INEQUALITY IN 3-D: INCOME, CONSUMPTION, AND WEALTH

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We do not need to and should not have to choose amongst income, consumption, or wealth as the superior measure of well-being. All three individually and jointly determine well-being. We are the first to study inequality in three conjoint dimensions for the same households, using income, consumption, and wealth from the 1989–2016 Surveys of Consumer Finances (SCF). The paper focuses on two questions. What does inequality in two and three dimensions look like? Has inequality in multiple dimensions increased by less, by more, or by about the same as inequality in any one dimension? We find an increase in inequality in two dimensions and in three dimensions, with a faster increase in multi-dimensional inequality than in one-dimensional inequality. Viewing inequality through one dimension greatly understates the level and the growth in inequality in two and three dimensions. The U.S. is becoming more economically unequal than is generally understood.

1. INTRODUCTION

Economic inequality is multi-dimensional. Income, consumption, and wealth, independently and jointly, inform the perception and reality of inequality. Yet most

studies of inequality limit analysis to one dimension. Even those using more than one ignore the joint distributions. Studying inequality in two and three dimensions for the same households deepens, broadens, and refines our understanding of inequality.

We are the first to study inequality in three conjoint dimensions of income, consumption and wealth. Using the Survey of Consumer Finances (SCF), we capture the top of the income and wealth distributions, and hence the consumption distribution, better than any other U.S. survey, such as the Panel Study of Income Dynamics (PSID) used in Fisher *et al*. (2016). As Piketty and Saez (2003) and Saez and Zucman (2016) show, the top of the distribution drives the increase in inequality, making the SCF crucial to use. We begin by showing inequality for the three measures individually, demonstrating that our sample replicates the one-dimensional understanding of inequality. Moving beyond the conventional analysis, we present the conjoint distribution of income, consumption, and wealth. The paper focuses on two questions. How do you measure inequality in two and three dimensions? Has inequality in multiple dimensions increased by less, by more, or by about the same as inequality in one dimension?

Our analysis also extends our understanding of inequality by looking at the full distribution, not only the top. Much of the recent research concentrates on the share held by the top 5 percent, motivated in large part by the seminal work of Piketty and Saez (2003). While the top drives much of the increase in uni-dimensional inequality, multi-dimensional inequality may look different at the bottom and middle of the distribution.

While previous research shows that uni-dimensional inequality has increased over the past three decades, we find that inequality in two dimensions and three dimensions has increased even more. The percent of households in the top 5 percent of two resource measures and all three measures increased between 1989 and 2016, and the share of resources going to the top 5 percent increased faster in two and three dimensions than in one dimension. These patterns persist when looking at multi-dimensional inequality by quintiles. Only the top quintile gained shares while the four lower quintiles lost shares.

The existing inequality literature typically studies one dimension of inequality. Piketty and Saez (2003) and Burkhauser *et al*. (2012) study income inequality alone. Those studying consumption inequality often compare the trend in consumption inequality to the trend in income inequality but focus on the univariate distributions and not the joint distribution (e.g., Blundell *et al*., 2008; Attanasio and Pistaferri, 2014; Aguiar and Bils, 2015; Fisher *et al*., 2015; Meyer and Sullivan, 2016). Similarly, wealth inequality is often studied alone or is compared to income inequality (e.g., Wolff, 2014; Saez and Zucman, 2016).

A few wealth inequality studies present information on the joint distribution of income and wealth, such as Saez and Zucman (2016) who report the share of income held by the top 1 percent of wealth. While Saez and Zucman (2016) present important information on the joint distribution, they lack data on consumption, report only pre-tax pre-transfer taxable income, use tax-filing units instead of households, and include only the very top of the distribution. Jäntti *et al*. (2008) focus on the middle and bottom of the distribution by studying the wealth of low- and middle-income populations cross-nationally. Wolff and Zacharias (2009),

Smeeding and Thompson (2011) and Armour *et al*. (2014) all incorporate predicted flows of income accruing to wealth holdings into income to study the level and trend in income inequality, but they do not account for the underlying stock of wealth. The stock of wealth is more than just an annuitized income flow, as it represents the power to consume, the power to self-insure, and the power to transfer wealth across generations.

Heathcote, Perri, *et al*. (2010), Krueger *et al*. (2016), Ruiz (2011), and Fisher *et al*. (2016) come closest to our approach. Heathcote, Perri, *et al*. (2010) present income, consumption, and wealth inequality together, but they use a different survey for each measure. Krueger *et al*. (2016) use the PSID for all measures and present the shares of income and consumption by wealth quintile. Their goal is to build a real business cycle model to help explain how the cross-sectional distribution of wealth shapes business cycle dynamics, similar to Fisher *et al*. (2016) who also use the PSID. The current paper goes beyond Fisher *et al*. (2016) by explicitly examining the joint distributions and how they alter our understanding of more standard single-dimension measures of inequality. Finally, we use the model in Krueger *et al*. (2016) to demonstrate that a standard real business cycle model predicts increases in two-dimensional inequality that are in line with our empirical findings.

We differentiate from these papers by going further in exploring multi-dimensional inequality. Moreover, we use the SCF to capture the top of the income and wealth distributions, which are not captured by the PSID. The SCF is the only household survey in the United States to capture the entire income distribution, including the top centiles.[1]

Our results will allow macroeconomic models to better reflect the underlying dynamics and heterogeneity across households. For instance, we build on the results in Kaplan *et al*. (2014) by identifying that households are more than just low wealth or high wealth. We expand on the results of Krueger *et al*. (2016) to examine the changes in the distributions of income and consumption for the wealthy. Furthermore, our results can help calibrate macroeconomic models such as the ones found in Krusell and Smith (1998); Castenada *et al*. (2003); Benhabib *et al*. (2011); Hintermeier and Koeniger (2011); Heathcote *et al*. (2010); Kaplan and Violante (2014); and, Krueger *et al*. (2016). For example, Mian *et al*. (2020a, 2020b) use our findings on the two-dimensional consumption shares (see Appendix Table B2) to help document the savings glut of high income households (Mian *et al*., 2020b), which then feeds into their two-agent overlapping-generations model. A key feature of the model is that the higher share of consumption from high income households leads to increasing debt of lower-income households. These empirical facts feed into their model and help understand how expansionary fiscal and monetary policies can lead the economy into a debt-driven liquidity trap (Mian *et al*., 2020a).

The common thread through all of the inequality research is increasing economic inequality. Given the consensus of increasing inequality, the necessity of studying multi-dimensional inequality begs for attention. Income, consumption,

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[1]By design, the SCF sample excludes individuals on the Forbes 400 list of richest people in America. Bricker *et al*. (2016) extend their analysis by adding the reported wealth of those individuals into the survey, which results in a higher concentration of wealth but similar patterns over time.

and wealth positions are not perfectly correlated. The life-cycle pattern of the measures best demonstrates this imperfect correlation. Younger adults often have consumption exceeding income along with low or negative wealth, while older adults often have relatively high consumption and high wealth but low income (Fisher *et al.*, 2018).

Stiglitz *et al.* (2009, p. 34) also argue for the joint study of inequality, stating, "the most pertinent measures of the distribution of material living standards are probably based on *jointly* considering the income, consumption, and wealth position of households or individuals." OECD (2013) builds on the recommendations of Stiglitz *et al.* (2009) and provides some evidence on multi-dimensional inequality for Australia and France (Ruiz, 2011). Beginning in 2017, the OECD and Eurostat convened an expert group on measuring multi-dimensional inequality, with Eurostat already publishing experimental statistics on the joint distribution of income, consumption, and wealth (see OECD, 2020, Zwijnenburg, 2020). Finally, Blundell (2014, p. 316), in his address to the Royal Statistical Society, also highlights the importance of all three measures stating that: "… the results of the research presented here provide a strong motivation for collecting consumption data, along with asset and earnings data."

2. Inequality and the Budget Constraint

To frame our understanding of inequality in three dimensions, we start with the intertemporal budget constraint.

$$\sum_{k=0}^{T-t} Q_{t+k} C_{t+k} = \sum_{k=0}^{L-t} Q_{t+k} Y_{t+k} + A_{i,t}$$

where Q is a discount rate, C represents consumption, Y represents income, and A represents net wealth. Time T is death, and time L is retirement. In surveys, we observe snapshots of consumption, income, and wealth. Each individual measure alone provides a noisy estimate of life-time well-being at a point in time. A retired household may have high wealth, with consumption above income. Using income alone would make the household seem worse off, while wealth may overstate the household's well-being because they are drawing down wealth, not building it.

