The Joint Distribution of Income, Wealth and Consumption in Germany

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Abstract

How wealth, income and consumption are jointly distributed, is an important topic in the empirical micro-economic literature and the theoretical literature using heterogeneous agent models. Most papers, due to a lack of data, focus on inequality in at most two dimensions. We analyse the joint distribution of income, wealth and consumption using micro-data from the German wealth survey. While wealth and income is directly collected in the wealth survey, total consumption is calculated using information on active savings flows and non-durable consumption is imputed. We find that net wealth and net saving flows are much more unequally distributed than income and consumption. The income and consumption distributions are more closely linked than the wealth and consumption distribution. Another finding is that the joint distribution of net wealth, net income and total consumption overlap much stronger at the bottom of the distribution than at the top. These results improve our understanding of inequality in the largest Euro area economy and furthermore add new dimensions to measuring inequality which has been impeded by data limitations in the past.

Keywords: wealth, consumption, multi-dimensional inequality, survey data

JEL-Classification: D31, E21, I31

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1 Introduction

How are wealth, income and consumption distributed? Do income rich households also accumulate the highest wealth holdings? Does inequality in wealth and income translate into consumption inequality? What is the role of saving flows across the wealth distribution? Most studies on these questions rely on (micro) data from different sources and usually present results on the different distributions separately. Doing so has limitations as inequality is a multidimensional phenomenon (Attanasio and Pistaferri 2016, Fisher et al. 2017).

We use a new panel data set that directly includes wealth and income measures for a representative sample of German households. The information on consumption directly collected is limited to food consumption, rents and utilities and a one-shot question on total non-durable consumption. However, using the detailed information on savings flows and net income, we are able to calculate total consumption for German households and using auxiliary information from the German household budget survey, we impute non-durable consumption to the wealth survey. Since ultimately utility is a function of (nondurable and durable) consumption, a reliable consumption measure that can be linked to income and wealth is a big asset in a wealth survey. We then document in detail how income, wealth and consumption are distributed jointly in two and three dimensions.

Recent research in micro- and macroeconomics stresses the importance of reliable information on the joint distributions of consumption, income and wealth. In microeconomics, existing inequality literature studies inequality in at most two dimensions at the same time with a strong focus on income inequality (Piketty and Saez 2003, Biewen and Juhasz 2012, Guvenen 2009). Only few papers attempt to put inequality in a broader context or for different countries but the US (see papers in the Special Edition of the RED 2010).

Studying consumption inequality along with income inequality is necessary to understand consumption-smoothing mechanisms such as borrowing or transfers, the nature of income shocks and poverty. In the debate on the rising levels of inequality in the US but also elsewhere, Attanasio and Pistaferri (2016), Aguiar and Bils (2015) therefore suggest to study consumption and income inequality jointly. An important aspect of using consumption data is the availability of high-quality consumption data at the micro level.

Following the Great Recession, information on consumption, income and wealth has been used extensively to study consumption responses to income and wealth shocks in

the presence of indebtedness (see Dynan 2012, Browning et al 2013, Disney et al 2010), to house price changes (Cooper 2013, Campbell and Cocco 2007) or to changes in policy (Jappelli and Pistaferri 2014, Sodini et al. 2016). These papers reveal that there is substantial heterogeneity of consumption responses along the income and wealth distributions. Another application of using income, consumption and wealth data at the same time is micro simulations to project redistribution (see Auerbach et al. 2016) or responses to shocks. Measuring income, wealth and consumption jointly is highly relevant for policy as the interplay of the three dimensions determines asset allocation and consumption behaviour of households.[2]

In macroeconomics, the shift from representative agent models to models with heterogeneous agents has increased the demand for high-quality household data. Recent models account for the fact that different groups of households across the income and wealth distribution behave differently with respect to saving and consumption and hence keeping track of the income and wealth distributions is important for understanding the distributional effects of shocks such as the Great Recession. In such models, the distribution of income and wealth in the population has substantial impacts on the aggregate dynamics of consumption, investment and output (see Krueger et al 2017, Kaplan and Violante 2014, Kaplan et al. 2014). Another motivating factor for this type of analysis is pointed out by Kaplan and Violante (2014): some households can be both wealthy but still behave as poor hand to mouth households if they have high holdings of illiquid wealth but little liquid wealth that could buffer shocks to their income. Evidence on the joint distributions of consumption, income and wealth is therefore informative for the calibration and estimation of these models. While there are few attempts to measure the multi-dimensionality of inequality for US data (Fisher et al 2018, Kuhn and Rios-Rull 2016), our paper is one of the first to draw a detailed picture of inequality in three dimensions in the largest European economy.[3]

The main data set we employ is a new household panel data set – the Panel of Household Finances (PHF) - for the year 2014. Additionally, we extend the analysis of the joint distributions to wave 1 (2010) for some aspects. The data set has three main advantages over previously used data for Germany: 1) it contains detailed information on income, wealth and active saving flows for a representative sample of German households, 2) it has a panel dimension covering the changes in these variables, 3) it covers a period of very low interest rates which might have had an impact on

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[2] Recent initiatives by the European Commission and the OECD reflect the importance that policy makers give to a good measurement of the joint distributions of consumption, income and wealth.
[3] Notable exceptions include Fuchs-Schuendeln et al (2010) who study earnings, income, wealth and consumption inequality trends in Germany using two different surveys. They do not have panel data which include all measures for the same households.

consumption, savings and wealth stocks. Analysing the joint distribution of income, wealth and consumption in the low interest-rate environment following the Great Recession is particularly interesting in Germany, a country where savers have traditionally accumulated wealth by investing in low-return assets.

Our main findings can be summarized as follows: Inequality is a pervasive phenomenon in Germany although it affects consumption, wealth and income differently. As in other countries, the income and consumption distributions are more equal than the wealth distribution. Approximately 60% of total wealth belongs to the 10% richest households, while only about 20% of total income and 20% of nondurable consumption are generated by the 10% of the income (consumption) richest households. We also find that the consumption and income distributions are more closely linked to each other than the consumption and wealth distribution, with the wealth and income distribution in between. The joint distribution of the three measures indicates that the distributions overlap much stronger at the bottom of the distribution than at the top. Only 2.6% of all households belong to the top of the joint distribution of income, wealth and total consumption, i.e. about 26% of the share that would results if the three distributions overlapped perfectly. In the bottom 50% of the joint distribution we find about 31% of households, i.e. 63% of the share if the three dimensions overlapped fully. One main advantage of our data set is the availability of active saving flows at the household level. We find that saving rates (i.e. net saving flows over net income) are increasing over the wealth distribution in line with previous literature (Carroll 2000) but in contrast to some recent findings for Sweden (Bach et al. 2018).

These results improve our understanding of inequality in the largest Euro area economy and furthermore add new dimensions to measuring inequality which has been impeded by data limitations in the past.

The remainder of the paper is structured as follows: Section 2 describes the data in detail and motivates our choice of consumption indicators, section 3 gives an overview of inequality in two and three dimensions in Germany. Section 4 concludes.

