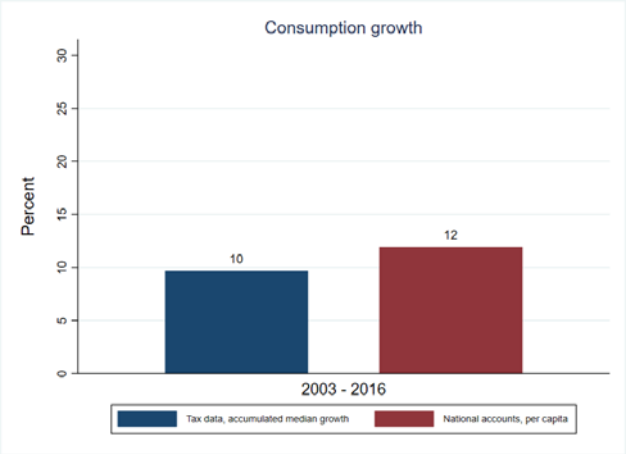
Notes: All subtotals are cumulative, e.g., all elements of total net employment income are included in disposable income. Means and medians are computed on the samples restricted to married heads of household that are over 30 years old. Values are denominated in CHF and represent yearly amounts. In the tax data, we use the sample after outlier cleaning. For the household survey, only people from Bern are considered, original values for one month are multiplied by 12 (except for sporadic income), and the data are weighted according to the sample weights reported by the Swiss Federal Statistics Office.

Figure 7: Comparison between tax data and household survey



Notes: Samples are restricted to married heads of households that are over 30 years old. Values are denominated in CHF and represent yearly amounts. In the tax data, we use the sample after outlier cleaning. For the household survey, only people from Bern are considered, original values for one month are multiplied by 12 (except for sporadic income), and the data are weighted according to the sample weights reported by the Swiss Federal Statistics Office.

Figure 8: Accumulated median consumption growth



growth in our tax data over the years 2003–2016. The results are shown in Figure 8 and indicate that, at the median, across all taxpayers, accumulated consumption growth was similar to the official national accounts. Between 2003 and 2016, it amounted to 10% according to the tax data and to 12% according to the national accounts (in per capita terms).

Overall, the comparison with external sources shows that our imputation method for consumption yields highly plausible estimates, but in addition comes with the advantage of covering the entire population and allowing us to follow the same individuals over time.

5.3 Necessity of additional sample restrictions

Even though the comparison with external sources highlighted that our imputation method for consumption based on tax data results in highly plausible estimates, there are some specific cases where our imputed consumption data may be unreliable or biased. These issues can be associated with certain events that a taxpayer undergoes at certain points over the life cycle and with certain clusters of taxpayers. In this section, we try to identify these events and clusters since we want to exclude them before analysing consumption patterns.

- *Subsidised consumption*: The distribution of consumption after the cleaning of outliers, shown in Figure 6 (blue bars), reveals that a nonnegligible amount of very low consumption estimates remains. A large share of these observations can be related to young people. There are two potential reasons for this. First, young people with low income, in particular students, may

receive financial support from their parents, which they do not state in their tax records.[35] Second, young taxpayers may have amounts of income and wealth below the taxable threshold and might state a value of zero instead of accurate amounts. In both cases, the resulting consumption estimates are biased. Thus, one might want to exclude young taxpayers before continuing with the analysis.

- *Change in civil status*: Since our consumption estimates are based on the budget constraint, a change in civil status can result in a substantial bias in consumption. As an example, a newly married couple only completes a joint tax declaration where the husband tends to head the tax liability. Therefore, a change in civil status may result in substantial changes in the income and wealth accounts of the household head. Since we do not know the respective wealth accounts of each partner before the marriage, a resulting increase in wealth of the household head could be falsely interpreted as higher savings, i.e., lower consumption. Therefore, one might want to exclude observations for years in which the civil status of a taxpayer changes.

- *Changes in the administrative value of real estate properties*: As described in Section 3.2, the administrative values of real estate properties are assessed on an irregular basis, and reassessments cannot be traced within our data. When the administrative value of an object changes, we cannot determine with certainty whether this is because a new acquisition (i.e., investment) has occurred or because there has been a reassessment of the administrative value of the property. If a reassessment occurs, the wealth of the respective taxpayer will change. Given that our consumption estimation is based on the budget constraint, this increase (decrease) in wealth would be erroneously interpreted as saving (dissaving) and would therefore bias our consumption estimate to the downside (upside). Therefore, one might want to exclude observations of years in which the administrative value of a taxpayer's real estate property changes.

- *Self-employed, agricultural or major shareholder status*: While tax records of nonself-employed taxpayers are typically quite standard and straightforward to interpret, tax records of the

[35] Note that the erroneously low consumption values of these young taxpayers with subsidised consumption cannot be distinguished from correctly imputed low consumption values of young taxpayers living in poverty.

remaining types (self-employed, agricultural and major shareholder) can potentially entail many special factors and may be prone to tax-related complications that make the reported values much more difficult to interpret. Therefore, one might want to concentrate the analysis on nonself-employed taxpayers only.

- *Membership in ownership community*: Taxpayers who are members of an ownership community report only the net value of their ownership share. For their wealth components, we thus cannot distinguish between changes in valuation and net acquisition of wealth, which is key to obtaining reasonable consumption estimates. Furthermore, for ownership shares that include real estate properties, we also cannot calculate the corresponding market value of the property and, in return, real estate wealth at market prices. Therefore, one might want to exclude taxpayers that are part of ownership communities.

- *Zero financial wealth and/or no change in financial wealth*: The data contain taxpayers that either report financial wealth of exactly zero and/or a change in financial wealth of exactly zero. One reason might be that some taxpayers whose financial wealth falls short of the taxation threshold state a wealth of zero instead of the accurate amount. In both cases, financial wealth of exactly zero and a change in financial wealth of exactly zero are not plausible. Thus, one might want to exclude these observations.

