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

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Abstract

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. JEL Codes: D31, E21, I31.

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I. 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. We use income, consumption, and wealth from the 1989-2016 Surveys of Consumer Finances (SCF). 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%, 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.

We find that inequality in two dimensions and three dimensions increased. The percent of households in the top 5% of two resource measures and all three measures increased between 1989 and 2016, with 44 percent of households in the top 5% of income also in the top 5% of both consumption and wealth in 2016. The share of resources going

to the top 5% 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, Feng, Jenkins, and Larrimore (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, Pistaferri, and Preston, 2008; Attanasio and Pistaferri, 2014; Aguiar and Bils, 2015; Fisher, Johnson, and Smeeding, 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 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, Sierminska, and Smeeding (2008) focus on the middle and bottom of the distribution by studying the wealth of low- and middle-income populations cross-nationally. Smeeding and Thompson (2011) and Armour, Burkhauser, and Larrimore (2014) capitalize 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, and Violante (2010), Krueger, Mittman, and Perri (2016), and Ruiz (2011) come closest to our approach. Heathcote et al. (2010) present income, consumption, and wealth inequality together, but they use a different survey for each measure. Krueger, Mittman, and Perri (2016) use the Panel Study of Income Dynamics (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, Johnson, Latner, Smeeding, and Thompson (2016b).

We differentiate from these papers by going further in exploring multi-dimensional inequality. Moreover, we use the SCF to capture the top of the distributions, which are missed or top-coded in the PSID. The SCF is the only household survey in the United States to capture the entire income distribution, including the top centiles.

Our results will allow macroeconomic models to better model the underlying dynamics and heterogeneity across households. For instance, we build on the results in Kaplan, Violante, and Weidner (2014) by identifying that households are more than just low wealth or high wealth. Furthermore, our results can help calibrate macroeconomic models such as the ones found in Krusell and Smith (1998); Castenada, Diaz-Gimenez, and Rios-Rull (2003); Benhabib, Bisin, and Zhu (2011); Kaplan and Violante (2014); and, Krueger, Mitman, and Perri (2016).

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, 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, Johnson, Smeeding, and Thompson, 2015).

Stiglitz, Sen, and Fitoussi (2009) 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.[1] Finally, Blundell (2014), 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]

II. 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

[1] Ruiz (2011) presents a measure of multi-dimensional inequality in France but does not discuss the differences in trends.

[2] Attanasio and Pistaferri (2016) argue for a different dimension to inequality – leisure. They view inequality through the utility function rather than the budget constraint. They look at inequality in consumption and leisure one dimension at a time and do not consider the joint distribution.

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.

We start from the observation that income inequality is increasing, and we want to understand how this increase in income inequality could affect consumption inequality and wealth inequality. To frame a basic understanding, 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, Pistaferri, and Preston (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 is 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 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, Pistaferri, and Preston, 2008; and, 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, Johnson, and Smeeding, 2015). In the model of Blundell, Pistaferri, and Preston (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, Johnson, Latner, Smeeding, and Thompson (2016a, 2016b) use the PSID and show that the marginal propensity to consume 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, Guiso, Malacrino, and Pistaferri, (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, Gabriel, and Painter, 2009; Carroll, Otsuka, and Slacalek, 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, Johnson, and Smeeding, 2014).

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 absent an 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.

III. Data and Imputation Overview

Understanding the conjoint distribution requires having income, consumption, and wealth in the same survey. The Panel Study of Income Dynamics (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 Survey of Consumer Finances (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. By using the SCF that 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.[3]

III. A. The Survey of Consumer Finances

We use data from the ten waves of the Federal Reserve Board's triennial Survey of Consumer Finances (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.[4] TAXSIM is used to estimate taxes (Feenberg and Coutts, 1993). Our wealth measure captures unrealized capital gains. Wealth, or net worth, is assets less liabilities. Assets

[3] Bostic, Gabriel, and Painter (2009) impute consumption to the SCF to study housing and financial wealth effects.

[4] 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 I, presented here use after-tax income including capital gains.

include all financial assets and non-financial assets. 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. 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. To impute consumption, we use the Consumer Expenditure (CE) Survey.

III. B. The Consumer Expenditure Survey

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

III. C. 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.

III. D. 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 I). 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 IIA) and mean imputed consumption (Figure IIB) 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% of the income distribution, as expected based on Figure I.

The CE is known to underestimate some Personal Consumption Expenditure (PCE) categories and the overall PCE (Bee, Meyer, and Sullivan, 2014; Garner et al., 2006). As the SCF captures more consumption at the top of the distribution (Figure IIA and Figure IIB), 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 III). The SCF consumption Gini exceeds the CE consumption Gini in every year. When removing households in the top 1% and especially the top 5% 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.

IV. Inequality in 1-D, 2-D, and 3-D using the Top 5%

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% in

income and the top 5% of wealth. An increase in the percent of households in the top 5% 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% 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% of the income distribution. We present the share of wealth held by the top 5% of income. Inequality in two dimensions increases if the share of wealth held by the top 5% of income increases.