The intertemporal budget constraint illustrates the importance of the joint distribution. Assume two individuals with identical future income growth and current consumption. However, one individual has income greater than consumption and is growing wealth, while the second individual has income less than consumption is drawing down wealth. Their prospects for future consumption are different, and this is only understood through looking at the joint distribution of income and consumption.

To understand how the joint distribution of income, consumption, and wealth inequality may change, we start from the observation that income inequality is increasing. We want to understand how this increase in income inequality could affect consumption and wealth inequality. To help illustrate, assume a world with

no income inequality in year t, and everyone makes the same consumption and savings decisions such that there is no consumption or wealth inequality. Now suppose one person's income doubles while everyone else's income stays the same in $t + 1$. The person with double income must increase consumption or savings, meaning inequality must increase in consumption or wealth, but it is not guaranteed that inequality must increase in both. A priori, a rise in income inequality does not have to lead to an increase in consumption inequality and wealth inequality.

Blundell *et al*. (2008) present a formal model for how changes in income inequality translate to changes in consumption inequality. Real log income contains a permanent component and a mean-reverting transitory component. The change in log unpredictable consumption contains three terms: the effect of a permanent change in income with a corresponding marginal propensity to consume (MPC); the effect of a transitory change in income with its MPC; and a random component that represents innovations to consumption independent of changes in income.

If households can completely self-insure against income shocks, the MPC out of permanent shocks and the MPC out of transitory shocks are zero, suggesting that an increase in income inequality generated by changes in permanent or transitory shocks does not affect consumption inequality. Instead wealth inequality increases. On the other extreme, if households have zero ability to self-insure and the MPCs instead equal one, then an increase in income inequality completely passes through to consumption inequality, with no change in wealth inequality. Anything between the two extreme MPCs leads to an increase in consumption inequality and an increase in wealth inequality when income inequality increases.

If income inequality is increasing because of larger, randomly distributed transitory income shocks, then neither consumption inequality nor wealth inequality need increase even as income inequality increases. Permanent income has not changed so households do not change consumption in the face of the transitory shocks. The positive transitory shock is saved, and wealth is drawn down in the face of a negative transitory shock, leaving overall wealth inequality (relatively) unchanged.

These theoretical models suggest that income inequality could increase with no increase in consumption inequality or wealth inequality. If consumption inequality and wealth inequality are unchanged, then multi-dimensional inequality does not need to increase even when one dimensional inequality increases. Therefore, it is an empirical question whether an increase in inequality in one dimension leads to increases in multi-dimensional inequality.

Some research finds that consumption inequality increased much less than income inequality, arguing that households were experiencing more transitory income shocks, which has an empirically lower MPC than permanent shocks, and these transitory shocks allowed households to smooth consumption (e.g., Krueger and Perri, 2006; Blundell *et al*., 2008; Meyer and Sullivan, 2016). More recent research finds that consumption inequality increased by about the same amount as income inequality (Attanasio and Pistaferri, 2014; Aguiar and Bils, 2015; Fisher *et al*., 2015). In the model of Blundell *et al*. (2008), the observation that income inequality and consumption inequality increased by about the same amount would indicate that households are sensitive to transitory shocks and these reactions

depend on the level of wealth, as low wealth households cannot adjust to shocks. Fisher *et al*. (2020) use the PSID and show that the MPC out of predictable income shocks is higher for low wealth households.

Another possible scenario is that wealth inequality could increase independent of a change in income inequality. Fagerang *et al*. (2016) find that returns to assets vary substantially across households. If high wealth households receive a higher rate of return than low wealth households, wealth inequality would increase with no change in income inequality. As those high wealth households consume out of the extra wealth (e.g., Bostic *et al*., 2009; Carroll *et al*., 2011), consumption inequality would increase as well, independent of a change in income inequality. Wealth effects could help explain why consumption inequality and income inequality do not always move in tandem, and wealth effects could help explain why consumption inequality fell during the Great Recession while income inequality was flat or increased slightly. High wealth households may have experienced larger negative wealth shocks, which led high wealth households to cut back consumption more than lower wealth households (Fisher *et al*., 2015).

All of these papers, however, focus on how a single dimensional measure of inequality (e.g., income or earnings inequality) affects either consumption or wealth inequality. Krueger *et al*. (2016) show the interaction between the distribution of wealth and the distributions of income and consumption by examining the shares of income and consumption by households in the wealth distribution, which is a measure of two-dimensional inequality.

In summary, the empirical record suggests that the increase in income inequality led to both an increase in consumption inequality and an increase in wealth inequality, even though both could have increased without a similar increase in income inequality. Thus, we expect to see that inequality in two dimensions and inequality in three dimensions should also increase. We now turn to how we measure income, consumption, and wealth before turning to results showing inequality in one, two, and three dimensions.

3. Data and Imputation Overview

Understanding the conjoint distribution requires having income, consumption, and wealth in the same survey. The PSID asks about income, consumption, and wealth in every wave since 1999. The PSID, however, does not completely capture the top of the distributions. Another drawback of the PSID is that it has only includes all three measures since 1999. Before 1999, the PSID asked a limited set of consumption questions and only included wealth in 1984, 1989, and 1994.

The Federal Reserve Board's triennial SCF captures the top of the income and wealth distributions better than any other survey and contains a consistent sample and consistent measures since 1989. This is critical for the analysis, as much of the recent literature demonstrates that the increase in income and wealth inequality has been driven by changes at the top of the distribution. The SCF only provides an incomplete measure of consumption: food, mortgage or rent, and the stock of vehicles. We impute the residual consumption components to the SCF using the Consumer Expenditure (CE) Survey. Using the SCF, which captures more of the

top of the distribution, our goal is to also capture more of the top of the consumption distribution. Our results represent the first time consumption is imputed to the SCF to study inequality.[2]

3.1. *The Survey of Consumer Finances*

We use data from the ten waves of the SCF conducted between 1989 and 2016. The survey collects detailed information about households' financial assets and liabilities, and it employs a consistent instrument and sample frame since 1989. To support estimates of the wealth distribution, the SCF employs a dual-frame sample design. The national area-probability sample provides coverage of widely spread characteristics. Because of the concentration of assets and non-random survey response by wealth, the SCF also employs a list sample that consists of households with a high probability of having high wealth.

The results presented here use an equivalence scale to adjust resources for family size, unless noted otherwise. We use the square root of family size as the equivalence scale. We use all households and do not restrict to those headed by prime-age working adults, as is common in the inequality literature. Our interest lies in economy-wide inequality, not inequality among a restricted age group.

We use after-tax income in all results and include realized capital gains income.[3] TAXSIM is used to estimate taxes (Feenberg and Coutts, 1993). All wealth measures reported in this paper are based on the SCF definition of net worth, which is assets less liabilities. Assets include all financial assets and non-financial assets, which includes defined contribution pensions but not defined-benefit pensions. Jacobs *et al*. (2020) has extended the SCF wealth to include these components. Liabilities include mortgages, credit card balances, student loans, automobile loans, and other miscellaneous forms of debt.

The SCF includes some consumption questions. Since 2004, the SCF has asked about food spending. Expenditures on automobiles are asked every wave, and the consumption value of automobiles is estimated based on the stock of automobiles. Our estimate of vehicle consumption assumes that households annually consume 20 percent of the retail value of new vehicles and 15 percent of the retail value of all vehicles with a model year more than 2 years older than the year of the survey (see online Appendix A for details). Renters are asked the dollar value of rent paid, and homeowners report payments for mortgage interest and principal along with property taxes. Because the SCF does not include full consumption, we impute the remaining components of consumption using the CE Survey.

There are several conceptual and practical complications related to estimating and comparing distributions of wealth—which is a stock—and income and consumption—which are flows. Conceptually, the time-period for the comparisons are not identical. The stock of wealth is measured at a point in time, while the flows of consumption and wealth are measured (or estimated) over the course of

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[2]Bostic *et al*. (2009) impute consumption to the SCF to study housing and financial wealth effects.