Table 10 documents the impact on the sample size and different variables when excluding these events and clusters.[36] As the sample restrictions are not cumulative, the same observation could be part of multiple groups. The last column shows the cumulative effect of all imposed restrictions. Obviously, each restriction by itself reduces the number of taxpayers and observations, thus, the sample size of the respective sample in comparison to the full sample. Excluding taxpayers under 30 years increases the median age, as well as the share of married couples, since younger people tend to be unmarried. Young people often show low income, low wealth and low consumption since they have only recently entered the workforce. Thus, excluding them increases median income, wealth and consumption in the restricted sample. For the real estate wealth of property owners, there is not

[36]For the cluster *subsidised consumption*, the criteria for exclusion must try to answer by what age most subsidised taxpayers (students and apprentices) become independent. We set the threshold at 30 years or older.

much change. This is because the share of property owners among young people is comparatively low (see also Figure 4, right panel). Excluding changes in civil status almost does not affect the relevant measures in Table 10. Excluding changes in administrative value mainly reduces the share of property owners, which decreases since only taxpayers with real estate property holdings are affected by these restrictions. Restricting the sample to only nonself-employed taxpayers reduces basically all values except for gender, which shifts towards a higher share of female taxpayers. Thus, in relative terms, there are more male taxpayers (or heads of tax records) with status self-employed, agricultural or major shareholder than female taxpayers. Excluding members of ownership communities lowers median financial and real estate wealth since reporting zero change in or zero financial wealth does apply relatively more often to nonproperty owners. Thus, the share of property owners increases when excluding these taxpayers and observations. Additionally, median financial wealth significantly increases since all zeros in financial wealth have been excluded. In turn, median gross and net wealth increase, too. Comparing the unrestricted sample with the sample where all restrictions apply, we observe that the median age increases and with it basically all other values except for real estate wealth of property owners (and of course the sample size due to the restrictions).

Table 10: Sample characteristics after imposing additional sample restrictions

	Consumption sample after outlier cleaning							
	Before imposing restrictions	Excl. under 30 year olds	Excl. changes in civil status	Excl. changes in adminis-trative value	Only nonself-employed	Excl. members of ownership community	Excl. zero financial wealth (change)	Imposing all restrictions
Year of birth (median)	1961	1955	1961	1961	1962	1962	1960	1953
Age (median)	49	54	49	48	48	48	50	57
Gender (0=M, 1=F; mean)	34.7%	32.3%	35.2%	35.4%	37.6%	35.1%	34.6%	37.1%
Share married	37.7%	45.4%	37.5%	36.5%	34%	36.9%	39.4%	42%
Share of taxpayers with deductions for children	20.7%	24.6%	20.3%	20.2%	18.3%	20.4%	20.5%	20.2%
Share of property owners	30.3%	37.4%	30.6%	28.2%	27.7%	28.9%	34.1%	36.7%
Taxable income (median)	60,621	68,959	60,133	59,742	58,584	59,140	63,545	67,404
Taxable gross wealth (median)	61,427	129,541	62,788	54,689	46,982	50,298	97,309	127,937
Taxable net wealth (median)	35,235	61,304	35,954	33,364	29,696	29,884	53,946	68,645
Disposable income (median)	54,489	61,376	54,045	53,699	52,722	53,168	56,770	59,436
Financial wealth (median)	29,173	44,825	29,649	27,652	26,033	25,016	42,702	51,809
Real estate wealth (median)	0	0	0	0	0	0	0	0
Property owners only	560,589	561,823	561,346	557,840	535,292	555,716	565,853	537,519
Gross wealth (median)	57,677	126,815	59,035	50,910	41,939	46,610	93,324	121,800
Net wealth (median)	42,670	83,849	43,717	38,718	35,815	35,363	68,687	93,832
Consumption (median)	52,617	59,316	52,201	51,987	51,259	51,529	54,442	58,114
Number of taxpayers	771,587	602,729	768,963	769,478	715,506	744,358	704,028	468,159
Number of observations	6,241,850	5,032,475	6,047,374	6,041,982	5,452,196	5,693,687	5,394,426	3,139,193

Notes: The table shows medians and means (in case of shares) of the variables over all years at the respective sample stage. The year of birth and gender both relate to the taxpayer head (in the case of married couples, usually the husband). Values of income, wealth and consumption are denominated in CHF.