2   Data, Methodology, and Descriptive Statistics

In this section we provide a short description of the construction of our consumption measures and the data sources used in our analysis. The main source for our analysis is the "Panel on Household Finances (PHF)". To construct our measure of non-durable consumption, we use data from the German Household Budget Survey ("Einkommens- und Verbrauchstichprobe") conducted by the German statistical office

2.1 Income and Wealth Data – The Panel on Household Finances

For our analysis we use data from the 2014 wave of the German Wealth Survey ("Panel on household finances" - PHF). The PHF is a representative survey of German households covering their wealth, income and consumption as well as rich socio demographic and additional qualitative information on households' finances. It was launched against the background of setting up a harmonized wealth survey for the euro area and is part of the Household Finance and Consumption Survey (HFCS).[4] The first survey was conducted in 2010/2011 and the second one, comprising a panel component, in 2014.

The survey is based on a random stratified sample of private households in Germany, with oversampling of wealthy areas.[5] The PHF net samples comprise 4 461 households in 2014. The survey has a large panel component: About 2 191 households (incl. 40 split offs) participated in both 2010 and 2014.

The survey is well suited for our analysis as it contains detailed information on monthly net household income and household net wealth at the time of the interview. It provides the values of real assets (properties, self-employed businesses, vehicles and valuables) and financial assets (current accounts, savings account, stocks, bonds and other securities, pension contracts, managed accounts, non-self-employed business wealth) as well as liabilities (mortgages, consumer loans, private loans, overdue bills). To deal with missing values the wealth and income variables of the PHF are multiply imputed. Except for pension assets all the information we use is collected at the household level. In our analysis, we will use net wealth calculated as the sum of all real and financial assets minus all liabilities and net income from a one-shot question on total monthly net household income.

2.2 Estimating Consumption for the PHF Households[6]

The PHF offers different ways to calculate total and nondurable consumption at the household level. As in other comparable household surveys, there are various questions on consumption components, such as food expenditure inside the home and outside,

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[4] The HFCS does not contain all variables of the national surveys, however, the harmonized data set has the same "Core Variables". For more information on the HFCS see https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html.

[5] The PHF survey was conducted by infas GmbH on behalf of the Deutsche Bundesbank in 2010 (September 2010 until June 2011) and 2014 (April to November 2014). Detailed data on households' assets and liabilities are collected by interviewers in face-to-face CAPI interviews, which last, on average, about one hour. For more information on the survey see von Kalckreuth et al. (2012) and www.bundesbank.de/phf-research.

[6] In this and the following sections we focus on results for the 2014 wave of the PHF survey. Descriptive Statistics for the 2010/11 wave are available upon request.

utilities and rent, and additionally in the 2014 wave a one shot question on total consumption expenditures. While these categories comprise some of the main components of consumption, the PHF does not contain further expenditure indicators. A different data set, the German Income and Expenditure survey (Einkommens- und Verbrauchsstichprobe EVS), covers all consumption expenditure components separately. The EVS is a large cross-sectional household budget survey that is conducted by the German statistical office and repeated every five years. One way to infer nondurable consumption in the PHF is the method used by Browning et al (2014), and Lamarche (2017), i.e. to impute nondurable consumption using the EVS.[7] The basic idea is to use consumption items and socio-demographic variables present in both surveys the EVS and PHF and estimate the relationship between those indicators and non-durable consumption using the EVS dataset. The coefficient estimates obtained using the EVS are then used to make out of sample predictions of total non-durable consumption for the PHF survey. The 2014 PHF survey also contains a direct one-shot question on total non-durable consumption. This indicator performs worse in comparison to the imputed non-durable consumption measure, as we show in an accompanying paper (Le Blanc and Schmidt, 2018). Figure 1 shows the distribution of the imputed non-durable consumption measures and the non-durable consumption observed in the HBS.

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[7] A task force on measuring consumption within the HFCN used the method proposed by Browning et al (2014) to estimate nondurable consumption for the euro area countries for wave 1 of the HFCS surveys from 2010/11 (Lamarche, 2017).

Figure 1 – Density Estimate of Non-durable Consumption
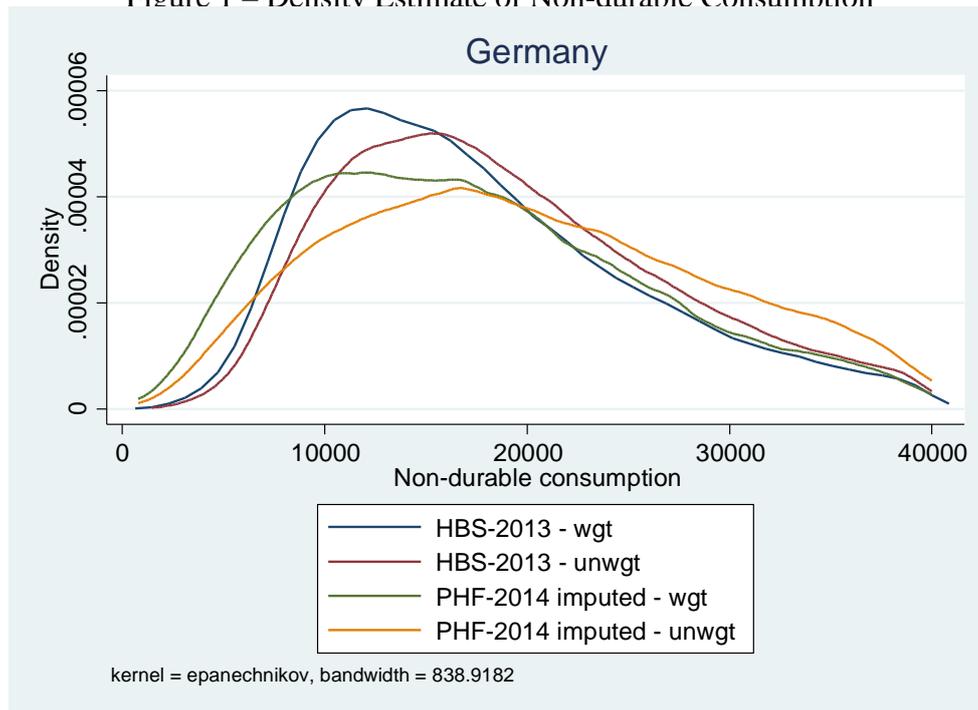
Sources: PHF 2014, HBS 2013: FDZ der statistischen Ämter des Bundes und der Länder, Einkommens- und Verbrauchsstichprobe (EVS) 2013, own calculations.

A different approach was used to get a measure of total consumption. To be more precise we infer total consumption from the household's budget constraint, i.e. by using
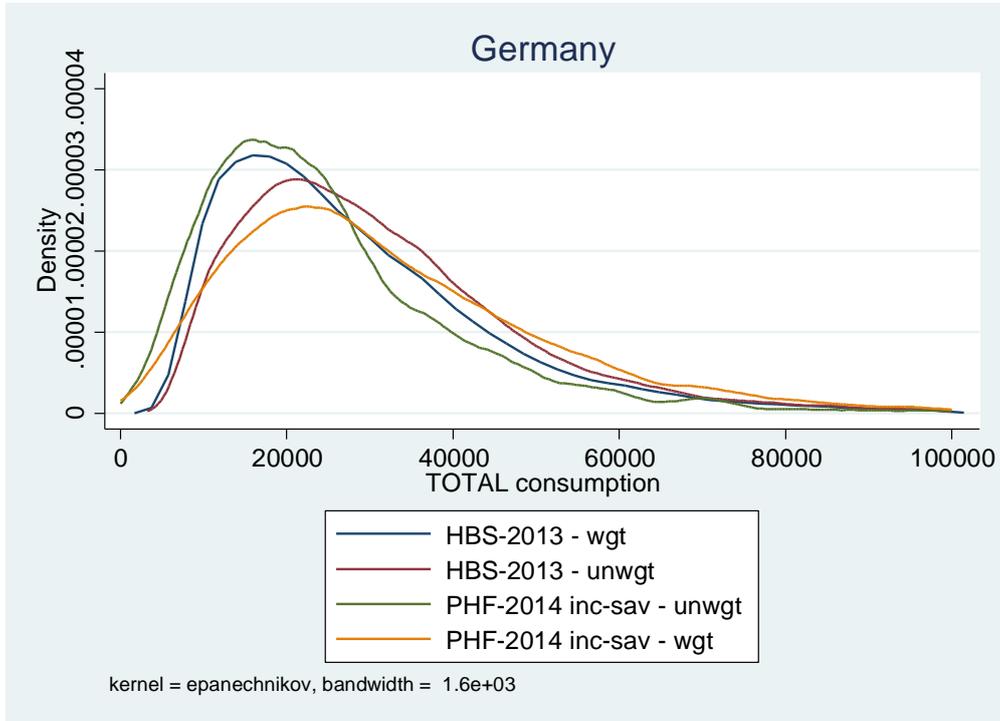
$$C = Y - S$$