[3]Income from capital gains is not captured in the CE. When imputing to the SCF, we use after-tax-income excluding capital gains in order to use the same income concept across the two surveys. All results, except Figure 1, presented here use after-tax income including capital gains.
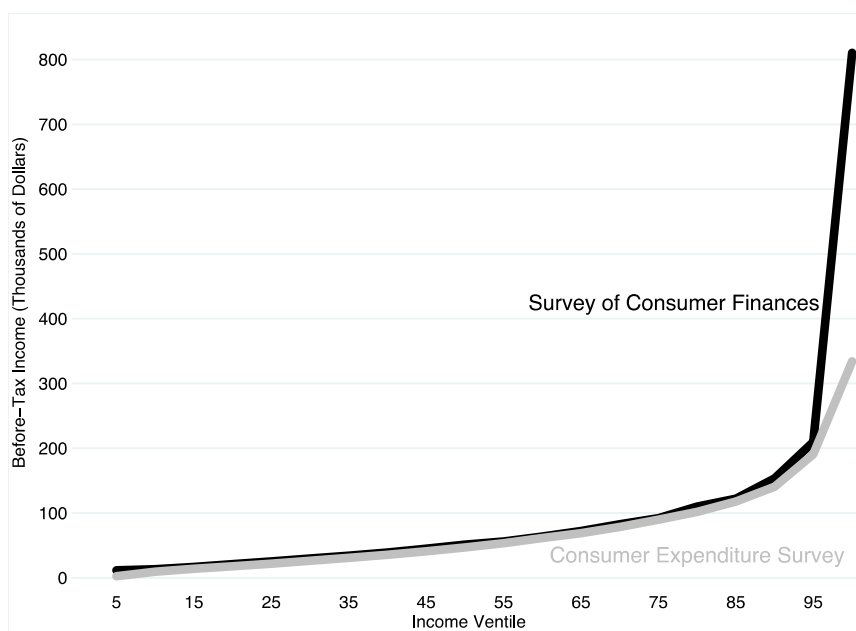
Figure 1. Mean Before-Tax Income by Income Ventile in the Survey of Consumer Finances and Consumer Expenditure Survey, 2016

Notes: SCF before-tax income excludes capital gains, as capital gains are not reported in the CE. Were capital gains included, the differences would be larger at the top of the distribution.

Sources: Consumer Expenditure Survey and Survey of Consumer Finances.

a calendar year. In addition, some items are included in both income and consumption, such as SNAP and the food purchased using SNAP. Since consumption includes the service flow of vehicles and home ownership, these consumption flows are estimated directly from the stock of vehicles and house price—both included in wealth stocks. Reported consumption in the SCF is based on the survey-year point-in-time measurement of the asset value.

3.2. *The Consumer Expenditure Survey*

The CE Survey interviews households four times over 1 year, with the consumption questions covering the previous 3 months. We aggregate the four quarters to arrive at annual consumption. In the last interview, the CE asks about income over the previous 12 months, covering the same 12 months as consumption.

We define consumption as total spending on goods and services for current consumption, excluding life insurance, pensions, and cash contributions. We calculate housing consumption as six percent of the house value for home owners, in place of mortgage, interest, and property tax payments. For renters, housing consumption is equal to rent paid.

As with other research on consumption, we do not include goods obtained through barter, home production, or in-kind gifts from others because these values are not available. In contrast to other research, our consumption includes education, health care expenses, and other durable goods. Excluding these components of consumption would break the explicit relationship between income, consumption, and wealth.

3.3. *Imputation Methodology*

We impute only the components of consumption not asked in the SCF. Reported SCF consumption items account for approximately 40 percent of consumption in the years when food is reported. We use a multiple imputation approach to consumption, following the SCF's own multiple imputation approach for missing components of income.

The variable we impute in the SCF is the ratio of reported consumption to total consumption. We calculate the dependent variable in the CE by dividing the sum of the consumption categories that are present in both surveys by total consumption. After imputing that ratio for the SCF households, we divide reported consumption by the imputed ratio to arrive at the level of total consumption. See the Appendix for a more detailed description of the methodology.

3.4. *Judging the Quality of the Imputation*

Our results depend crucially on the imputation. One concern is the quality of the source data. The CE Survey reports lower aggregate expenditures than those reported in the Personal Consumption Expenditures (PCE). One source of this under-reporting is that the CE Survey receives a lower response rate from high-income zip codes (Sabelhaus *et al.*, 2014). The SCF oversamples the high-income households that the CE misses. The SCF oversampling high-income areas creates a separate issue; the CE may lack support to impute consumption for the highest income SCF households.

To judge imputation quality, we need a proper benchmark. One simple comparison is the original CE data. We expect differences between the two surveys. The SCF captures high-income households missed by the CE. The CE matches the SCF up to at least the 75th percentile of the before-tax income distribution (Figure 1). Given that SCF exceeds CE income at the top, we expect that SCF consumption will also be higher at the top. Mean reported consumption (Figure 2, top panel) and mean imputed consumption (Figure 2, bottom panel) in the SCF and CE overlap until around the 80th percentile of before-tax income. The difference between consumption in the SCF and CE is particularly large for the top 5 percent of the income distribution, as expected based on Figure 1.

The CE is known to underestimate some PCE categories and the overall PCE (Garner *et al.*, 2006; Bee *et al.*, 2014). As the SCF captures more consumption at the top of the distribution (Figure 2), aggregate consumption in the SCF is on average 7 percent (or $292 billion) higher than CE aggregate consumption.

Our interest is in measuring inequality, and thus we turn to the Gini coefficient (Figure 3). The SCF consumption Gini exceeds the CE consumption Gini in every year. When removing households in the top 1 percent and especially the top 5
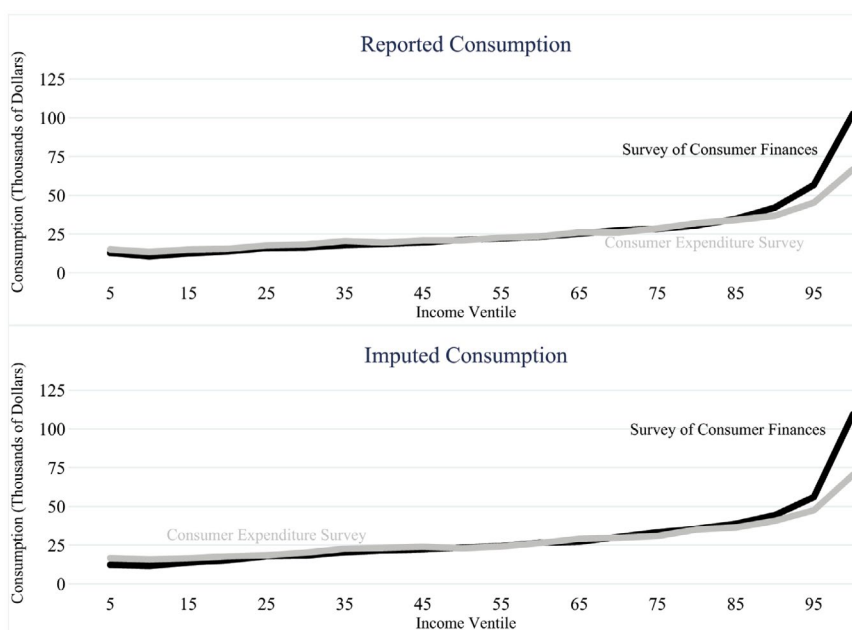
Figure 2. Mean Reported and Imputed Consumption by Before-Tax Income Ventile in the Survey of Consumer Finances and Consumer Expenditure Survey, 2016
Notes: The top figure shows the consumption components reported in the SCF. The bottom figure shows mean imputed consumption by income ventile.
Sources: Consumer Expenditure Survey and Survey of Consumer Finances.

percent of the income distribution from the SCF, the SCF and CE Gini coefficients line up more closely. SCF consumption differs from CE consumption in predictable ways but matches the CE over the part of the income distribution where the two should line up. With that established, we move to studying inequality in one, two, and three dimensions.

4. Inequality in 1-D, 2-D, and 3-D Using the Top 5 Percent

We measure multi-dimensional inequality in two ways. As an example of two-dimensional inequality, we first estimate the percent of households in the top 5 percent in income and the top 5 percent of wealth. An increase in the percent of households in the top 5 percent of income and wealth represents an increase in inequality in two dimensions.