Figure 9: Distribution of consumption before and after imposing all restrictions

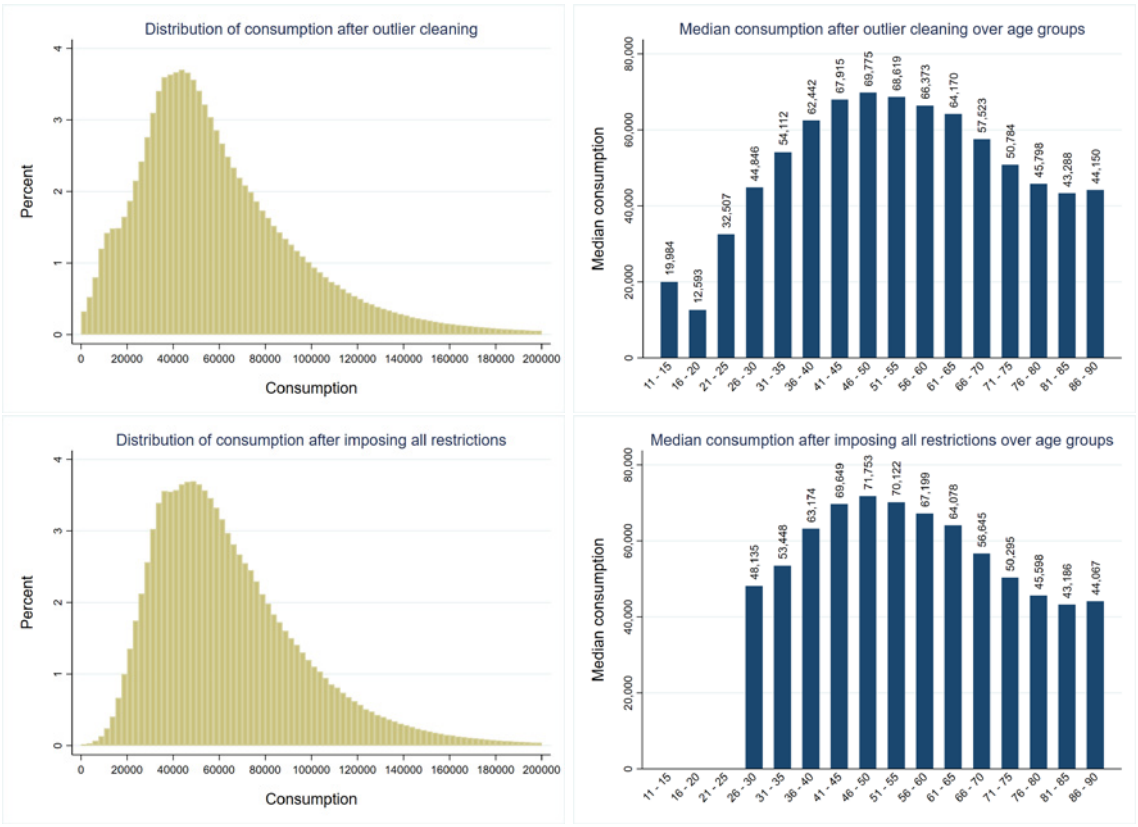


Figure 9 shows the distribution of our consumption sample after cleaning outliers (top panels) as well as the distribution after additionally imposing all restrictions, as depicted in Table 10 (bottom panels). Comparing the top-left chart with the bottom-left chart, we observe that the distribution becomes smoother for low consumption estimates. This might in particular be due to eliminating younger taxpayers. Median consumption peaks in both samples at approximately the age of 50 and declines thereafter (right panels).

Note that imputed consumption values linked to events and clusters presented in this subsection do not necessarily need to be implausible. The goal was solely to identify potential biases. Depending on the research question, one might want to reconsider these cases.

6 Consumption and saving patterns of households

Based on our imputed consumption estimates, in what follows, we conduct an analysis on consumption and saving patterns of households.

We are fully aware of the fact that our data technically cover taxpayers and that taxpayers may not always correspond to a household. However, for the sake of simplicity, in what follows, we will refer to the more general term household and use the terms taxpayer and household equivalently.

In the following analysis, we use the consumption sample after outlier cleaning and impose all sample restrictions, as discussed in section 5.3. First, we investigate consumption and saving patterns over the life cycle. Then, we analyse how consumption and saving patterns differ across household characteristics such as income groups, property owner status, or civil status. Finally, we try to shed some light on how inequality in consumption and income has evolved over time.

To conduct the analysis on saving behaviour, we first need to calculate the saving rate for all taxpayers and years. The saving rate, SR_t, is usually defined as savings S_t over disposable income Y_t, where savings S_t are defined as the difference between disposable income Y_t and consumption C_t, thus:

$$SR_t = \frac{S_t}{Y_t} = \frac{Y_t - C_t}{Y_t}. \tag{13}$$

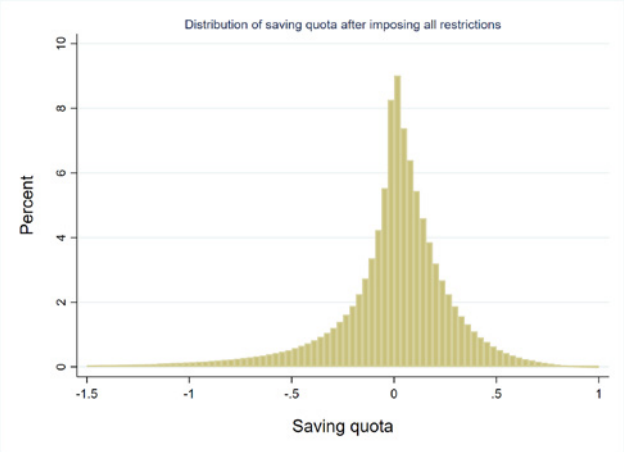
Figure 10 shows the distribution of the resulting saving rates. We see that while the mode is slightly above zero, the distribution of the saving rate is quite wide and incorporates a large share of taxpayers that dissave, i.e., have a negative saving rate.

6.1 Consumption and savings over the life cycle

Figure 11 shows the median consumption-age profile (left panel) and median saving rate-age profile (right panel) for specific years[37]. The chart on consumption indicates that consumption increases steeply at younger age and flattens at approximately 50. Already before the age of retirement, consumption starts to decrease. This downwards tendency then intensifies with older age. The resulting hump-shaped consumption-age profile is well in line with, e.g., Browning and Crossley

[37]Data limited to years where at least 20 taxpayers had the corresponding age.

Figure 10: Distribution of saving rate across households



(2001), Deaton (1991) or Carroll (1994). Comparing these consumption patterns across the four different yearly vintages shows that while the level of consumption increased over time, the pattern over the life cycle remained quite stable.

In terms of saving patterns, we observe that the median saving rate is quite stable over the working age. With retirement and the associated decrease in disposable income, the median saving rate decreases substantially and becomes negative, i.e., households start dissaving at the median. Dissaving is strongest immediately after retirement and lessens somewhat afterwards with aging. One reason might be that older people become restricted in their consumption possibilities and therefore consume less and less. Again, comparing the patterns of the saving rate across the four different yearly vintages shows that overall, they remained quite stable over time; however, the fall in the median saving rate around the age of retirement became more pronounced.

Our previous figures are based on pooled cross sections. However, cohort- and period-specific patterns may have an effect on the pooled consumption-age profile, and thus, the pooled consumption-age profile could be misleading. To illustrate this, Figure12 shows the consumption-age profile with different cohorts. While the pooled data indicate that consumption tends to decrease after the age of 60, this is much less the case for different cohorts. Therefore, the decrease in the pooled data may be caused by cohort effects. For saving patterns, the different cohorts appear to be more aligned, at least before retirement, and thus cohort effects might play a smaller role.

In the next step, we therefore computed adjusted age profiles. However, simultaneously

Figure 11: Consumption and saving rate over the life cycle for different vintages