where Y stands for net household income and S for the value of active savings flows.

The PHF survey is unique in the sense, that in contains a large set of questions on active savings data. For each financial asset the PHF not only collects information on its current value, but also on active regular savings directed towards this assets. In addition detailed information on mortgage payments and other types of loan repayments are collected. Finally, the regular savings measures are complemented with questions on irregular savings. Data on (consumer) loans and dissolved savings is also collected. Our measure of total savings thus comprises a whole range of savings information and dissaving by households. Along several dimensions this measure of total consumption performs better or at least as well as consumption measures imputed analogous to the non-durable consumption measure, with a machine learning approach ("random forest") or an approach based on differencing stocks of wealth and liabilities for panel households (see Le Blanc and Schmidt, 2018).

Figure 2 below shows how our total consumption calculated using net income and the savings measure described above, lines up with total consumption from the budget survey.

Figure 2 – Density Estimates - Total consumption (income minus savings)

For the analysis below we adjust household income, consumption and wealth for household size using the modified OECD equivalence scale (OECD …). Most other studies on three dimensional inequality do adjust the measures for household size (e.g. Fischer et al. 2018), even though it is unclear whether equalizing wealth by household size is meaningful.[8]

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[8] All tables and figures with income, consumption and wealth in levels are available upon request.

2.3 Univariate distributions of net income, net wealth and consumption

Before we analyse the joint distribution of income, wealth and consumption we provide some information on the univariate distribution of these measures. In table 1 we present the mean, standard deviation, several percentiles, the Gini coefficient and the P90/P10 as well as the P90/P50 ratios of those measures. The Gini, P90/P10 and P90/P50 ratios indicate that consumption is much less concentrated than net wealth. Non-durable and total consumption as well as income have similar concentration measures. Net savings flows are very unequally distributed, even if only positive values for this indicator are considered.

Table 1 – The univariate distributions of income, wealth and consumption

	Total Consumption	Non-Durable Consumption	Net Wealth	Net Income	Net Saving Flows
Mean	18114	13420	142121	19589	2166
P10	7716	5449	0	8400	-1020
P25	10888	8179	4000	12000	0
Median	15220	12033	43000	17112	720
P75	21600	17255	152000	24000	3600
P90	30267	22867	318100	32000	8771
SD	12604	7407	389498	11849	14447
P90/P10	3.9	4.2	.	3.8	-8.6
P90/P50	2.0	1.9	7.4	1.9	12.2
Gini-coefficient[9]	0.317	0.292	0.708	0.295	0.645

Sources: PHF 2014.

Calculating the share of a specific quintile in the total of the respective measure (table 2), confirms the findings from the analysis of P90/P10 and P90/P50 ratios. While the wealthiest 20% of households own 75% of total net wealth, the top quintile of the income richest households only hold 38% of total net income. Similarly the top quintile of the total consumption distribution contribute 39% to total consumption. The respective figure for non-durable consumption is 37%. Again the savings flows measures shows a completely different pattern, mainly due to the fact that the bottom 25% of households in the net savings distribution on average dis-save.

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[9] Only positive values are used for the calculation of the Gini coefficient for wealth and net savings flows. Gini coefficient including zero and negative values for net wealth is 0.748 and net savings flows 1.92.

Table 2 – Share of Quintiles in Total Consumption, Net Wealth, Income and Savings -

	Total Consumption	Non-Durable Consumption	Net Wealth	Net Income	Net Saving Flows
Quintile 1	8%	8%	-1%	8%	-65%
Quintile 2	13%	13%	1%	13%	0%
Quintile 3	17%	18%	6%	20%	8%
Quintile 4	23%	24%	18%	20%	27%
Quintile 5	39%	37%	75%	38%	131%
Total	100%	100%	100%	100%	100%

Sources: PHF 2014.

Finally with regards to the distribution, we plot the Lorenz curves for the different measures.[10] Not surprisingly, the Lorenz curve also shows that net wealth is very unequally distributed. The graph also shows that income and the two consumption measures are similarly distributed.

Figure 3 - Lorenz Curves for Net Wealth, Net Income and Consumption
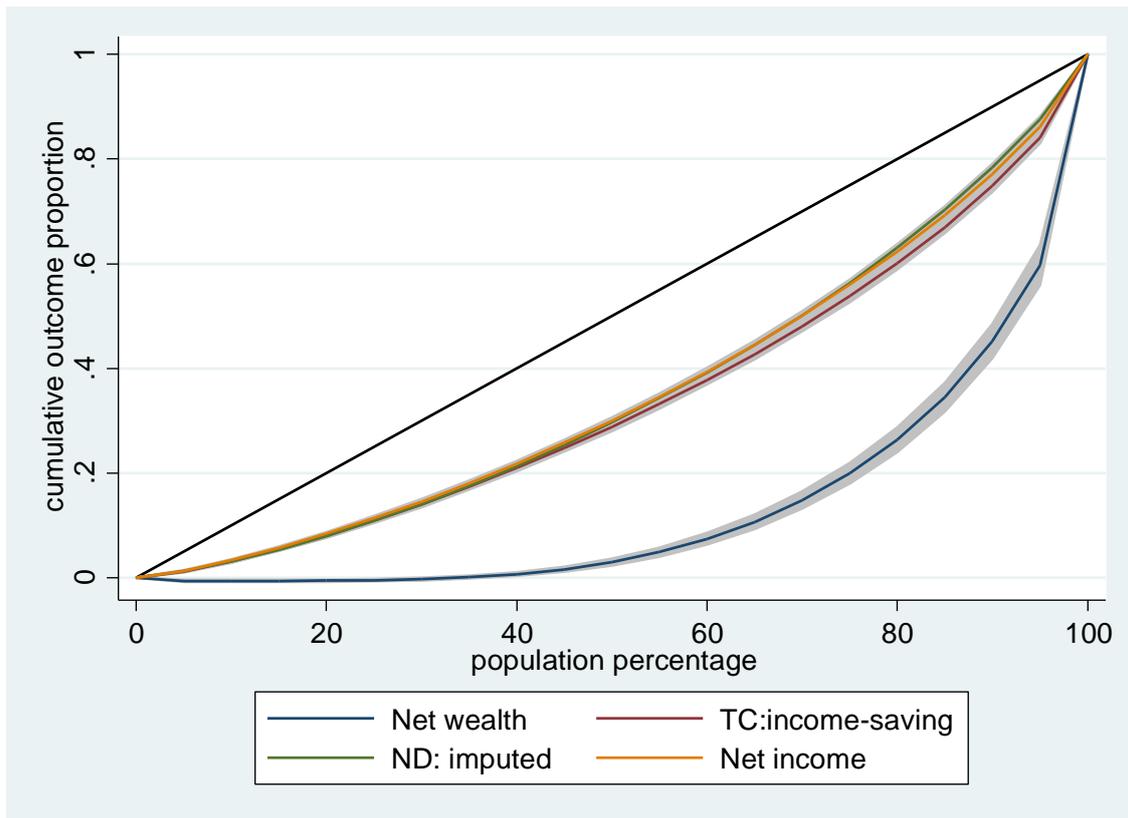
Sources: PHF 2014

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[10] We do not include the savings measures here, as the large number of negative values would distort the picture.