The second measure of multi-dimensional inequality is the share of wealth held by the top 5 percent of the income distribution and vice versa, which is the two-dimensional analog of the Piketty and Saez (2003) measure. Piketty and Saez (2003) use the share of income held by the top 5 percent of the income distribution. We present the share of wealth held by the top 5 percent of income. Inequality in
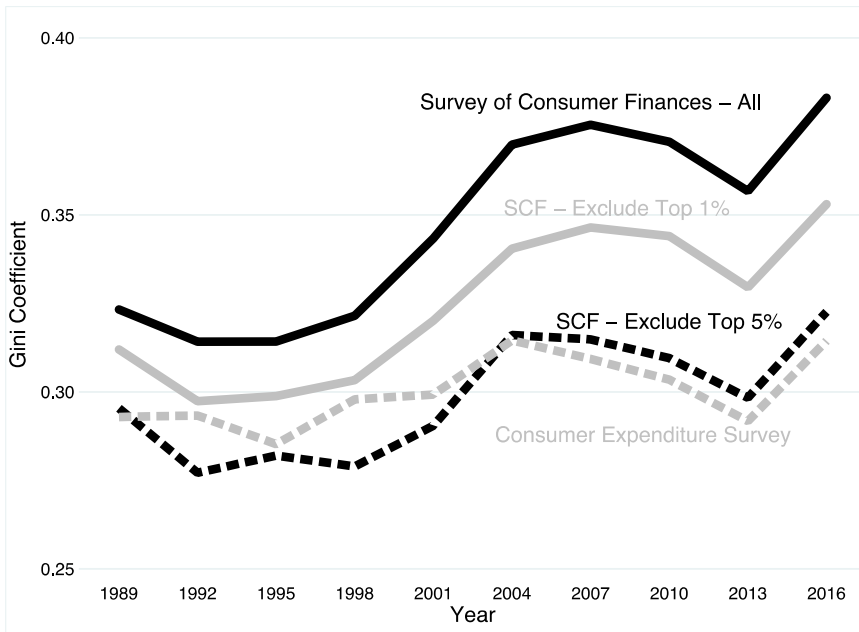
Figure 3. Consumption Gini in the Survey of Consumer Finances and the Consumer Expenditure Survey: 1989–2016

Notes: The line excluding the top 5 percent removes the top 5 percent of the income distribution from the SCF and then, calculates the Gini coefficient for consumption in the SCF. The sample excluding the top 5 percent from the SCF attempts to mimic the sample in the CE.

Sources: Survey of Consumer Finances and Consumer Expenditure Survey

two dimensions increases if the share of wealth held by the top 5 percent of income increases.

4.1. *Inequality in 1-D*

We begin with the traditional one-dimensional share analysis and compare SCF results to the existing literature. According to the SCF in 2016, the top 5 percent of the uni-dimensional income, consumption, and wealth distributions held 39 percent, 21 percent, and 65 percent (Figure 4). The SCF results are comparable to existing research (Piketty and Saez, 2003; Saez and Zucman, 2016). To compare directly to Piketty and Saez (2003), we show before-tax income shares in Figure 4. Subsequent figures use after-tax income and show a lower share but a similar trend. The only significant difference in the level or trend in shares is for consumption. The differences in the share of consumption from Figure 4 match the differences in the Gini coefficient from Figure 3, which is explained by the SCF better capturing the top of the distribution.

Discussions of shares sometimes lose context and grounding in terms of dollar amounts. The dollar amounts help illuminate the magnitude of the inequality underlying the share analysis. We present the thresholds to enter the top 5 percent,
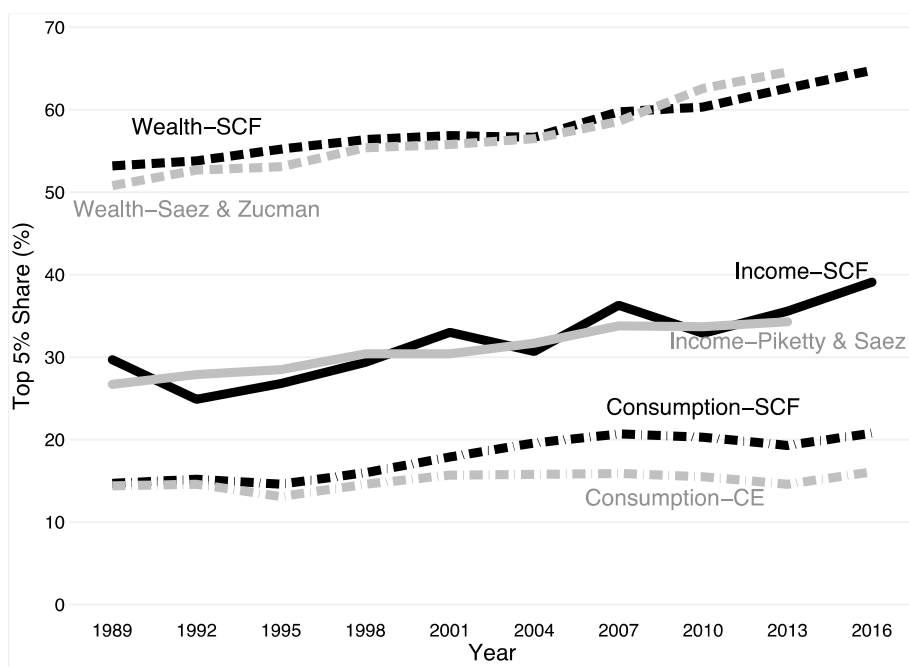
Figure 4. Shares Held by Top 5 percent of Respective Distributions, 1989–2016
Notes: The non-SCF wealth shares come from Saez and Zucman (2016). The Saez and Zucman (2016) series ended in 2012. We used the 2012 number for 2013 in the figure above. The non-SCF income shares come from Piketty and Saez (2003) and from updates on the World Wealth and Income Database. The SCF income share uses before-tax income. Subsequent SCF results use after-tax income.
Sources: Survey of Consumer Finances and Consumer Expenditure Survey.

using the equivalized values to rank households. We present the dollar values not adjusted for family size because it is easier to relate to known values. The 95th percentiles for income, consumption, and wealth in 2016 are $197,000, $135,000, and $2,388,000 (Table 1).

The values at the top of the distributions dwarf the middle and bottom. The top of the distribution has 4.2 times as much income, 3.1 times as much consumption, and 24.5 times as much wealth as the middle of the distribution (Table 1). These ratios rose considerably since 1989, with wealth headlining the increase. The ratio of wealth at the 95th percentile to the median increased by 67 percent since 1989. The level and trend in the ratios for income and consumption seem reasonable only in comparison to wealth.

4.2. *Inequality in 2-D*

Now we move to two-dimensional inequality. Our first measure of two-dimensional inequality is the percent of households in the top 5 percent of two measures, which would be 5 percent if the top 5 percent of both measures contains the same households. In 1989, for example, 2.6 percent of households were in the top 5 percent of both the income distribution and the wealth distribution

TABLE 1
INCOME, CONSUMPTION, AND WEALTH AT THE 10TH, 50TH, AND 95TH CENTILES (1989–2016)

	1989	1992	1995	1998	2001	2004	2007	2010	2013	2016
Pre-tax income										
10th Centile	6,262	6,764	6,882	8,271	10,285	11,092	12,340	13,381	13,798	15,056
50th Centile	25,735	26,647	30,723	33,447	39,950	43,237	47,305	45,743	46,668	52,657
95th Centile	104,372	107,611	112,572	130,571	169,649	184,863	206,906	205,268	229,637	260,248
95/50 Ratio	4.1	4.0	3.7	3.9	4.2	4.3	4.4	4.5	4.9	4.9
After-tax income										
10th Centile	5,586	5,814	6,292	7,661	9,861	10,932	12,370	13,525	13,696	15,007
50th Centile	21,228	21,845	24,376	27,344	32,843	37,288	40,609	41,123	41,504	47,125
95th Centile	78,368	78,151	80,605	91,661	122,673	136,309	158,253	154,362	173,628	196,530
95/50 Ratio	3.7	3.6	3.3	3.4	3.7	3.7	3.9	3.8	4.2	4.2
Consumption										
10th Centile	10,482	11,431	12,472	13,812	15,119	15,546	17,858	18,498	19,187	19,821
50th Centile	22,858	24,510	26,465	28,614	32,356	35,747	39,334	38,949	40,389	43,792
95th Centile	61,661	64,494	67,407	75,004	90,282	105,156	115,734	120,283	115,944	135,464
95/50 Ratio	2.7	2.6	2.5	2.6	2.8	2.9	2.9	3.1	2.9	3.1
Wealth										
10th Centile	0	0	50	0	100	200	40	−975	−2,080	−1,000
50th Centile	46,912	49,544	57,838	71,692	86,580	93,126	120,625	77,280	81,200	97,300
95th Centile	688,650	664,826	683,307	896,832	1,307,832	1,430,080	1,901,203	1,864,139	1,871,775	2,387,500
95/50 Ratio	14.7	13.4	11.8	12.5	15.1	15.4	15.8	24.1	23.1	24.5