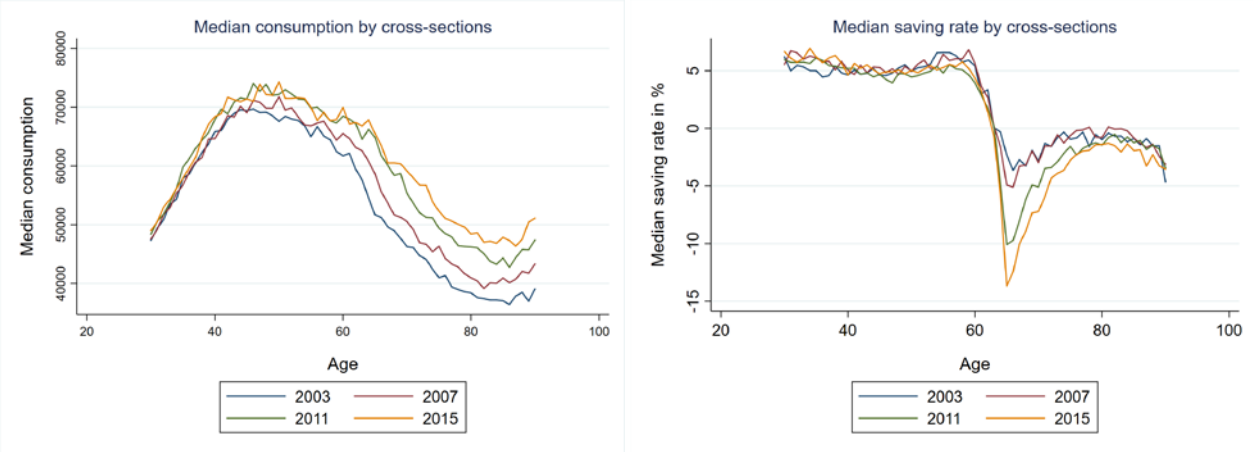
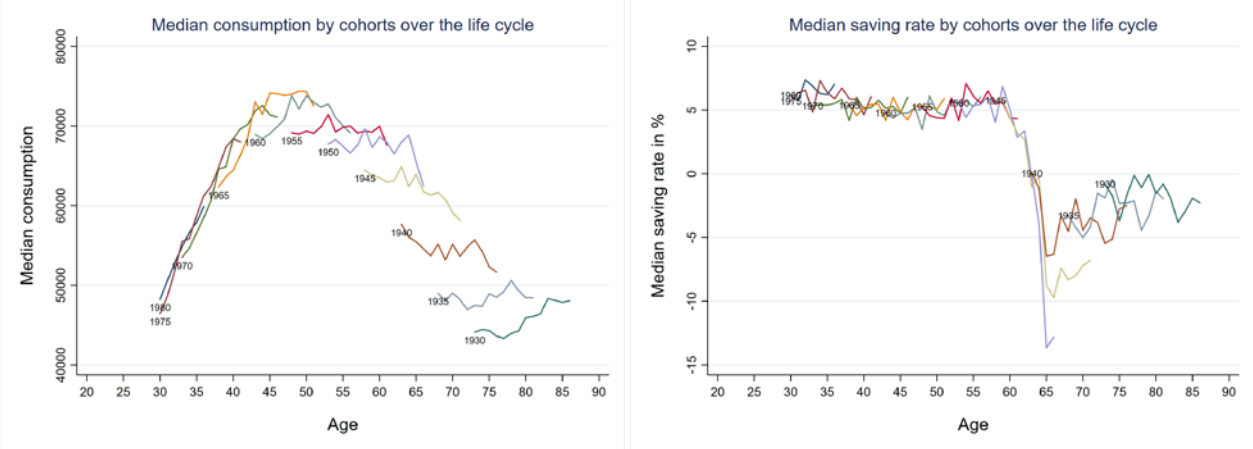


Figure 12: Consumption and saving rate over the life cycle for different cohorts



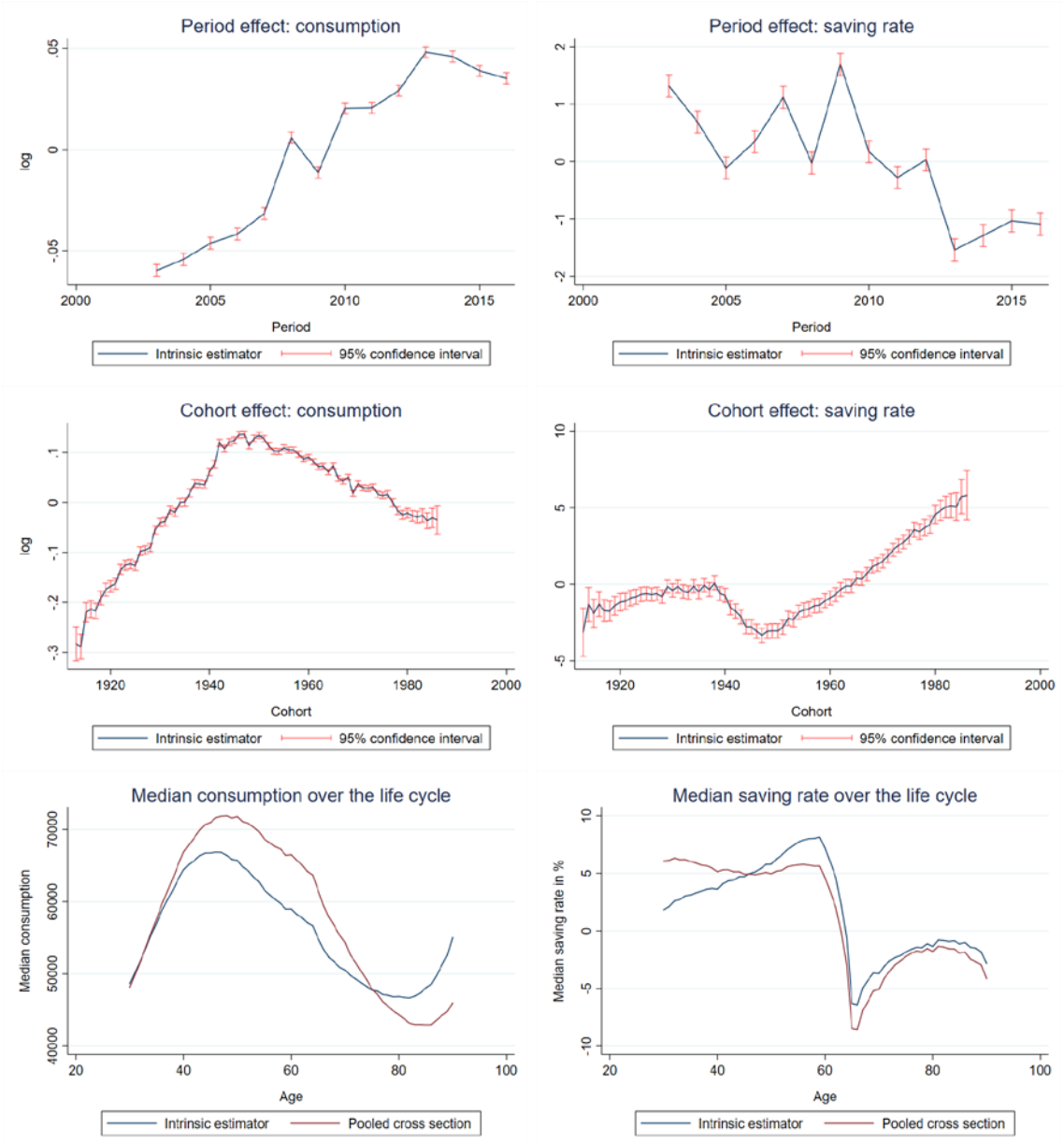
accounting for potential cohort- and period-specific effects in the age profiles of consumption and savings is not straightforward since there is an exact linear dependency between age, cohort and period. To overcome this problem, we use the intrinsic estimator for age-period-cohort analysis, proposed by Fu (2000) and further outlined in Yang, Schulhofer-Wohl, Fu, and Land (2008).