The individual distributions show a consistent pattern across the age of a household's head (Figure 4). At young age households save little, have few assets and low income and consumption. As they grow older all indicators rise, approximately until they retire. Consistent with life-cycle theory households seem to smooth their consumption relatively well between age 30 and the time the household head retires.[11]

Figure 4 - Consumption, net income, net wealth, savings (medians), by age of household head

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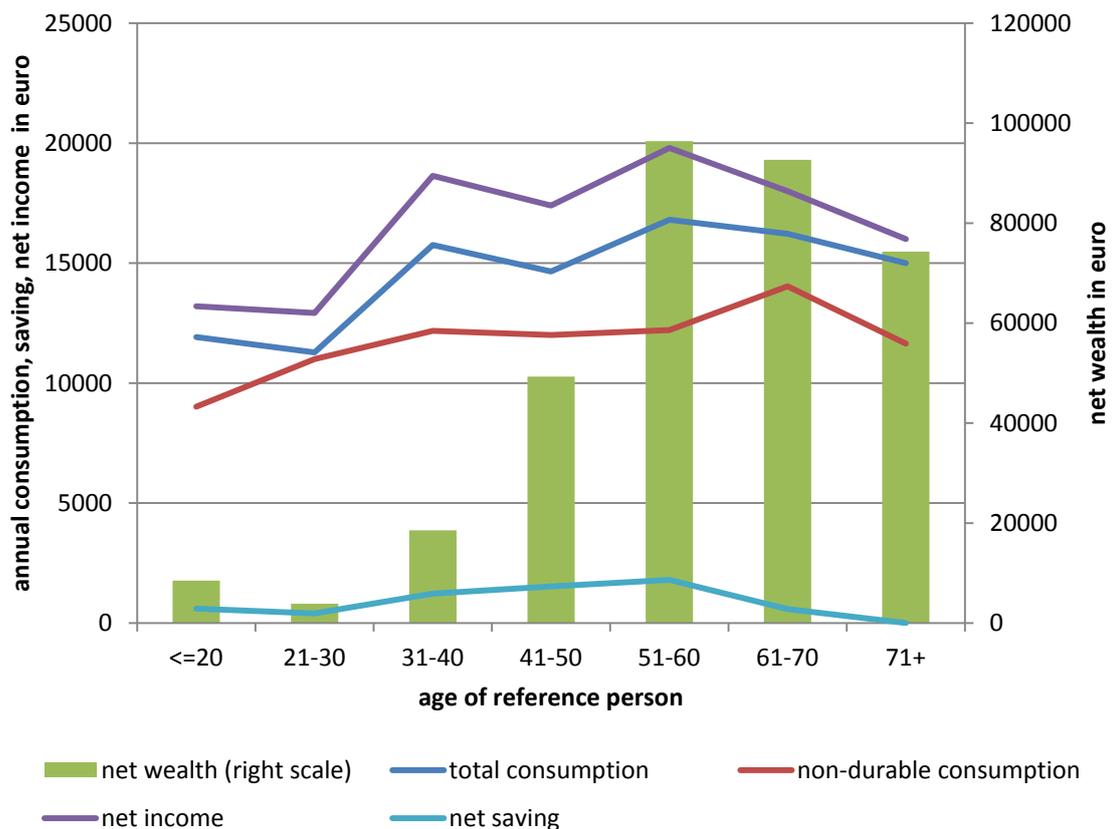
[11] We are aware that with our cross-sectional analysis it is difficult to make statements about life-cycle behaviour as we cannot disentangle age from cohort effects.

3   The joint distribution of income, wealth and consumption in Germany

3.1   Inequality in one dimension

We start our analysis of the joint distribution of income and wealth and of consumption and wealth by dividing households from the 2014 wave of the PHF into net worth quintiles and calculating the share of income, consumption expenditures and savings within each net worth quintile (Table 3A) and net income quintile respectively (Table 3B).

Table 3A – Share of consumption, net income and net savings along the <u>net wealth</u> distribution

	Total Consumption: Income - Saving	Non-durable Consumption: imputed	Net Wealth	Net Income	Net Saving Flows
Net wealth Q1	14%	16%	-1%	12%	-1%
Net wealth Q2	17%	19%	1%	16%	8%
Net wealth Q3	20%	20%	6%	20%	19%
Net wealth Q4	21%	20%	18%	22%	26%
Net wealth Q5	29%	25%	75%	30%	49%
Top 10% net wealth	15%	13%	58%	17%	31%

Sources: PHF 2014.

Table 3B – Share of consumption, net income and net savings along the <u>net income</u> distribution

	Total Consumption: Income - Saving	Non-durable Consumption: imputed	Net Wealth	Net Income	Net Saving Flows
Net income Q1	9%	14%	6%	8%	0%
Net income Q2	15%	17%	10%	13%	2%
Net income Q3	21%	23%	17%	20%	10%
Net income Q4	20%	20%	19%	20%	26%
Net income Q5	35%	27%	48%	38%	63%
Top 10% net income	20%	14%	33%	23%	45%

Sources: PHF 2014.

Households with higher net worth have higher earnings and higher consumption expenditures. The households in the upper quintile of the income or wealth distribution account for about 30% and 35%, respectively, of total consumption. Their share in non-durable consumption is also substantial. Households at the other ends of the

distributions also contribute a substantial part to total non-durable consumption and to the total consumption aggregate. The bottom half of the net wealth distribution for example has on average approximately zero net wealth, but still accounts for 30% of total consumption and even more for non-durable consumption. This picture is consistent with earlier findings for the US (Krueger et al, 2017), although wealth inequality is even more pronounced in the US than in Germany.

Again we see that net savings is more concentrated at the top of the distribution than our other measures and even more so than net income. Households from the top quintile of the income and wealth distribution account for 50% and more of total net savings flows. In those parts of the distribution we also find the lowest median expenditure shares (see Tables 4A and 4B), i.e. consumption to income ratios. In general those shares decline as one moves from the bottom to the top of the income or wealth distributions. Households in the lowest wealth and income quintile use essentially all their net disposable income for consumption while those in the highest quintile still consume over 90% of their income. The pattern is similar for non-durable consumption. The findings are again similar for the US (see Krueger et al 2017). Given that high income households consume a smaller fraction of their income than low income households, it is not surprising that they achieve higher wealth levels and contribute more to overall savings.[12]

Table 4A – Share of consumption in net income along the <u>net wealth</u> distribution (median)

	Consumption share 1: total consumption / net income	Consumption share 2: Non-durable consumption / net income
Net wealth Q1	100%	77%
Net wealth Q2	97%	75%
Net wealth Q3	90%	65%
Net wealth Q4	89%	64%
Net wealth Q5	91%	58%
Top 10% net wealth	90%	55%

Sources: PHF 2014.