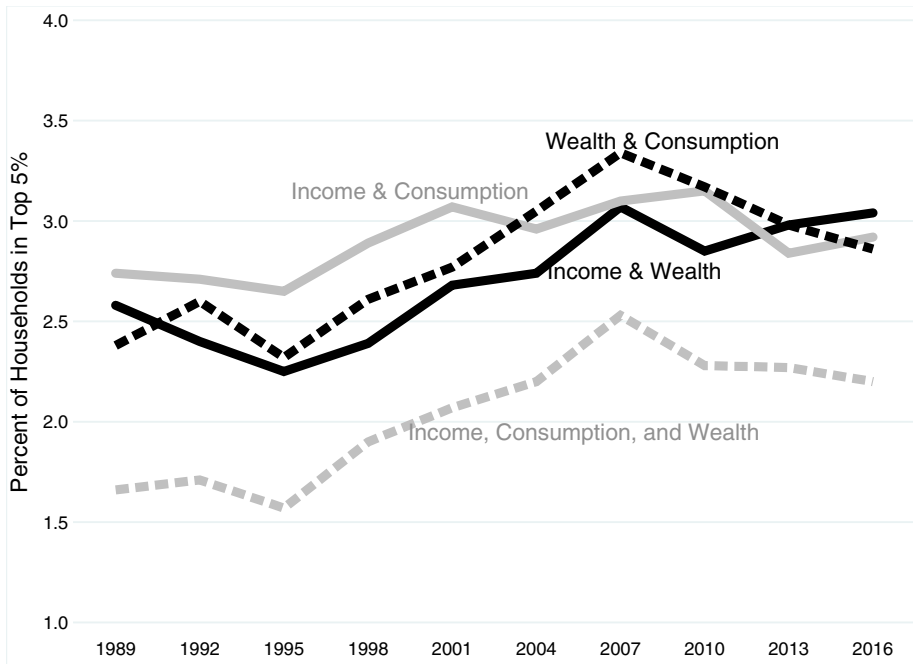*Source*: Survey of Consumer Finances.

Figure 5. Percent of Households in Top 5 percent of Two Measures and Three Measures (1989–2016)
Source: Survey of Consumer Finances, 1989–2016. Data for Figure included Online Appendix Table B1.

(Figure 5), meaning over half of the households that were in the top 5 percent of the income distribution were also in the top 5 percent of the wealth distribution. By 2016 the share of households in the top 5 percent of both income and wealth had risen to 3.0 percent. Another way to describe this development is that at the beginning of the period five of every ten high-income households was also a high-wealth household, and by the end of the period six of every ten high-income households was also a high-wealth household.

We have three measures of two-dimensional inequality: income and wealth; wealth and consumption; and consumption and wealth.[4] The percent of households in the top 5 percent of all three increases between 1989 and 2007. After 2007, all three decrease or are stable but remain above 1989 levels. Increasing shares indicates a growth in two-dimensional inequality as more households are in the top 5 percent of at least two measures. The highest growth in two dimensions occurs for the wealth and consumption series, increasing from 2.4 to 2.9 percent between 1989 and 2016.

Our second measure of two-dimensional inequality is referred to as "cross-shares" and displayed in Figure 6. A cross-share is the share of one economic resource held by some part of the distribution of another economic resource. We calculate, for example, the share of wealth held by the top 5 percent of the income distribution. Two comparisons interest us here. First, did the cross-share increase

[4]For the numbers supporting Figures 5–7, please see Appendix Table B1.

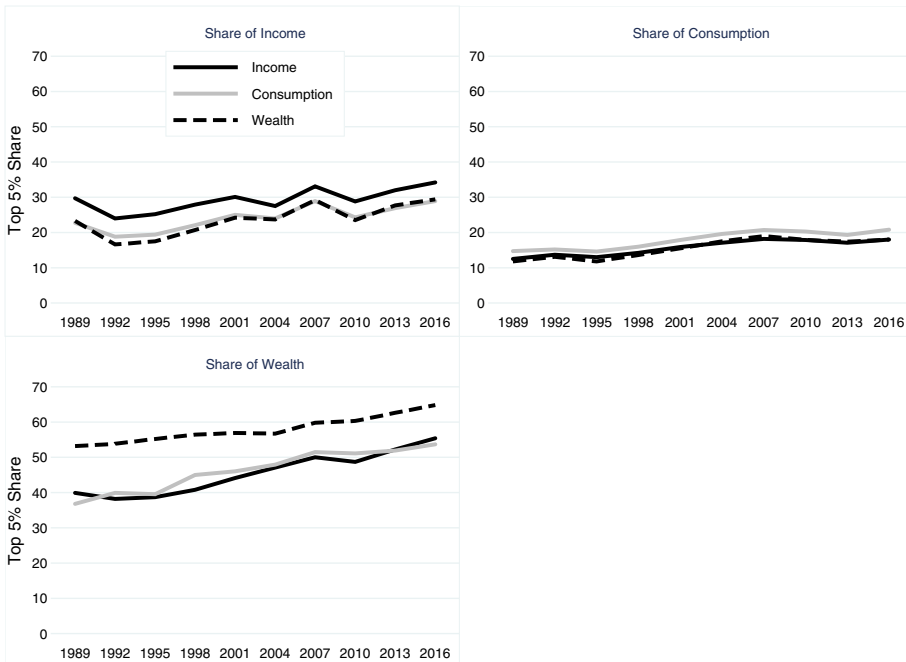© 2021 International Association for Research in Income and Wealth

Figure 6. Top 5 percent Shares in Two-Dimensions (1989–2016)

Notes: The top-left panel shows the share of income held by the top 5 percent of the income distribution, the top 5 percent of the consumption distribution, and the top 5 percent of the wealth distribution. The top-right panel shows the share of consumption of the top 5 percent of the three distributions. The bottom-left panel shows the share of wealth of the top 5 percent of the three distributions. Data for Figure included Online Appendix Table B1.

over time? Given the results of Figure 5 showing an increase in the percent of households in the top 5 percent of income and wealth, we expect the cross-share to increase as well. Second, did the cross-share increase faster than the own share? In other words, did the share of wealth held by the top 5 percent of the income distribution (cross-share) increase faster than the share of wealth held by the top 5 percent of the wealth distribution (own share)? At each point in time, the own-share will, by definition, always be higher than (or equal to) the cross-share.[5] If the cross-share is rising faster, however, we say that multi-dimensional inequality has increased more than single-dimensional inequality.

The top-left panel of Figure 6 displays the share of income received by the top 5 percent of the income distribution, consumption distribution, and wealth distribution. In 2016, the top 5 percent of the income distribution received 34 percent of income, while the top 5 percent of consumption and the top 5 percent of wealth received 29 percent of income. Between 1989 and 2016, the top 5 percent own-share of income rose 15 percent—climbing from 30 percent to 34 percent.

[5]In the extreme case where it was the same households in the top five percent of each distribution you would find that the cross share and the own-share would be equal. In all other cases, the cross-share will be lower.
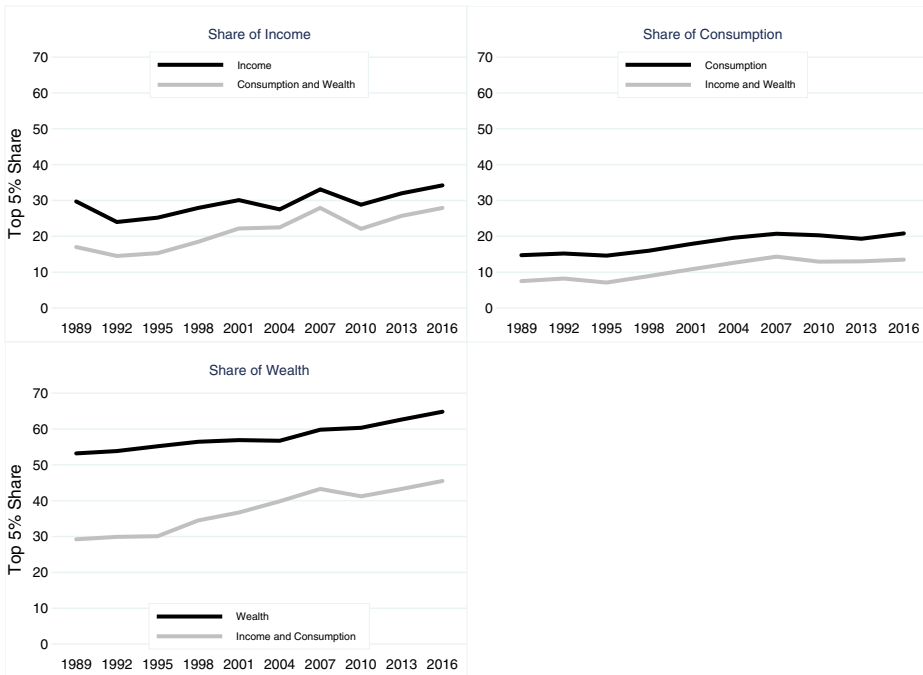
Figure 7. Top 5 percent Shares in Three-Dimensions (1989–2016)

Notes: The top-left panel shows: the share of income held by the top 5 percent of the income distribution and the share of income held by those in the top 5 percent of both consumption and wealth. The other two panels show similar results but using the share of consumption or the share of wealth. Data for Figure included Online Appendix Table B1.