IV. A. 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% of the uni-dimensional income, consumption, and wealth distributions held 39 percent, 21 percent, and 65 percent (Figure IV). The SCF results are comparable to existing research (Piketty and Saez, 2003; Saez and Zucman, 2016). To be comparable to Piketty and Saez (2003), we show before-tax income shares in Figure IV. 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 IV match the differences in the Gini coefficient from Figure III, which is explained by the SCF better capturing the top.

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%, 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 I).

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 I). 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.

IV. B. 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% of two measures, which would be 5% if the top 5% of both measures contains the same households. In 1989, 2.6 percent of households were in the top 5% of both the income distribution and the wealth distribution (Figure V), meaning over half of the households that were in the top 5% of the income distribution were also in the top 5% of the wealth distribution.

We have three measures of two-dimensional inequality: income and wealth; wealth and consumption; and, consumption and wealth. The percent of households in the top 5% 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% 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.

We turn to the cross-shares, defined as the share of wealth held by the top 5% of the income distribution. Two comparisons interest us. Did the cross-share increase over time? Given the results of Figure V showing an increase in the percent of households in the top 5% 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% of the income distribution (cross-share) increase faster than the share of wealth held by the top 5% of the wealth distribution (own share)?

The top-left panel of Figure VI displays the share of income received by the top 5% of the income distribution, consumption distribution, and wealth distribution. In 2016, the top 5% of the income distribution received 34 percent of income, while the top 5% of consumption and the top 5% of wealth received 29 percent of income. The top 5% of consumption and the top 5% of wealth received a higher share of total income in 2016 than it received in 1989. The increases in these series of cross-shares represent an increase in two-dimensional income inequality.

The top-right panel in Figure VI 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 more or less steadily between 1989 and 2016.

We turn to whether the increase in two-dimensional inequality exceeds the increase in one-dimensional inequality. We find that the growth in inequality in two-dimensions exceeds the growth in inequality in one dimension for all two-way combinations. The share of income received by the top 5% of the income distribution increased by 15 percent between 1989 and 2016, while the share of income received by the top 5% of consumption increased by 27 percent (Figure VI). The share of income received by the top 5% of wealth-holders increased by 26 percent. Faster two-dimensional inequality growth is also seen for consumption and wealth.

We add context to our 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 VI. Those in the top 5% of income had mean income of $541,000 in 2016, while those in the top 5% of consumption had mean income of $457,000, and the top 5% of wealth had mean income of $465,000 (Table II).

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% of the income distribution growing 188 percent and mean income of the top 5% of consumption and top 5% of wealth growing 218 percent and 215 percent (Table II). 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% of consumption or wealth reinforces the finding that inequality is growing faster in two dimensions than in one dimension. Those in the top 5% of consumption experienced

greater income growth than those in the top 5% of the income distribution, and we see this pattern in every pair of measures.

IV. C. 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% of income, consumption, and wealth. We next present the share of income held by those in the top 5% of both the consumption and wealth distributions.

In 1989 1.7 percent of households were in the top 5% of income, consumption, and wealth (Figure VI), well below the percent of households in the top 5% of two of these three measures. By 2007 the share in the top 5% of all three measures increased to 2.5 percent, which is comparable to the percent of households in the top 5% of any two measures in 1989. Inequality in three dimensions in 2007 equaled the level of inequality in two dimensions in 1989. Another way to relate these results is that half of the households in the top 5% of one measure in 2007 are in the top 5% of all three measures. The top 5% was a much more exclusive group in 2007 than it was in 1989.

Since 2007, the percent of households in the top 5% of all three measures declined to 2.2 percent, but it still exceeds the 1989 level. The decline in the percent of households in the top 5% of all three measures indicates that the Great Recession uncoupled some of the relationship between income, consumption, and wealth.

Our second measure of three-dimensional inequality is the share of income held by those in the top 5% of consumption and wealth. The results in Figure VII show the one-dimensional share and the three-dimensional shares. The top-left panel displays the share of income by the top 5% of the income distribution and by those in the top 5% of

consumption and wealth. Those in the top 5% of the consumption and wealth distributions received 17 percent of the income in 1989, which is 57 percent of what the income received by the top 5% of the income distribution. Reflecting what we saw in the two-dimensional shares, the share of income received by those in the top 5% of consumption and wealth increased faster between 1989 and 2016 than the own share of income. Those in top 5% of consumption and wealth increased their share of income by 64 percent. The income own share increased by 15 percent. Inequality in three dimensions also increased faster than inequality in two dimensions.

The pattern continues when using consumption or wealth as the resource measure. The share of consumption for those in the top 5% of income and wealth increased 81 percent since 1989 (Figure VII). The share of wealth for those in the top 5% 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.