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[12] Recently, Bach et al (2018) proposed to standardize consumption by wealth instead of income. This indicator is decreasing even stronger along the wealth distribution, as a measure based on income (see Figure 8 in the appendix). Our data confirm the finding of Carroll (2000) that saving rates are increasing in wealth.

Table 4B – Share of consumption in net income along the <u>net income</u> distribution (median)
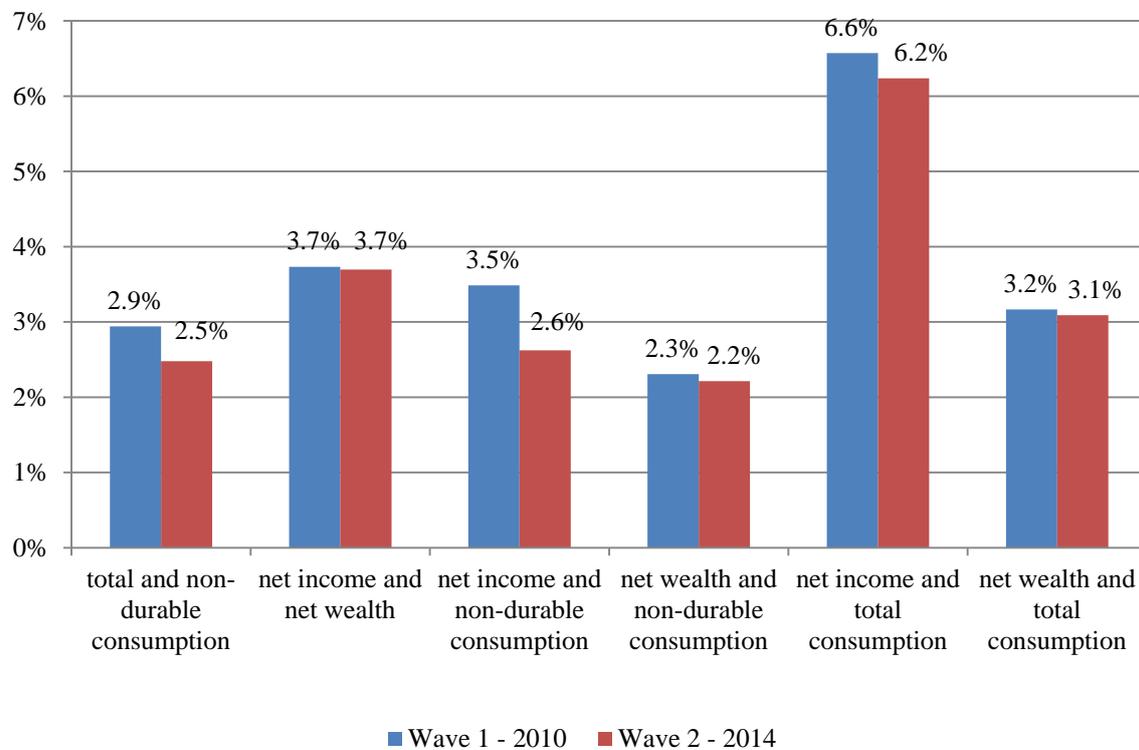
	Consumption share 1: total consumption / net income	Consumption share 2: Non-durable consumption / net income
Net income Q1	100%	99%
Net income Q2	98%	78%
Net income Q3	95%	69%
Net income Q4	90%	61%
Net income Q5	88%	48%
Top 10% Net income	84%	43%

Sources: PHF 2014.

3.2 Inequality in two dimensions

Moving on to analysing how the top shares in two and three dimensions are distributed, Figure 5 displays the shares of the top 10% of two different measures for the two waves. In other words, the chart shows by how much the different distributions overlap. If two distributions were overlapping fully, the share of households in the joint distribution would be 10%, if they were completely disjoint it would be 0%.

Figure 5 – Share of households in top 10% of the joint distributions

Sources: PHF 2010, 2014.

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For example, the first bar of Figure 5 shows that in 2010, around 3% of households were both in the top 10% share of non-durable and total consumption. Hence, although the two measures are highly correlated, the two groups who are in the top 10% of non-durable and durable consumption overlap only partially. Only about one third of the households in the top of the total consumption distribution are also in the top of the non-durable consumption distribution. For this indicator, as well as for all the others the structure did not change significantly between 2010 and 2014.

Except for the net income and total consumption joint distribution, the other joint top shares are of a similar magnitude. For example, 2.6% of households in the top 10% of wealth are also in the top 10% of non-durable consumption, and about 3.2% of households fall in the top 10% of the net wealth and total consumption distribution in 2014. The largest overlap, besides comparing the two different consumption measures, occurs for the net income and total consumption distributions with more than 6% of households falling both in the top 10% of both distributions in 2010 and 2014.

Focusing only on the top of the distribution presents an incomplete picture, in the following we therefore examine two-dimensional inequality across the entire distribution using quintile on quintile tabulations. These tables show the share of households in the various quintiles of each distribution.

Table 5 – Share of households in specific parts of two distributions, in %

	net wealth				
Non-durable cons.	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	7.11	4.6	3.55	3.14	1.62
Quintile 2	4.55	4.11	4.12	4.18	3.09
Quintile 3	4.19	3.83	4.32	4.34	3.25
Quintile 4	2.22	4.1	4.02	4.37	5.29
Quintile 5	1.92	3.23	4.05	4.08	6.71

	net income				
Non-durable cons.	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	8.61	5.47	3.53	1.44	0.97
Quintile 2	5.28	4.8	4.89	3.02	2.06
Quintile 3	2.77	4.8	5.38	3.95	3.03
Quintile 4	2.14	3.04	4.56	4.71	5.55
Quintile 5	1.04	2.1	4.34	4.25	8.26

	net wealth				
Total Consumption	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	8.63	4.39	3.15	2.14	1.69
Quintile 2	5.26	4.89	3.92	4.29	1.79
Quintile 3	3.19	4.88	4.49	4.6	2.93
Quintile 4	2.11	3.93	5.19	4.77	4.4
Quintile 5	1.03	2.04	3.57	4.34	8.38

	net income				
Total Consumption	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	15.86	2.28	1.08	0.45	0.33
Quintile 2	3.37	12.46	2.98	0.96	0.39
Quintile 3	0.27	4.87	11.18	2.8	0.97
Quintile 4	0.24	0.33	6.11	10.22	3.5
Quintile 5	0.18	0.54	1.39	2.8	14.45

	net income				
Net wealth	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	10.11	5.18	2.76	1.28	0.69
Quintile 2	5.01	5.38	5.26	2.97	1.37
Quintile 3	2.13	4.45	5.65	4.13	3.63
Quintile 4	1.66	3.46	5.07	5.17	4.65
Quintile 5	1.11	1.7	3.78	3.77	9.64

	Non-durable consumption				
Total Consumption	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Quintile 1	8.04	5.1	3.09	2.25	1.48
Quintile 2	5.54	5.07	3.91	3.38	2.24
Quintile 3	3.52	4.42	4.92	4.19	3.14
Quintile 4	1.74	3.54	4.85	5.43	4.95
Quintile 5	1.23	2.18	3.19	4.75	7.85

Sources: PHF 2014.