The results of the intrinsic estimator are shown in Figure 13. For consumption, the period effect clearly increases over time (top left panel). The cohort effect initially increases from the oldest cohorts to the baby boomer generation but decreases thereafter towards the youngest cohorts (centre left panel). The comparison of the intrinsic estimator for the consumption-age profile with the results from the pooled cross sections shows that the decrease in consumption around the age

of retirement is less drastic and consumption starts decreasing earlier, after the age of 50 (bottom left panel).

For savings, the intrinsic estimator suggests that the saving rate tends to be lower for the more recent years (top right panel). Over different cohorts, the saving rate tends to be higher for the younger cohort (centre right panel). Comparing the intrinsic estimator for the savings-age profile with the results from the pooled cross sections reveals that instead of being flat, the saving rate is actually increasing over the working age (bottom right panel). For example, Bebczuk, Gasparini, Garbero, and Amendolaggine (2015) also document that the saving rate is increasing over the working age. It should be highest among working adults versus individuals at both tails of the age distribution.

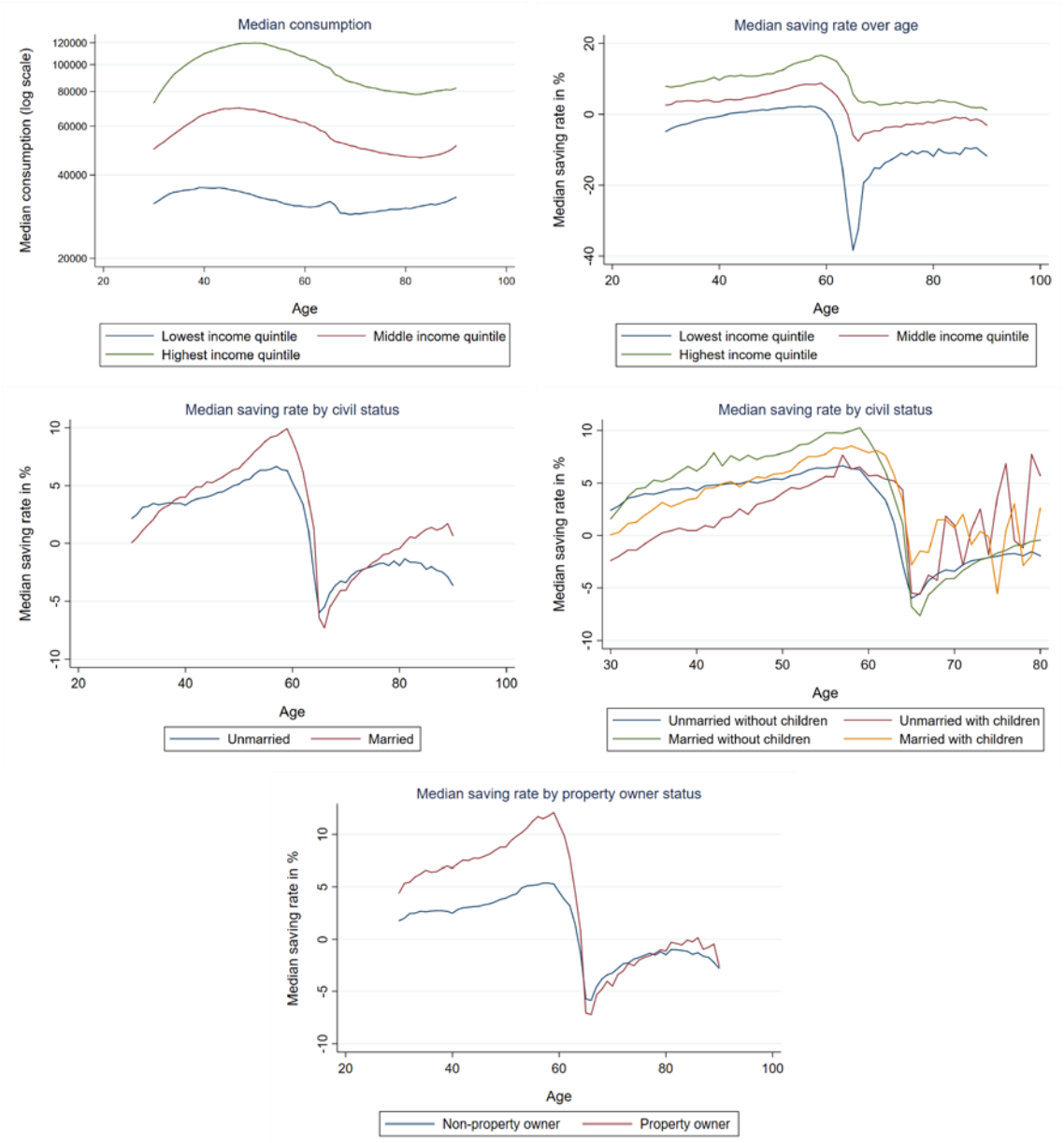
Figure 13: Consumption over the life cycle using the intrinsic estimator



6.2 Life-cycle consumption and saving patterns across different household groups

In this subsection, we analyse how consumption and saving patterns differ across three household characteristics: income, civil status and property owner status. We again corrected for period and cohort effects as explained in the previous subsection. Among others, Ziegelmeyer, Porpiglia, Teppa, Le Blanc, and Zhu (2015) find consumption and saving heterogeneity across different household

Figure 14: Consumption and savings over the life cycle for different household groups



Note: All data adjusted for cohort and period effects. The term with children in the middle right panel stands for claiming deductions for children in the tax record.

characteristics.