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% of consumption and wealth had mean income of $668,000 in 2016, which is higher than mean income of those in the top 5% of income (Table II). Similarly, those in the top 5% of income and wealth had higher mean consumption ($257,000) than those in the top 5% of consumption ($240,000). The difference is even more dramatic for wealth, with the top 5% of income and consumption holding $10.7 million in wealth on average, compared to $8.9 million for the top 5% 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 level and the growth in inequality in two and three dimensions. The conclusion is that the U.S. is becoming more economically unequal than is generally understood.

V. Inequality using Quintiles

While the top 5% 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.

V. A. 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 VIII). 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% gained shares since 1989, the bottom four quintiles all lost shares or at best were flat (Figure VIII). The bottom 20% only had 4.0 percent, 7.6 percent, and -.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.

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 VIII). 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.

V. B. 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 IX). 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 IX). The share of consumption for the middle quintile of income and the middle quintile of wealth fell 15 percent and 14 percent. 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 IX). These changes in wealth shares were primarily focused around the two financial crashes, between 1998 and 2001 and between 2007 and 2010. The middle quintiles lost shares of wealth during both of these financial crashes and never recovered. 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 IX). 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%. Identical calculations using the PSID show trends in two-dimensional inequality rising more than one-dimensional inequality (see Fisher, et al., 2016a).

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 IX). 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 VIII and IX 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 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.

VI. Conclusions

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. 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. Presenting 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. We construct a new data series that contains income, consumption, and wealth. Using the SCF incorporates the top of these distributions. Inequality in one dimension increased since 1989 for each income, consumption, and wealth. We find an even larger increase in inequality in two- and three-dimensions. For instance, in 2007, half of all households that were in the top 5% of income were also in the top 5% of consumption and wealth. In 2016, around 60 percent of households in the top 5% of wealth were also in the top 5% of income or the top 5% of consumption.

We also show that the gains since 1989 have accrued to the top quintile of the income, consumption, and wealth distributions. The bottom 80 percent lost shares of income, consumption, and wealth. The gains at the top have come at the expense of everyone else. The gains to the top quintile were even more dramatic in two-dimensions.

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, Johnson, Latner, Smeeding, and Thompson (2016a)

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.

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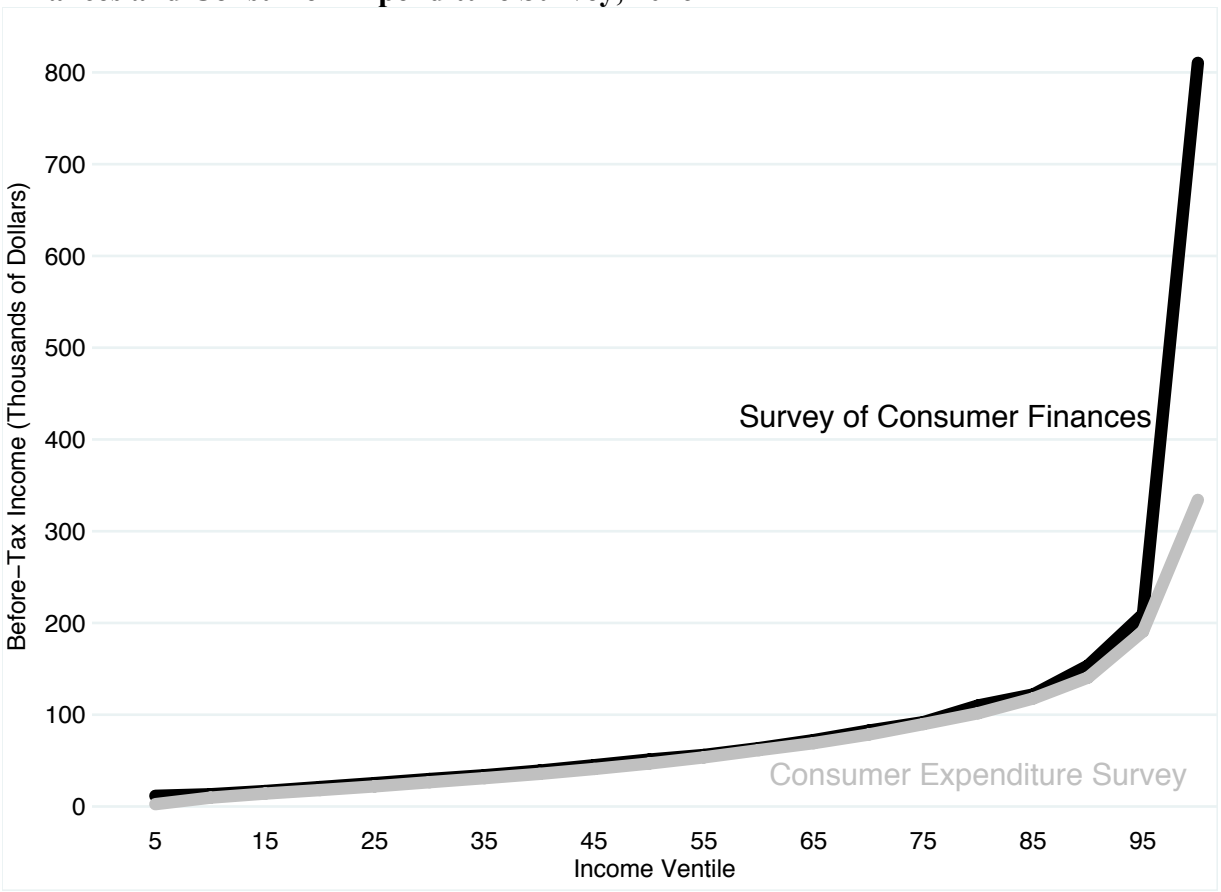
Figure I: Mean Before-Tax Income by Income Ventile in the Survey of Consumer Finances and Consumer Expenditure Survey, 2016