Over that same period the cross-shares of income rose faster; the income share of households in the top 5 percent of consumption rose 27 percent, and among top wealth households it rose 26 percent. The increases in these series of cross-shares represent an increase in two-dimensional income inequality, which rose at a faster clip than single-dimension income inequality.

The top-right panel in Figure 6 displays the own- and cross-shares for consumption, and the bottom-left panel displays the same for wealth. All cross-shares increase since 1989, again indicating an increase in two-dimensional inequality. For consumption and income, the increase in two-dimensional inequality occurred largely between 1989 and 2007, with no increase in two-dimensional inequality since 2007. Two-dimensional income inequality rose between 2010 and 2016, but two-dimensional income shares have only just returned to 2007 levels. In the case of wealth, two-dimensional inequality in wealth rose steadily between 1989 and 2016.

We find that the growth in inequality in two-dimensions exceeds the growth in inequality in one dimension for all two-way combinations. In addition to the case for income, described above, we also see faster two-dimensional inequality growth for both wealth and consumption. The share of wealth held by top-wealth households rose 22 percent, but the share held by top consumption and income

households increased 46 percent and 39 percent, respectively. The distinctions between single- and multi-dimensional inequality were somewhat less notable for consumption, with the share of consumption by top consumption households rising 42 percent, and the shares of consumption among top-income and top-wealth households going up 44 percent and 53 percent, respectively.

We add context to our cross-share analysis again by presenting mean income, consumption, and wealth for the cross distributions, advancing the concept behind the two-dimensional inequality measures in Figure 6. Those in the top 5 percent of income had mean income of $541,000 in 2016, while those in the top 5 percent of consumption had mean income of $457,000, and the top 5 percent of wealth had mean income of $465,000 (Table 2).

The trends interest us more than the levels because the trends show whether the means are converging over time. We see convergence between 1989 and 2016, with mean income of the top 5 percent of the income distribution growing 188 percent and mean income of the top 5 percent of consumption and top 5 percent of wealth growing 218 percent and 215 percent (Table 2). We observe the same patterns for consumption and wealth, with the own mean growing by less than the cross-mean.

The fact that mean income is growing faster for those in the top 5 percent of consumption or wealth reinforces the finding that inequality is growing faster in two dimensions than in one dimension. Those in the top 5 percent of consumption experienced greater income growth than those in the top 5 percent of the income distribution, and we see this pattern in every pair of measures.

4.3. *Inequality in 3-D*

Our treatment of three-dimensional inequality follows our treatment of two-dimensional inequality. We begin with the percent of households in the top 5 percent of income, consumption, and wealth (ONS (2020) uses a similar approach for Great Britain). We next present the share of income held by those in the top 5 percent of both the consumption and wealth distributions.

In 1989 1.7 percent of households were in the top 5 percent of income, consumption, and wealth, and by 2016 that number had increased to 2.2 percent (Figure 5). The top 5 percent was a much more exclusive group in 2016 than it was in 1989. Forty-four percent of households in the top 5 percent of any single resource measure were also in the top 5 percent of the other two, up from just 33 percent in 1989.

By construction, the share of households in the top five percent of all three resource measures is lower than the share in the top five percent of any two of the resource measures. The increase between 1989 and 2016, though, was greater in the three-dimensional measure than in two of the two-dimensional measures and equivalent of that in the other. The share belonging to the top 5 percent of all three measures rose 9 percent, compared to increases of 10 percent for households in top wealth and consumption, five percent for households in top wealth and income, and four percent for households in top income and consumption.

Over the 1989 to 2016 period, each of these multi-dimensional concentration measures followed a very similar path, holding steady between 1989 and 1995, rising

TABLE 2

MEAN INCOME, CONSUMPTION, AND WEALTH FOR TOP 5 PERCENT OF VARIOUS DISTRIBUTIONS

	In Top 5 by			
	Income	Consumption	Wealth	
Panel A: After-tax income				Wealth and Consumption
1989	187,819	143,605	147,817	215,367
1992	142,684	111,215	98,391	147,683
1995	168,697	129,223	116,961	187,457
1998	222,973	176,144	165,285	247,645
2001	308,304	255,308	248,807	359,206
2004	309,759	268,545	263,625	363,806
2007	439,966	384,818	388,945	507,252
2010	358,589	302,884	292,026	376,091
2013	443,121	373,165	386,465	529,253
2016	540,872	457,331	465,442	668,233
Growth (1989–2016)	187%	188%	218%	215%
Panel B: Consumption				Wealth and Income
1989	68,868	80,617	64,765	79,490
1992	80,369	89,668	77,114	101,114
1995	80,732	91,037	73,571	99,094
1998	97,367	109,479	93,083	127,198
2001	128,055	144,234	124,611	163,296
2004	158,682	179,506	160,407	210,984
2007	189,226	214,180	196,174	240,908
2010	184,334	208,285	183,940	230,394
2013	176,530	200,029	180,253	224,648
2016	208,183	240,260	207,337	256,579
Growth (1989–2016)	201%	202%	198%	220%
Panel C: Wealth				Income and Consumption
1989	1,482,045	1,365,736	1,976,910	1,977,256
1992	1,419,788	1,484,348	1,999,226	2,049,280
1995	1,645,164	1,676,207	2,335,623	2,406,973
1998	2,310,920	2,530,246	3,191,122	3,353,135
2001	3,505,596	3,645,092	4,506,800	4,772,781
2004	4,280,362	4,298,697	5,089,299	6,030,290
2007	5,579,674	5,741,702	6,666,822	7,787,105
2010	4,840,614	5,092,836	6,009,454	6,489,542
2013	5,565,616	5,535,200	6,722,782	8,127,982
2016	7,640,811	7,420,684	8,947,381	10,700,000
Growth (1989-2016)	430%	416%	443%	353%

Source: Survey of Consumer Finances.

sharply from that point until 2007, and then falling back modestly or remain flat until 2016. In each case, the 2016 measures of overlap in the top 5 percent of distributions of different resource measures, however, remain well above 1989 levels. The three different concentration measures that include consumption see the largest declines since 2007, while the measure including households in the top 5 percent of income and wealth recovers modestly between 2010 and 2016. This post-2007 break in the trend (in Figure 5), coincident with the Great Recession, appears to be driven by a flattening out in consumption inequality, as seen in the flattening of the top 5 percent consumption share in Figure 4 (and Figure 6). Krueger *et al*. (2016) similarly find that the consumption response to the recession was different across

the wealth distribution. During the recession, wealthy households experienced larger reductions in wealth and sharper declines in the level of consumption than those lower in the wealth distribution. The heterogeneous consumption response across the wealth distribution during the Great Recession led to some decoupling of wealth, income, and consumption at the top of the distributions.

Our second measure of three-dimensional inequality is the share of another resource (e.g., income) held by households in the top 5 percent of the other two other resource measures (e.g., wealth and consumption). These are referred to as three-dimensional cross-shares. The results in Figure 7 show the one-dimensional shares and the three-dimensional shares. In the case of income, for example, (Top left panel of Figure 7) this is the share of income held by those in the top 5 percent of consumption and wealth. Those in the top 5 percent of the consumption and wealth distributions received 17 percent of the income in 1989 and 28 percent in 2016. Similar to what was discussed earlier in the case of two-dimensional inequality, three-dimensional cross shares are—by definition—less than (or equal to in an extreme case) both two-dimensional cross-shares or single-dimensional shares. Reflecting what we saw in the two-dimensional shares, the share of income received by those in the top 5 percent of consumption and wealth increased faster between 1989 and 2016 than the own share of income. Those in top 5 percent of consumption and wealth increased their share of income by 64 percent. The single-dimensional income share increased by 15 percent. Inequality in three dimensions also increased faster than inequality in two dimensions. As pointed out earlier, the income share of top wealth households rose 26 percent, and income share of top consumption households rose 27 percent.

The pattern continues when using consumption or wealth as the resource measure. The share of consumption for those in the top 5 percent of income and wealth increased 81 percent since 1989 (Figure 7). The share of wealth for those in the top 5 percent of both income and consumption increased 56 percent since 1989. These findings represent an increase in inequality in three dimensions and an increase in three-dimensional inequality that exceeds increases in two-dimensional and one-dimensional inequality.