Focusing on income first, the top panels of Figure 14 show median consumption and the median saving rate of the lowest, middle and highest income quintiles. For consumption (which is shown in log scale and therefore directly allows us to assess percentage changes in the level of

consumption), we observe that – not surprisingly – consumption is highest for the highest income quintile and lowest for the lowest income quintile. Over the working age, consumption is much more hump-shaped for middle and high incomes than for low incomes. Consumption initially increases continuously for middle and high incomes until the age of 50, while this is only initially and to a much lesser extent the case for the lowest income quintile. After the initial slight increase, consumption for low-income households roughly remains at the same level over the entire working age. This may be related to a typically rather limited scope for career opportunities and therefore limited income growth over the life cycle in low-income jobs. For middle and high incomes, after having peaked around the age of 50, consumption starts decreasing. This may be related to the fact that households may switch to part-time work before retirement or opt for early retirement but potentially also be children leaving the household. With retirement, the developments for high and middle incomes are quite homogeneous, while the lowest quintile income group again shows a different pattern.

For the saving rate, the top right panel indicates that the saving rate is quite constant over the pre-retirement life cycle for all three income quintiles. This supports the view that the abovementioned divergence in the dynamics of consumption over the working age between low-income and middle/top-income households is due to differences in income developments and not to consumption/savings decisions. A few years prior to the official retirement age, the saving rate starts to decrease for all three income quintiles, reaching its through around the official retirement age. Thereafter, it gradually starts increasing again but remains lower than preretirement. Not surprisingly, the saving rate is highest for the highest income quintile and lowest for the lowest income quintile. The median saving rate of the top income quintile is approximately 15% preretirement, then declines with retirement but never falls below zero over the entire life cycle. For the bottom income quintile, in contrast, households are hand-to-mouth consumers at the median before the age of retirement and do not save. With retirement, the median saving rate of the bottom income quintile drops and settles well below zero throughout the postretirement period. Note that we analyse pooled cross sections; thus, the low-income households are not necessarily the same. A low-income household may not be able to save preretirement, and if so, he or she cannot dissave after retirement. The dissaving of the bottom income quintile could be due to households that accumulated capital over their working age and have their pension fund paid out when they retire

instead of withdrawing the balance as a pension. These households would have low income after retirement but still the possibility to dissave out of their wealth. This could also explain why we observe that consumption is increasing in the lowest income quintile after retirement (top left panel). In line with our results are, e.g., Dynan, Skinner, and Zeldes (2004), who find a strong positive relationship between saving rates and life-time income for the United States and Gandelman (2017) for Latin American countries.

The two middle panels of Figure 14 show the difference in the median saving rate across civil status. Most of the time, the median saving rate of married taxpayers is above that of unmarried taxpayers. When claiming deductions for children in the tax record, this pattern becomes even clearer. Furthermore, claiming deductions for children reduces the saving rate for both married and unmarried taxpayers.

The bottom panel of 14 shows the difference in the median saving rate between property owners and nonproperty owners. Preretirement, the saving rate of property owners is clearly above that of nonproperty owners. After retirement, however, the saving rates of the two household groups are very similar and drop below zero for both groups.

6.3 Consumption and income inequality

An advantage of tax data is that it covers the entire population and therefore allows us to analyse issues related to inequality. Figure 15 shows median consumption over time for the bottom, middle and top quintiles in indexed (left panel) and absolute terms (right panel). Growth of median consumption of the lowest quintile clearly outperformed growth of median consumption of the middle and top quintiles (left panel). However, this increase was not enough to significantly reduce the gap between median consumption of the lowest and the two other quintiles: the gap between the three groups remained relatively constant over time and does not point to large changes in inequality.

To analyse this question in more detail, Figure 16 shows two measures of inequality: the Gini index (left panel) and the ratio between the 90th and 10th consumption percentiles (right panel). Both metrics indicate that consumption inequality (red lines) did not increase between 2003 and 2016. The Gini index suggests that consumption inequality remained stable, and the

Figure 15: Median consumption by quintile over time

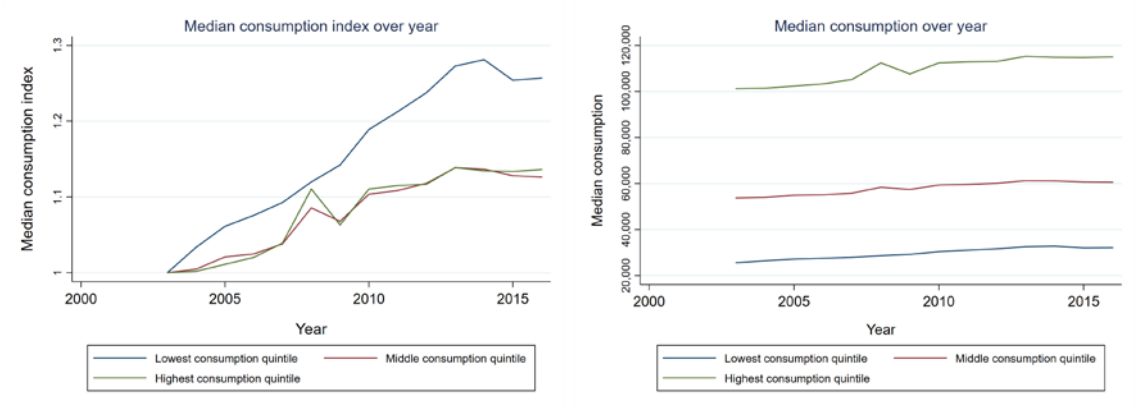
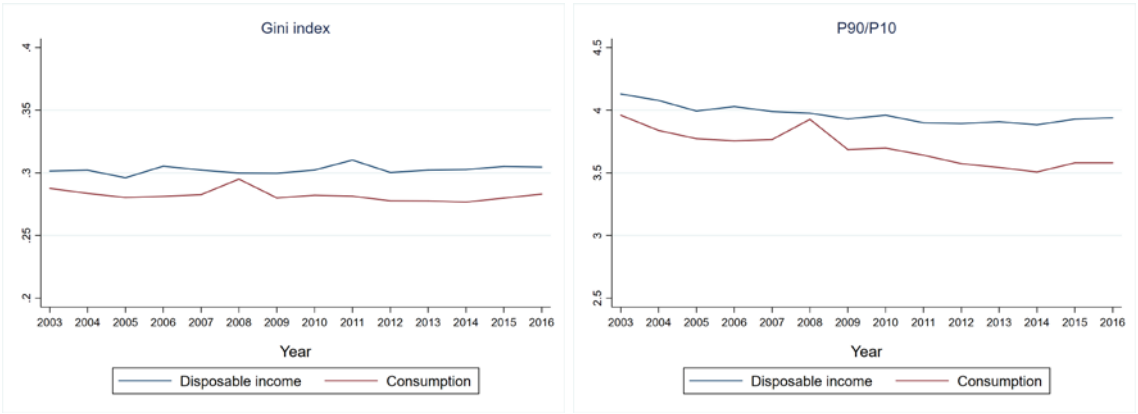