Sources: Consumer Expenditure Survey and Survey of Consumer Finances.
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.

Figure IIA: Mean Reported Consumption by Before-Tax Income Ventile in the Survey of Consumer Finances and Consumer Expenditure Survey, 2016

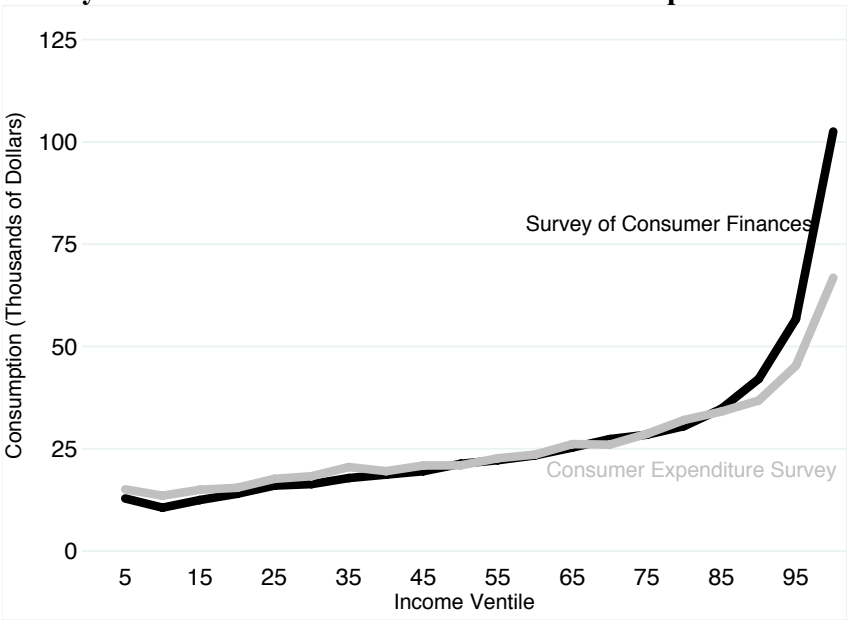
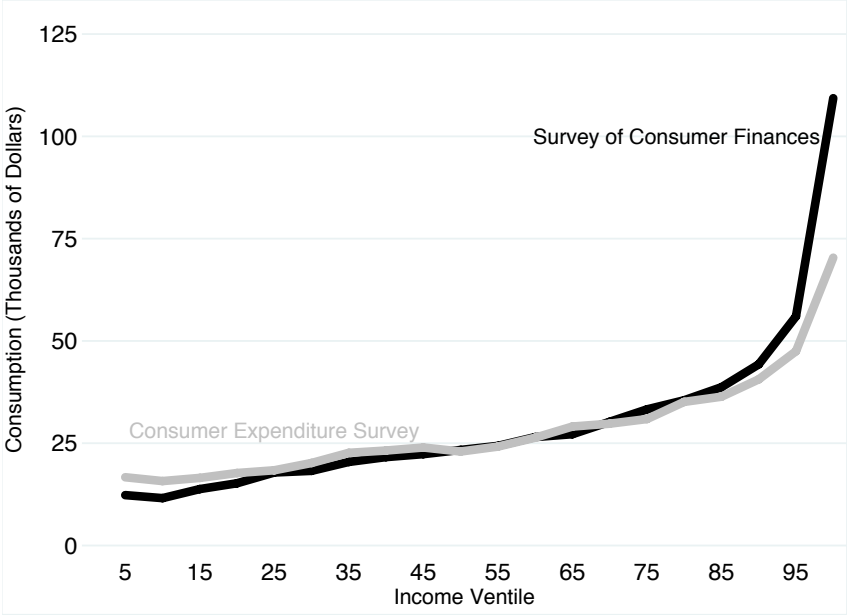
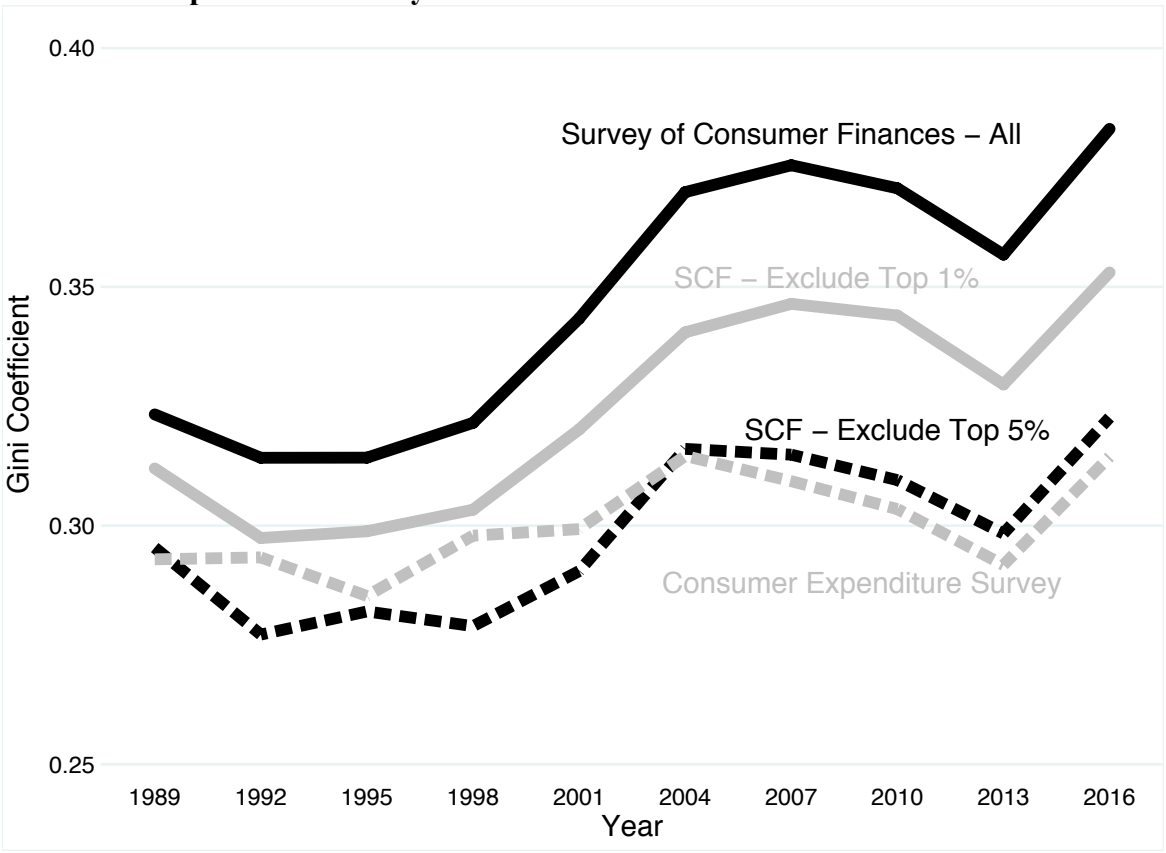