In line with the literature (see Fisher et al. 2018, Fisher et al. 2016), we find so called "twin peaks", i.e. the shares for the top quintile and the bottom quintile are highest. The higher values on the diagonals for the joint net income and consumption distributions compared with the net wealth and consumption distributions indicates that the consumption and income distributions are more closely linked than the consumption and wealth distributions.[13] A simple correlation analysis of the levels of income, wealth and consumption or the centiles, underscores this finding (Table 6). The correlation coefficients for net income and the two consumption measures are substantially larger than for net wealth and consumption. This is in line with the literature on marginal propensities to consume, which postulate a higher marginal propensity to consume out of wealth than out of income (see, for example, Carroll et al 2017).

Table 6 – Correlation Coefficients for net wealth, income and consumption in 2014

Levels	Net wealth	Net income	Total Consumption	Non-durable consumption
Net wealth	1.00			
Net income	0.45	1.00		
Total Consumption	0.34	0.70	1.00	
Non-durable consumption	0.22	0.42	0.33	1.00
Centiles	Net wealth	Net income	Total Consumption	Non-durable consumption
Net wealth	1.00			
Net income	0.56	1.00		
Total Consumption	0.44	0.84	1.00	
Non-durable consumption	0.31	0.49	0.44	1.00

Sources: 2014.

So far we have looked at the share of wealth, income or consumption contributed by households in different parts of the wealth distribution and the share of households belonging to certain parts of joint distributions. We will now combine both types of analysis by looking at the share of net wealth, net income and consumption attributable to the top 10% of the joint distributions (Table 7 below)

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[13] An increasing literature looks at the evolution of consumption versus income inequality, see, for instance, Aguiar and Bils (2015), Attanasio and Pistaferri (2016), Attanasio and Pistaferri (2014).

Table 7 – Share of net wealth, net income and consumption attributable to the top 10% of the individual and joint distribution

	Net Wealth	Net income	non-durable consumption	total consumption
Net Wealth	58%	17%	13%	15%
Net income	33%	23%	14%	20%
Non-durable Consumption	21%	14%	22%	14%
Total Consumption	29%	20%	13%	25%
Net income and Net wealth	27%	10%	6%	8%
Net income and Non-durable Consumption	12%	7%	6%	6%
Net income and Total Consumption	23%	15%	9%	16%
Net wealth and Non-Durable Consumption	16%	5%	5%	4%
Net wealth and Total Consumption	22%	8%	5%	9%
Total and non-durable consumption	9%	6%	6%	6%
Net income, net wealth and non-durable consumption	11%	4%	3%	3%
Net income, net wealth and total consumption	20%	7%	4%	7%

Sources: PHF 2014.

Households in the top 10% of the net worth distribution hold 58% of total net wealth. If we restrict the analysis to the households that are both in the top 10% of the net wealth and net income distribution this share drops to 27%, indicating that there is a substantial share among the wealthy households with income below the 90th percentile. The analysis of the households in the top 10 of the joint distributions show a picture similar to the one obtained looking at the share of individual quintiles in the total distributions (Tables 3A and 3B). The share of income attributed to the top 10% of a specific joint distribution is very similar to the share of total consumption contributed by that group. The share for non-durable consumption is also similar to that of income and total consumption, while the net wealth shares are in general two to three times higher, if net wealth is included in the joint distribution. The strong concentration of wealth at the top – the top 10 share with 58% also about two and a half times as large as the equivalent top 10 share for income and the total consumption concept – seem to dominate in the joint distributions.

Returning to individual consumption distributions, the top 10% of the non-durable consumption distribution contributed 22% of total non-durable consumption in 2014. In

other words, households in the top 10% of the non-durable consumption distribution do consume more than their share in the total distribution. The same is true for total consumption distribution as the share of the top 10% of the total consumption distribution is at 25%.

3.3   Inequality in three dimensions

Finally, we will discuss inequality in all three dimensions. Again we look first at the share of households belonging to the top and bottom parts of the joint distributions. We find that the share of households belonging to the top and bottom of the joint distribution is stable across waves (Table 8).[14] Only about 1% of households belong to the top 5 of the joint income, wealth and total consumption distribution. For the joint distribution of income, wealth and non-durable consumption the respective share is only 0.44%. In general the shares for the respective percentiles are lower for the joint distribution including non-durable consumption. To put the observed shares into perspective we divide them by the share that would result if all three distributions overlapped fully, i.e. we divide the top 5 shares by 5%, the top 10 shares by 10% and the bottom 50 by 50%. We find that the overlap of the distributions declines from the bottom to the top of the joint distribution, as this measure is more than 60% for the bottom of the joint distribution and only 20% for the top 5.

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[14] Note, that we analyse the data as two cross-sections. A stable share does thus not imply that households do not move in and out of specific parts of the distribution.

Table 8 – Share of households in the top and bottom of the joint distribution of income, wealth and consumption

	PHF 2010/11	PHF 2014	PHF 2010/11	PHF 2014
	Share of households		Share of households / max share of households	
Top 5 - income, wealth and total consumption	0.88 %	1.04 %	18%	21%
Top 10 - income, wealth and total consumption	2.35 %	2.47 %	24%	25%
Bottom 50 – income, wealth and total consumption	30.1%	30.3%	60%	61%
Top 5 - income, wealth and non-durable consumption	0.61 %	0.44 %	12%	9%
Top 10 - income, wealth and non-durable consumption	1.59 %	1.37 %	16%	14%
Bottom 50 – income, wealth and non-durable consumption	24.5%	23.7%	49%	47%

Sources: PHF 2010, 2014.

To compare the whole three-way joint distributions to the joint distributions of only two indicators is not straight forward. We try to illustrate the relationships by calculating "scores" of the joint distributions. We first estimate centiles for each individual distribution and then add up the centiles the household belongs to for two or three distributions. To give an example, if a household is in the 50th centile in the total consumption, in the 30th centile of the income, and the 20th centile of the net wealth distribution, the score for this household would be 50+30+20=100. In order to make the scores for the joint distributions of three and two indicators, respectively, comparable, we standardize the score by dividing it by 300 (three dimensions) and 200 (two dimensions) respectively. This analysis shows again that income and consumption are more closely linked than wealth and consumption, as the density of higher scores is larger for the former (green line in Figure 7) compare with the latter (red line in Figure 7).

Figure 6 – Summary "Scores" for three and two dimensional distributions of income, wealth and total consumption, 2014[15]