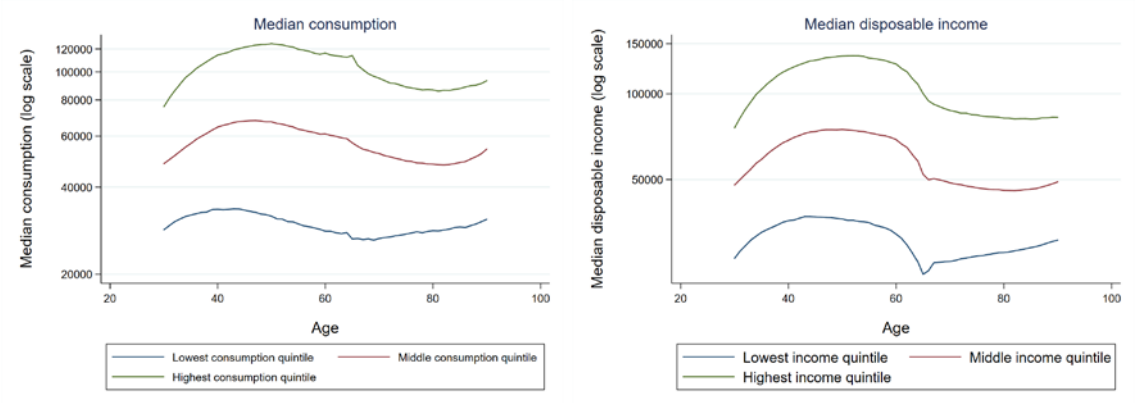
Figure 16: Consumption and income inequality over time



same applies to income inequality. The ratio of the 90th to the 10th percentile even suggests that – at least when focusing on the top and bottom of the distribution only – consumption inequality has rather decreased somewhat, and so has income inequality. Evidence of a comovement of income and consumption inequality was also found, e.g., by Aguiar and Bils (2015) and Attanasio and Pistaferri (2014).

Our data not only allow us to analyse how inequality has evolved over time but also how inequality changes over the life cycle. For this analysis, we again account for period and cohort effects as explained above. Figure 17 shows how median consumption (left panel) and median disposable income (right panel) of the respective top, middle and bottom quintiles evolve over the life cycle. The consumption-age profile of the middle and top quintiles is more hump-shaped than that for the lowest consumption quintile. The absolute and relative increase in median consumption

Figure 17: Consumption and income by quintile over the life cycle

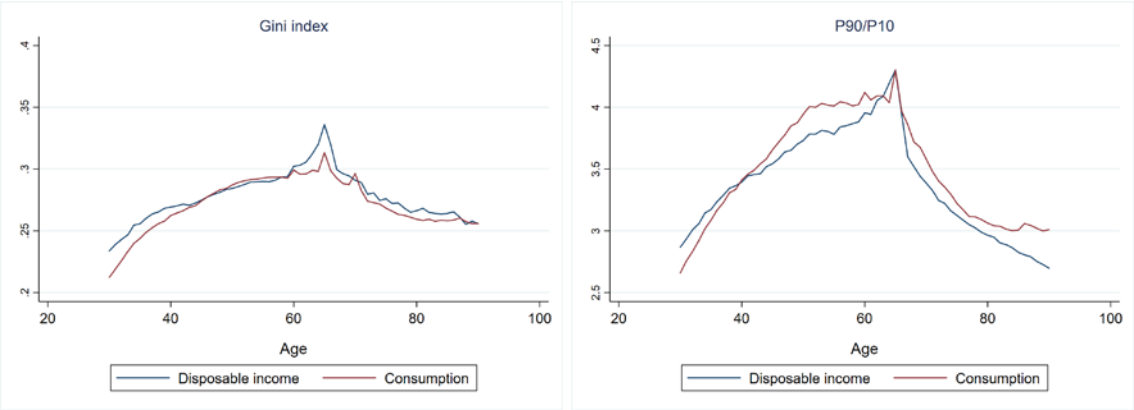


Note: All data adjusted for cohort and period effects.

over working age is largest for the top consumption quintile. Furthermore, the peak level is reached later than for the middle and bottom quintiles. The overall variation in consumption over the life cycle is largest for the top quintile and lowest for the bottom quintile. Disposable income evolves similarly to consumption. In the highest income group, it increases roughly until the age of 50, while the peak is already reached at approximately 40 for the lowest income quintile and starts declining immediately thereafter.

To analyse the question of how consumption inequality evolves over the life cycle in more detail, Figure 18 shows the Gini index (left panel) and the ratio between the 90th percentile and the 10th percentile (right panel) over the life cycle. Consumption inequality is initially low at a young age but increases steadily until the age of 50 and flattens thereafter before declining after retirement. Income inequality follows a similar pattern. The ratio of the 90th to the 10th percentile is similar to the evolution of the Gini index but much more pronounced. For both income and consumption, the increase before retirement and the decrease after retirement are more drastic.

Figure 18: Consumption and income inequality over the life cycle



Note: All data adjusted for cohort and period effects.