Figure IIB: Mean Imputed Consumption by Before-Tax Income Ventile in the Survey of Consumer Finances and Consumer Expenditure Survey, 2016



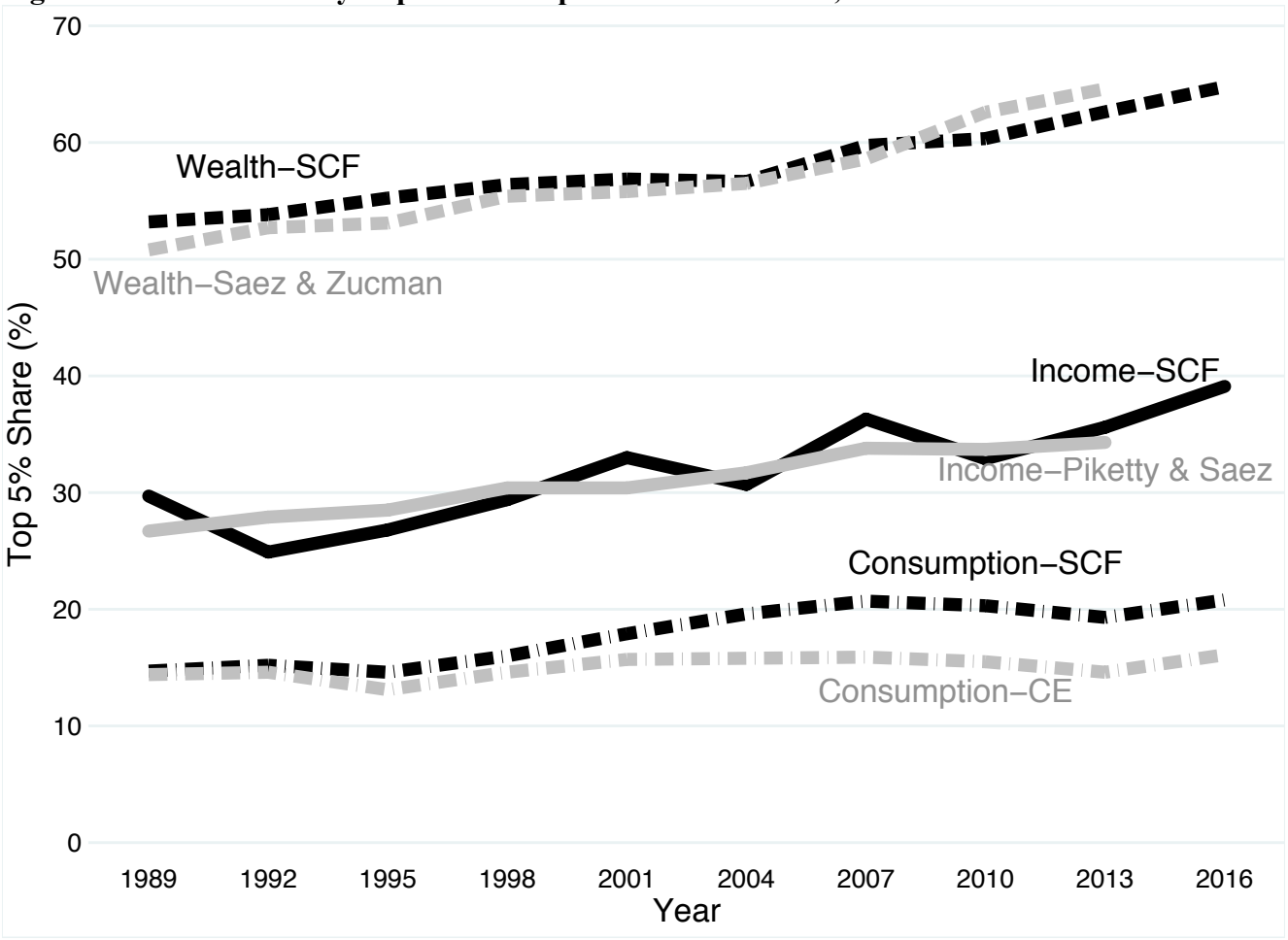
Sources: Consumer Expenditure Survey and Survey of Consumer Finances.
Notes: The top figure shows the consumption components reported in the SCF. The bottom figure shows mean imputed consumption by income ventile.