Kernel density estimate

kernel = epanechnikov, bandwidth = 0.0425
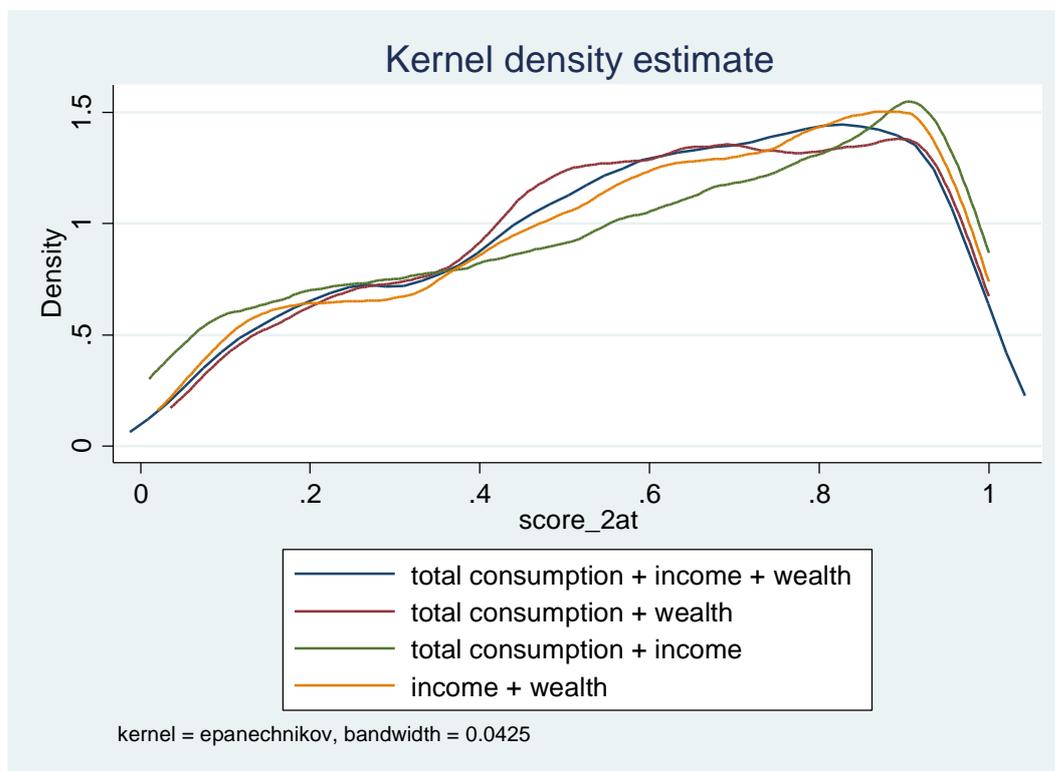
Sources: PHF 2014.

Another way to look at the concentration of wealth, income and consumption in different parts of the joint distribution is to calculate the share a particular part of the joint distribution contributes to the total. The 1.04% of households in the top 5% in the joint distribution hold 14% of total wealth, but only 4% of total income and 4% of total consumption (Table 9). For the 2.47% of households in the top 10% of the joint distributions the respective numbers are 20%, 7% and 7%. In both cases the share of the group in total wealth is more than ten-times as high as their share in the total population of households, while the share of the group in income and consumption is about 3 to 4 times as high. The concentration of wealth at the top of the distribution is much more pronounced than the concentration of income and consumption at the top. The numbers for the bottom of the distribution confirm this. The households in the bottom 50% of the joint distribution contribute about 20 % to consumption and income, but only 1% to total net wealth. Some high income households seem to hold little wealth. Life-cycle considerations likely play a role for this pattern, young households with high income (prospects) still have to accumulate wealth and may be highly leveraged, e.g. because

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[15] The figure with non-durable consumption instead of total consumption looks very similar. It is included in the appendix (figure 9).

they just bought a house. In the joint distribution these households will belong to the bottom part of the distribution.

Table 9 – Share of wealth, income and consumption held at the top and bottom of the distribution in 2014

	Share of wealth	Share of income	Share of total consumption	Share of non-durable consumption
Top 5 - income, wealth and total consumption	14%	4%	4%	2%
Top 10 - income, wealth and total consumption	20%	7%	7%	4%
Bottom 50 – income, wealth and total consumption	1%	18%	18%	24%
Top 5 - income, wealth and non-durable consumption	5%	2%	1%	1%
Top 10 - income, wealth and non-durable consumption	11%	4%	3%	3%
Bottom 50 – income, wealth and non-durable consumption	1%	19%	20%	17%

Sources: 2014.

Heads of household in the bottom of the distribution are indeed younger than household heads belonging to the top of the joint distribution. On average households in the bottom 50% of the joint distribution are less likely to live in wealthy regions and more likely to live in East Germany. Their household heads are less educated. The difference in the size of the household is noteworthy. Households in the bottom of the distribution are on average larger than those in the top of distribution. If none-equivaliced measures are used, the households in the top of the distribution are larger. Through equivalicing the consumption, income and wealth measures, we take care of the fact that larger households typically have higher consumption levels than smaller households, also the

combined income of their members tends to be higher than for single households if more than one person in the household has any income.

Table 10 – Socio-demographic characteristics (mean, percent) of households in the joint distribution of wealth, income and consumption in 2014

	HH size	Wealthy Region	East Germany	Age of reference person	At least college education
Top 10 - income, wealth and total consumption	1.87	35%	4%	58.8	71%
Bottom 50 – income, wealth and total consumption	2.06	6%	28%	49.2	12%
Top 10 - income, wealth and non-durable consumption	1.60	34%	6%	60.2	67%
Bottom 50 – income, wealth and non-durable consumption	2.12	6%	31%	48.6	12%

Sources: 2014.

Turning to the asset composition, nine in ten households in the top of the joint distribution own the home they live in (Table 10) and even though more than one third of them still has to pay off a mortgage, their wealth levels seem to be high enough to qualify for the top of the joint distribution. As expected business ownership, an asset component closely linked to wealth, is also much more frequent among the households in the top of the joint distribution. In the bottom of the distribution we see very few homeowners with or without mortgage debt. More than one third of households in the bottom 50% of the joint distributions have non-mortgage debt, compared with around 10% in the top 10% of the joint distributions.

Table 11 – Asset ownership of households in the joint distribution of wealth, income and consumption in 2014

	Home-owner	Business owner	Has debt	has mortgage debt	has other debt
Top 10 - income, wealth and total consumption	88%	35%	45%	40%	13%
Bottom 50 – income, wealth and total consumption	11%	4%	41%	7%	38%
Top 10 - income, wealth and non-durable consumption	79%	27%	42%	39%	11%
Bottom 50 – income, wealth and non-durable consumption	12%	4%	44%	8%	42%

Sources: 2014.

We finally look at consumption levels along the net wealth and net income distributions. Median total consumption is increasing stronger with net income than with net wealth (Figure 7). Within an income quintile there is little increase along the wealth dimension. The two dimensional analysis already points in this direction. In Figure 5 and Table 5 above we show that the share of households in the top 10% of the total consumption and income distribution is much higher than the share belonging to the top 10% of the total consumption and net wealth distribution.

Figure 7 - Median total consumption by net wealth and net income
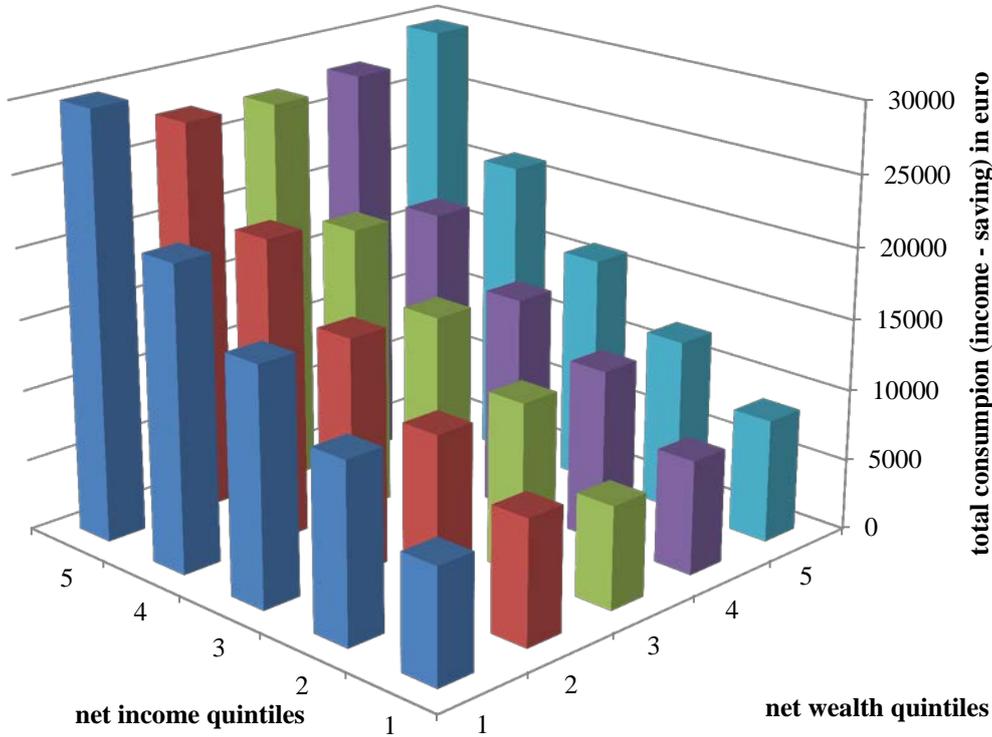
Sources: PHF 2014.