Finally, we return to the levels of income, consumption, and wealth to add depth to our understanding of the levels and trends in three-dimensional inequality. Those in the top 5 percent of consumption and wealth had mean income of $668,000 in 2016, which is higher than mean income of those in the top 5 percent of income (Table 2). Similarly, those in the top 5 percent of income and wealth had higher mean consumption ($257,000) than those in the top 5 percent of consumption ($240,000). The difference is even more dramatic for wealth, with the top 5 percent of income and consumption holding $10.7 million in wealth on average, compared to $8.9 million for the top 5 percent of the wealth distribution.

It is worth reemphasizing that the increase in inequality in three dimensions exceeds the increase in two dimensions and is much greater than the increase in one dimension. Viewing inequality through one dimension greatly understates the growth in inequality in two and three dimensions, and the significance that the top of each distribution are increasingly becoming part of the other distributions. The conclusion is that the U.S. is becoming more economically unequal than is generally understood.

5. Inequality Using Quintiles

While the top 5 percent share results represent a detailed look at the top of the distributions and have a long history in economics, focusing on top shares misses a deeper understanding of the rest of the distribution. We apply the share analysis to the entire distribution, presenting results by quintile in one and two dimensions.

5.1. *One-Dimensional Inequality Using Quintiles*

We start with the one-dimensional shares. The top quintile of the income distribution received 57 percent of income in 2016 (Figure 8). The top quintile of the consumption distribution had 44 percent of consumption in 2016, and the top quintile of wealth held 88 percent of wealth in 2016. All of these top quintile shares increased since 1989, with the Great Recession interrupting somewhat the long-term rise for income and consumption inequality, but not for wealth.

Where the top 20 percent gained shares since 1989, the bottom four quintiles all lost shares or at best were flat (Figure 8). The bottom 20 percent only had 4.0 percent, 7.6 percent, and −0.5 percent of income, consumption, and wealth in 2016. The share going to the bottom quintile was flat for wealth between 1989 and 2016, but fell for consumption, from 8.7 percent to 7.6 percent, and slightly rose for income, from 2.4 to 4.0 percent.
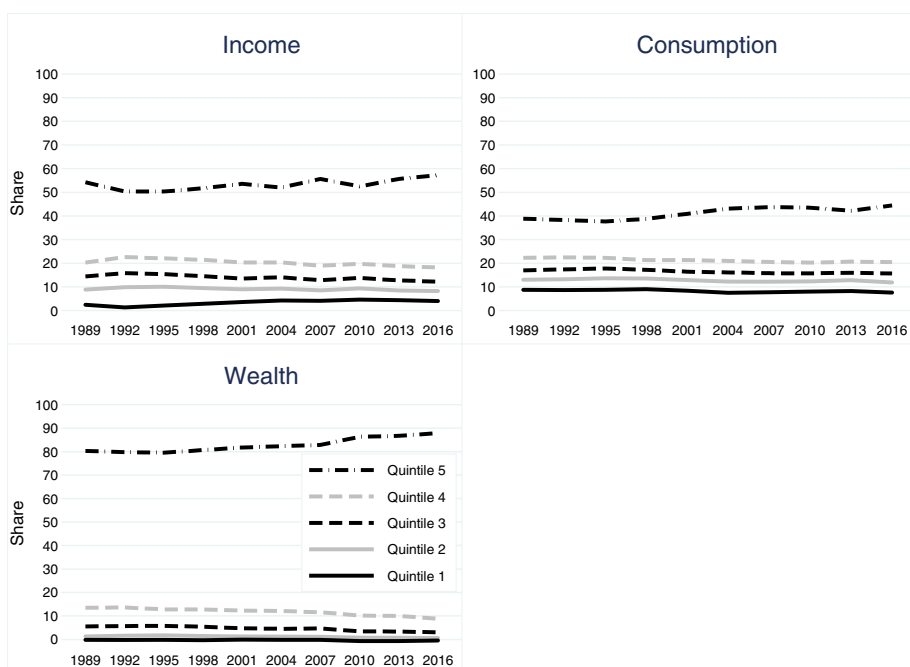

Figure 8. Shares by Quintile for Income, Consumption, and Wealth (1989–2016)
Notes: The top-left panel shows the share of income held by the five quintiles of the income distribution. The top-right panel shows the share of consumption held by the five quintiles of the consumption distribution. The bottom-left panel shows the share of wealth held by the five quintiles of the wealth distribution.

The middle quintile lost ground in all three measures between 1989 and 2016. The middle quintile's shares fell: from 14.4 percent to 12.2 percent for income; from 17.0 percent to 15.7 percent for consumption; and, from 5.5 percent to 3.0 percent for wealth (Figure 8). Most of these decreases occurred post-1995. The Great Recession affected wealth shares in the middle quintile, with their share falling from 4.7 percent in 2007 to 3.4 percent in 2010. The consumption share was relatively flat from 2007 to 2016 for the middle quintile.

5.2. *Two-Dimensional Inequality using Quintiles*

We present analogous two-dimensional results for our quintile analysis. The two-dimensional measure is the share of income held by the top quintile of consumption or wealth. We present results for the bottom, middle, and top quintiles. The bottom quintile in two dimensions tells the same story as the bottom quintile in one dimension. The bottom quintile has few resources and little change (Figure 9; top row). The bottom quintile of consumption received around 10 percent of income in 1989 and in 2016.

The middle quintile continued its pattern of losing shares. The biggest losses for the middle quintile were in wealth (Figure 9; middle row). The share of consumption for the middle quintile of income and the middle quintile of wealth fell 15 percent and 14 percent, respectively. Shares of wealth fell even more, with the share of wealth held by the middle quintile of income and the middle quintile of consumption falling by 49 percent and 46 percent (Figure 9; middle row). These changes in wealth shares were primarily focused around the two financial crashes that occurred between the 1998 and 2001 surveys and between the 2007 and 2010 surveys. The middle quintile lost shares of wealth during both of these downturns, losing retirement account assets in the first and primarily housing wealth in the second, and never recovered (Bricker *et al.*, 2019). The patterns for the middle quintile persist into the fourth quintile.

The top quintile gained share at the expense of the bottom four quintiles. Wealth and consumption exhibited the largest gains in two-dimensional inequality. The top quintile of income and the top quintile of wealth increased their share of consumption by 16 percent and 24 percent (Figure 9; bottom row). These increases in consumption share were larger than the increase in consumption for the top consumption quintile, representing a larger increase in two-dimensional inequality than one-dimensional inequality. The pattern of faster two-dimensional inequality growth at the quintiles is consistent with the results for the top 5 percent. Identical calculations using the PSID show trends in two-dimensional inequality rising more than one-dimensional inequality (see Fisher *et al.*, 2016).

We observe the same patterns for wealth. The share of wealth going to the top quintile of income and the top quintile of consumption increased by 24 percent and 22 percent (Figure 9; bottom row). These increases in shares of wealth were faster than the increase in the share of wealth by the top quintile of the wealth distribution.

Overall, Figures 8 and 9 tell a compelling story. The top quintile of the distribution gained in own and cross shares, and the bottom four quintiles lost own and cross shares. The top quintile has a higher share of income, consumption, and wealth
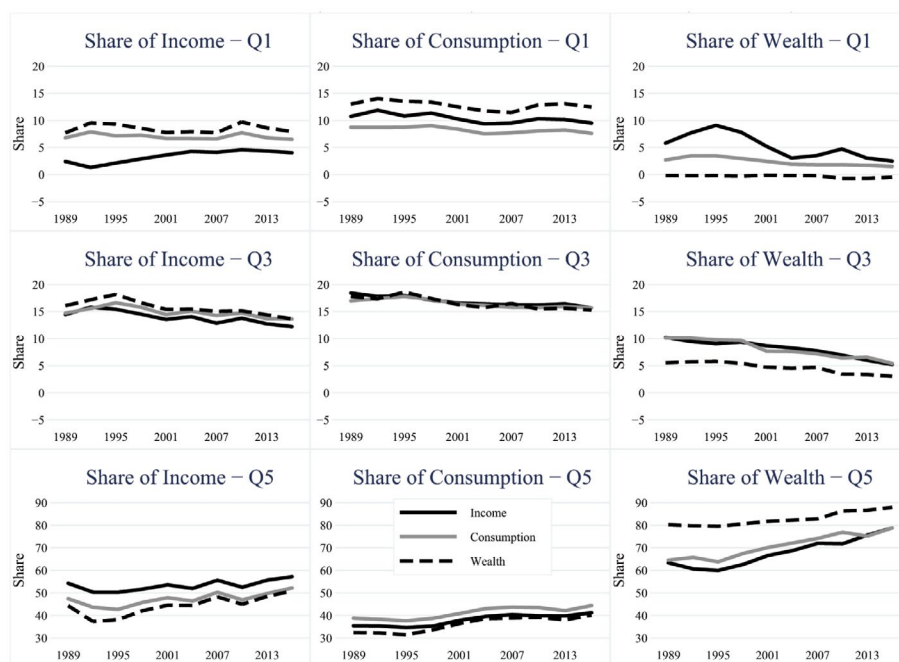
Figure 9. Shares by Quintile (Q1, Q3 and Q5) in Two Dimensions (1989–2016)
Notes: The top three panels show the share of income held by the bottom quintile of the income distribution, the bottom quintile of the consumption distribution, and the bottom quintile of the wealth distribution.
Source: Survey of Consumer Finances.

in 2016 than 1989, and there is a stronger correlation between the three measures in 2016 as well. We also see that the gains at the top came from all four lower quintiles, with the exception of the after-tax income share of the bottom quintile of income.