Figure III: Consumption Gini in the Survey of Consumer Finances and the Consumer Expenditure Survey: 1989-2016



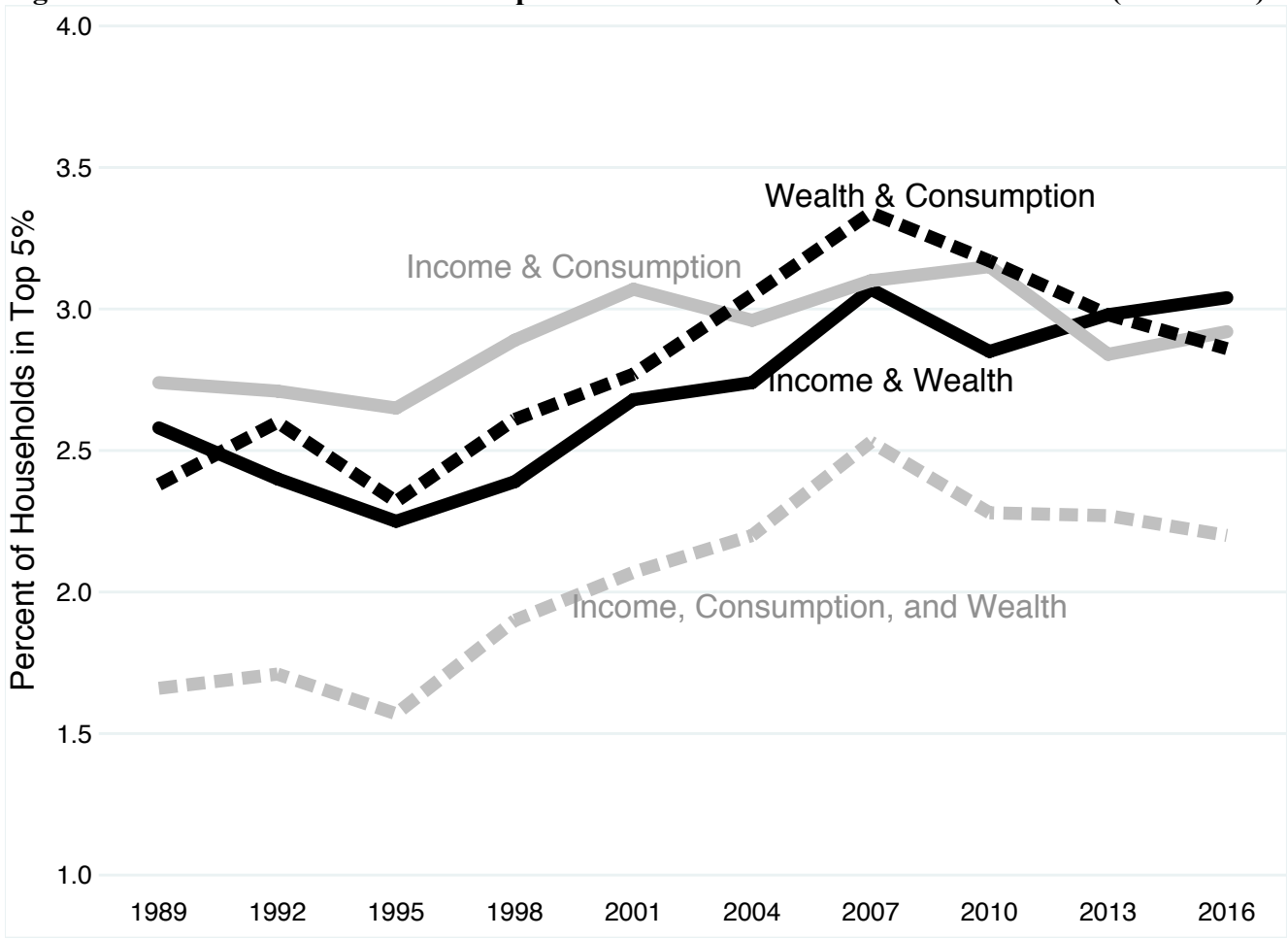
Sources: Survey of Consumer Finances and Consumer Expenditure Survey
Notes: The line excluding the top 5% removes the top 5% of the income distribution from the SCF and then calculates the Gini coefficient for consumption in the SCF. The sample excluding the top 5% from the SCF attempts to mimic the sample in the CE.