4 Conclusions

In this paper we analyse the distribution of income, wealth and consumption jointly. These results improve our understanding of inequality in the largest Euro area economy and furthermore add new dimensions to measuring inequality which has been impeded by data limitations in the past.

Our findings underscore the importance of treating inequality as a multi-dimensional phenomenon. We show that the income and consumption are more closely related than the income and wealth distribution, indicating that wealth-poor households can still achieve adequate consumption levels. To understand poverty it may thus be more important to look at the income distribution rather than the wealth distribution. In economic terms our findings regarding the pair-wise distributions seem to underscore the finding that the marginal propensity to consume is higher for (permanent) income than for wealth. This is an avenue for future research.

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In general we find more overlap of the three distributions at the bottom of the joint distribution of income, wealth and consumption compared with the top. The highly unequal distribution of wealth in Germany seems to play a role here. Households need substantial wealth to reach the top of the joint income, wealth and consumption. Whether mobility across the joint distribution is also less pronounced in the top than in the bottom of the distribution is an interesting question we did not address in this paper with data from two points in time, only.

As to the question on the evolution of inequality in Germany, we cannot say much at this stage. In a future version of this research, we plan to use the three waves of the PHF to uncover how inequality in several dimensions has evolved in the period of 2010-2017, a period of robust economic growth in Germany and historically low interest rates.

We hope that the literature using heterogeneous agent models can benefit from our work and use some of the derived moments to calibrate and inform their models. We e.g. clearly show that wealth poor households contribute substantially to overall consumption, a pattern not addressed in classic heterogeneous agent models alá Krussell-Smith.

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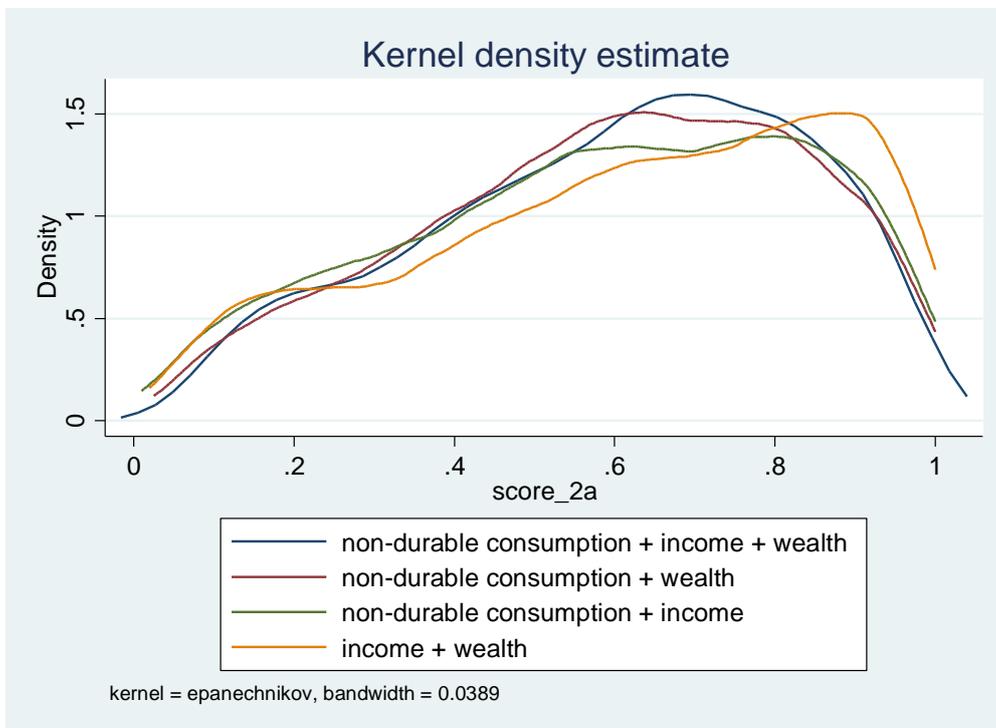
Appendix

Figure 8 - Non-Durable and Total Consumption Shares by Net Wealth Deciles
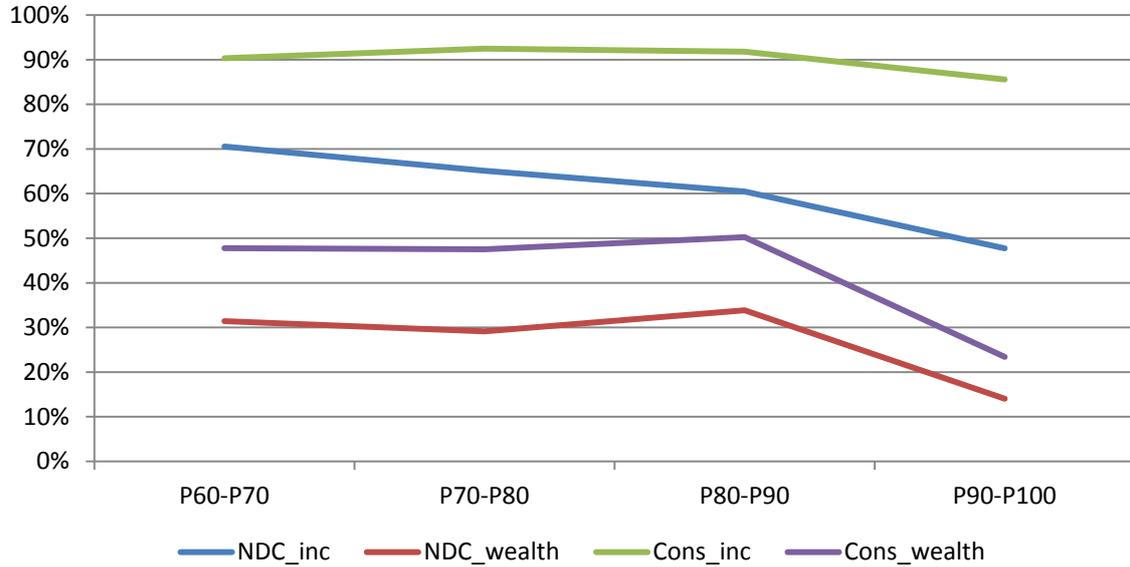
Source: PHF 2014

Figure 9 - Summary "Scores" for three and two dimensional distributions of income, wealth and non-durable consumption, 2014

Source: PHF 2014