7 Conclusions

We showed that imputing consumption from Swiss tax data is not straightforward. Numerous adjustments and calculations are needed to transform the information given by the tax data into economically interpretable measures. Nevertheless, the use of tax data has notable advantages – the dataset is rich, of good quality, has a panel structure, and covers the full population, allowing for a granular analysis. While we also presented details on wealth and income across the distribution and for different subgroups of taxpayers, our main focus lied in imputing consumption estimates and descriptively analysing the resulting consumption and savings patterns. Since tax data do not include a direct measure of consumption, we imputed consumption based on the simple budget constraint of a household. One difficulty in applying this approach was the distinction of changes in valuation of assets and net acquisitions of assets. Having calculated disposable income and net acquisition of financial and real estate wealth allowed us to impute consumption. We then identified outliers in these consumption estimates and cleaned these outliers. The cleaning of outliers excluded all negative consumption estimates and reduced the variation in consumption per taxpayer significantly. We validated the resulting consumption estimates with two external sources, one on the micro-level (HABE) and one on the macro-level (official national accounts) and found that our estimates from tax data were highly plausible. Before analysing consumption and saving patterns over the life cycle, across different household groups and studying consumption inequality, we restricted

the sample further to account for certain clusters and events a taxpayer may undergo with the aim of reducing potential biases. In addition, we made use of the intrinsic estimator to account for specific period and cohort effects, which is important when analysing life-cycle profiles based on panel data. For consumption, we found the typical hump-shaped profile over the life cycle with a peak at approximately 50 years of age. For savings, we found an increasing saving rate over the working age with a substantial fall with retirement (and the associated decrease in disposable income) and dissaving thereafter. We also showed that consumption and saving behaviour vary across different household characteristics. Finally, our analysis suggests that consumption and income inequality remained rather stable between 2002 and 2016. Over the life cycle, however, consumption and income inequality do change: they are rather low initially at a young age but increase thereafter.

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A Appendix

A.1 Composition of financial assets in 2014

Table 11 provides an overview of the portfolio structure in 2014 of those taxpayers who completed their tax declaration online in that specific year, reported wealth and did not solely attach tax directories from banks to report their financial wealth.[38]

Table 11: Types of financial assets and their relevance

Category	Share of taxpayers with such assets	Average share of total wealth
Bank account	99.7%	90.2%
Stocks	25.0%	5.7%
Bonds	3.2%	0.7%
Loans	5.9%	2.0%
Diverse	7.5%	0.9%
Qualitative holdings	1.4%	0.6%

Notes: $N = 246{,}192$ taxpayers for 2014 (i.e., subsample of taxpayers where detailed financial asset register data are available).

A.2 Data cleaning and corrections

Although the raw tax data are already of high quality, there was still a need to clean the data since there were misleading or false entries, which could lead to biases in our calculations.[39] This section describes these entries and how we correct for them. Moreover, Table 12 summarises them and our corrections in brief.

The first type of critical entries relates to real estate properties that are given away with usufruct. This legal construct is related to a right of abode and implies that the ownership of a house is transferred to the gift recipient, but the tax liability and other obligations remain at the former owner. This legal construct is popular with elderly people who hand their house over to their children to protect the property from high costs of geriatric care. In such cases, the tax data show a high number of gifts made without a corresponding decrease in wealth. This leads to biases

[38] Tax directories are not digitalised by the tax authority, and we therefore do not have the portfolio composition of these taxpayers.

[39] Note that these errors do not imply that a person's tax assessment was eventually wrong. The tax administration made corresponding corrections in the calculation of the tax liability but left the raw input data unchanged.

when imputing consumption. Therefore, we ignore gifts that are undoubtedly related to this legal construct. However, identifying such cases with certainty is only possible when the number of gifts made equals exactly the administrative value of real estate property, which might not always be the case.

The second and third types of critical entries are related to actual reporting errors. There are cases where no flow of heritage is recorded, while the stock of inherited wealth owned as part of an ownership community changes. This is plausible if this wealth component was nonzero in the previous period, as a transaction may have occurred. However, if there was no such type of wealth in the previous period, such entries are implausible. In the latter cases, we therefore assume that the change in inherited wealth as part of an ownership community represents a flow of heritage in the current period. Another data anomaly is cases where the number of gifts received is exactly equivalent to the flow of heritage. In such cases, we set the number of gifts to zero.

Table 12: Corrections made

Type of entry	Correction made	Number of corrections
Value of gift made = Total administrative value of real estates	Set value of gift made to zero	236
Wealth from inheritance or ownership community missing or 0 in previous period, nonzero in current period and heritage missing or 0 in current period	Set heritage to wealth from inheritance or ownership community	94,796
Value of gift received = Value of heritage	Set value of gift received to zero	460

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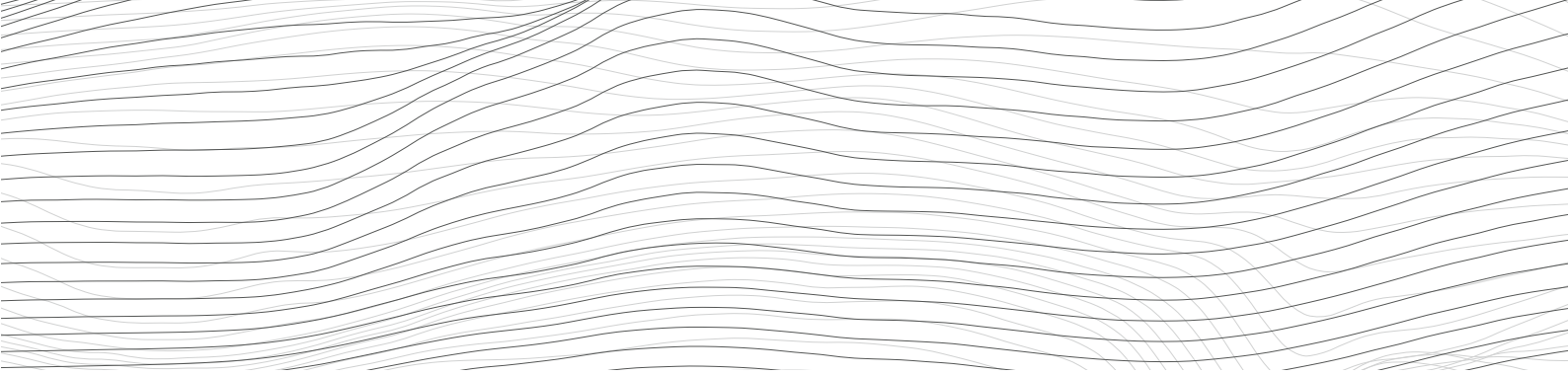

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