Figure IV: Shares Held by Top 5% of Respective Distributions, 1989-2016



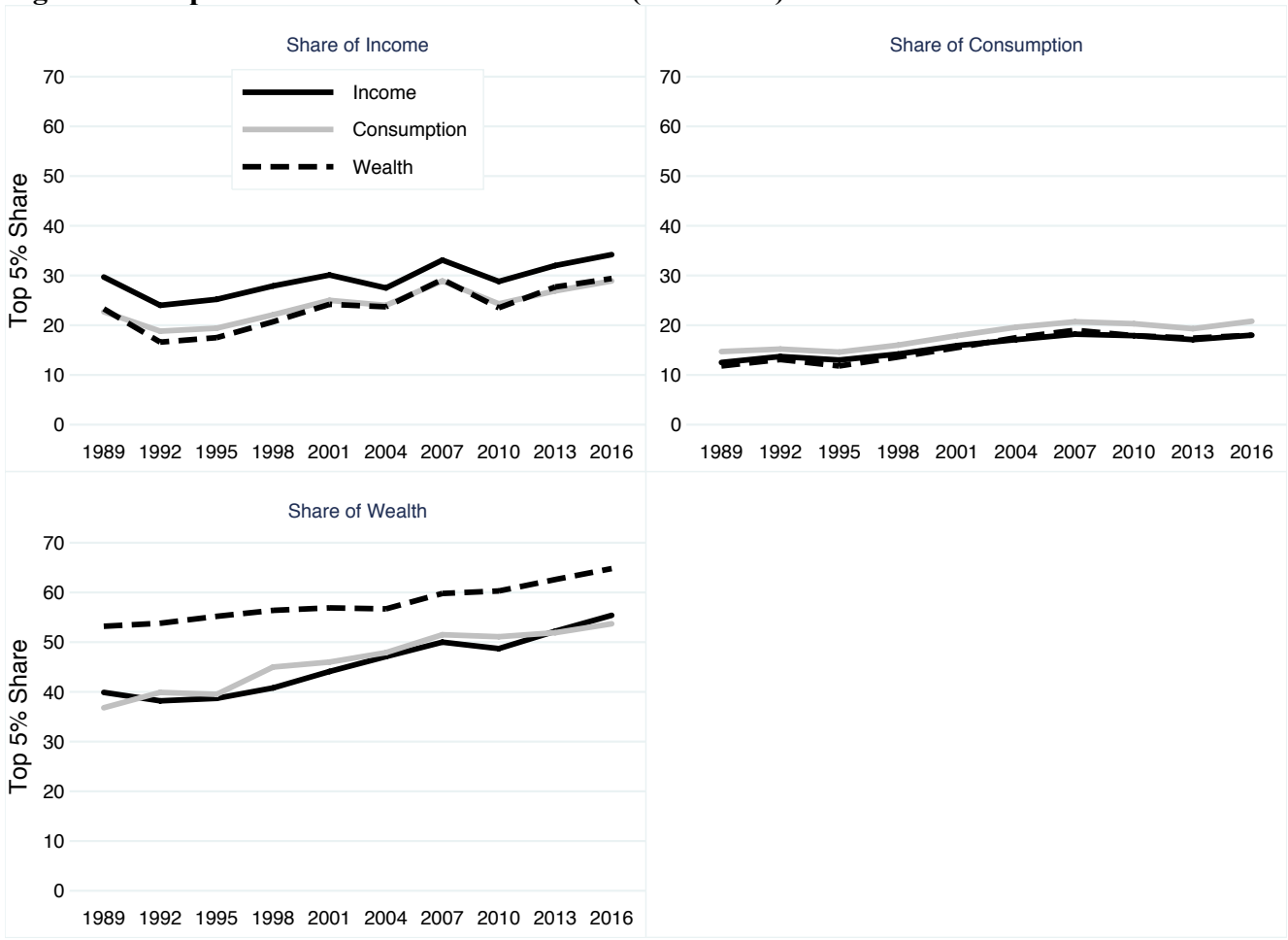
Sources: Survey of Consumer Finances and Consumer Expenditure Survey
Notes: The non-SCF wealth shares come from Saez and Zucman (2016). The Saez and Zucman (2016) series ended in 2012. We used the 2012 number for 2013 in the figure above. The non-SCF income shares come from Piketty and Saez (2003) and from updates on the World Wealth and Income Database (http://www.wid.world/).