6. Model-Based Assessment of Multidimensional Inequality Findings

Given these new facts we document, it is important to understand whether these facts can be generated from standard real business cycle models. Are the facts we document consistent or inconsistent with existing models? We utilize findings from Krueger *et al*. (2016) to understand whether their model captures the increase in two-dimensional inequality that we observe in the SCF. We use Krueger *et al*. (2016) for two reasons. Their model finds large wealth inequality, while other models, such as Krusell and Smith (1998), find much lower levels of wealth inequality. In addition, Krueger *et al*. (2016) explicitly model the joint distribution of wealth, income, and consumption, again a feature not included in the rest of the literature.

Krueger *et al*. (2016) modify the Krusell and Smith (1998) real business cycle model by including unemployment insurance, persistent earnings shocks and heterogeneous time preferences. With their modifications and relying on the PSID, Krueger *et al*. (2016) find the top wealth quintile holds 77.8 percent of wealth in 2004, while the bottom two wealth quintiles hold negligible shares of wealth,

TABLE 3

SIMULATION OF TWO-DIMENSIONAL INEQUALITY USING KRUEGER ET AL. (2016)

Wealth quintile	Wealth		Disposable Income		Consumption	
	SCF	KMP Model	SCF	KMP Model	SCF	KMP Model
1998						
1st	-0.3%	0.3%	8.6%	6.0%	13.4%	6.6%
2nd	1.4%	1.2%	12.8%	10.5%	15.1%	11.3%
3rd	5.4%	4.7%	16.6%	16.6%	17.4%	16.6%
4th	12.8%	16.0%	19.9%	24.3%	20.6%	23.6%
5th	80.6%	77.8%	42.2%	42.7%	33.6%	42.0%
2016						
1st	-0.5%	0.1%	7.9%	5.2%	12.5%	4.9%
2nd	0.7%	0.5%	10.0%	9.1%	13.5%	8.4%
3rd	3.0%	2.7%	13.6%	15.0%	15.3%	12.4%
4th	8.9%	11.2%	17.5%	23.7%	18.7%	19.0%
5th	87.9%	85.5%	50.9%	47.0%	40.2%	55.3%
Changes in top quintile shares	9.0%	9.9%	20.7%	10.2%	19.5%	31.7%

Source: SCF results from Figures 8 and 9. KMP model results based on author's calculations using Krueger *et al.* (2016) Tables 1 and 9.

which match our wealth shares (Figure 8). Then they use the observed change in wealth inequality between 2004 and 2006 to see how it filters through to income and consumption inequality by wealth quintile. We use the results of their model to evaluate how our observed increase in wealth inequality would translate into income and consumption inequality in two dimensions, using the share of income and the share of consumption by wealth quintile.

For our simulation, we examine the longer period between 1998 and 2016. Using the actual increases in wealth, we find a similar increase in one-dimensional wealth inequality as is predicted by the Krueger *et al.* (2016) model. In percent terms, the share of wealth held by the top wealth quintile increases by slightly more in the model than we observe in the SCF (9.9 percent vs. 9.0 percent; Table 3; see Online Appendix C). Turning to inequality in two-dimensions, between 1998 and 2016, both the SCF and our modified Krueger *et al.* (2016) model show lower shares of income and consumption for the bottom two wealth quintiles and higher shares of both for the top two wealth quintiles. Thus, inequality in two-dimensions is increasing in both the data and the model. The share of income received by the top wealth quintile increased by 20.7 percent in the SCF between 1998 and 2016, while the Krueger *et al.* (2016) model predicts that it would only increase by 10.2 percent (Table 3). Moreover, the Krueger *et al.* model predicts a larger increase in two-dimensional inequality in consumption. The share of consumption by the top wealth quintile increased by 19.5 percent in the SCF while the Krueger *et al.* (2016) model predicts it would by 31.7 percent (Table 3). To compare these two-dimensional inequality measures to one-dimensional inequality we need the results from the SCF data shown in Figure 9. These figures show that the top shares of income and consumption increased by 10.6 and 14.7 percent, respectively. Hence, two-dimensional consumption inequality from the model increases more than the one-dimensional inequality in the data.

Overall, a standard real-business cycle model that replicates the high wealth inequality in the United States can generate increases in two-dimensional inequality that we observe. Thus, the model predicts increases in the correlation of wealth and consumption (and wealth and income) at the top that leads to increases in two-dimensional inequality. While the model underpredicts the increase in two-dimensional income inequality and overpredicts the increase in two-dimensional consumption inequality, these results help put our empirical results into context.

7. Conclusions

By presenting results using the conjoint distributions of income, consumption, and wealth for the same households, we improve our understanding of the breadth and depth of inequality in the U.S. Evaluating inequality using only income, consumption, or wealth understates the level and trend in inequality. The picture of inequality drawn here both aligns with previous research in that inequality is rising in all three dimensions, but the results also clarify the picture by incorporating the relationship between income, consumption, and wealth for the same households.

We are the first to impute consumption to the SCF for studying inequality and construct a new data series that contains income, consumption, and wealth, which incorporates the top of these distributions. Inequality in one dimension increased

since 1989 for income, consumption, and wealth; however, we find an even larger increase in inequality in two- and three-dimensions. The top five percent share of income (by income), for example, rose 15 percent between 1989 and 2016, while the share of income held by the those in the top five percent of wealth rose 26 percent (Figure 6). Also, the top five percent share of wealth (by wealth) rose 22 percent over that same period, while the share of wealth held by those in the top five percent of income and consumption rose 39 percent and 46 percent (Figure 7).

We can also see multidimensional inequality rising sharply based on the increasing overlap of households at the very tops of the distribution of multiple dimensions. For instance, in 1989, 33 percent of all households that were in the top 5 percent of income were also in the top 5 percent of consumption and wealth; by 2016 the share of households who were in the top five percent of income, consumption and wealth had risen to 44 percent (Figure 5).

Most concerning is the growing concentration of the most unequal component, wealth. The stock of wealth allows one to increase own income and/or consumption, and it gives the power to make strategic intergenerational transfers. Reeves (2017) emphasizes the growth of the top quintile share of income and its effects on the intergenerational mobility. Fisher *et al*. (2016) show the implications of inequalities in income, consumption, and wealth for intergenerational mobility.

One area for future research is to explore the off-diagonals in the quintile results. What types of households are in the top quintile of the income distribution but in the third quintile of lower in wealth and/or consumption? Here we focused on those households that are along the main diagonal, but there are still many off the diagonal, and these households need special attention. Another area of future work is to examine the results in OECD (2013) and Ruiz (2011) to incorporate the entire joint distributions in the trends in inequality in three-dimensions. Future real business cycle models should also expand on the modeling of multi-dimensional inequality that Krueger *et al*. (2016) began.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Appendix A: Imputation Methodology for Inequality in 3-D

Figure A1: Ratio of Reported Consumption to Total Consumption by After-Tax Income Ventile for the Survey of Consumer Finances and Consumer Expenditure Survey, 2016

Figure A2: Comparing Reported Food Consumption to Imputed Food Consumption in the Survey of Consumer Finances: 2004 and 2016

Figure A3: Comparing the Gini Coefficient when Always Imputing Food Consumption versus Imputing only when Food is not Reported in the Survey of Consumer Finances: 1989-2016

Table A1: Distribution of Households by Different Spending-to-Income and Savings Categories (2016)

Appendix B: Supporting Data Tables

Table B1: Data Supporting Key Multidimensional Inequality Results

Table B2: Data Supporting Multidimensional Inequality Results (using Public Data) for Top 1% (used in Mian *et al*. (2020b)

Appendix C: Simulation of inequality in two dimensions

Table C1: Shares by wealth quintile from Krueger *et al*. (2016)

Table C2: Annualized changes by wealth quintile from Krueger *et al*. (2016)

Table C3: Simulation of two-dimensional inequality using Krueger *et al*. (2016)