Figure V: Percent of Households in Top 5% of Two Measures and Three Measures (1989-2016)



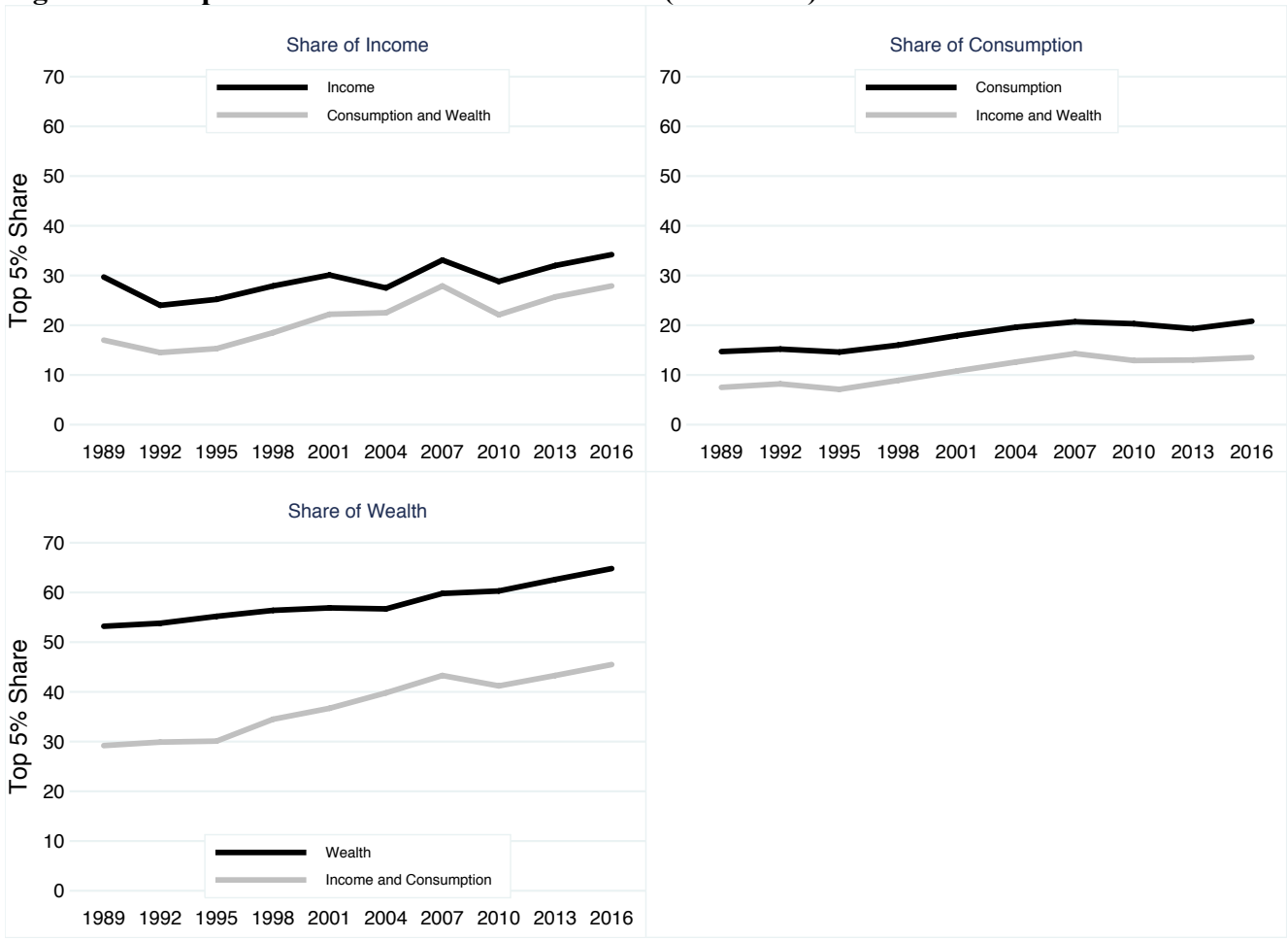
Source: Survey of Consumer Finances, 1989-2016.

Figure VI: Top 5% Shares in Two-Dimensions (1989-2016)



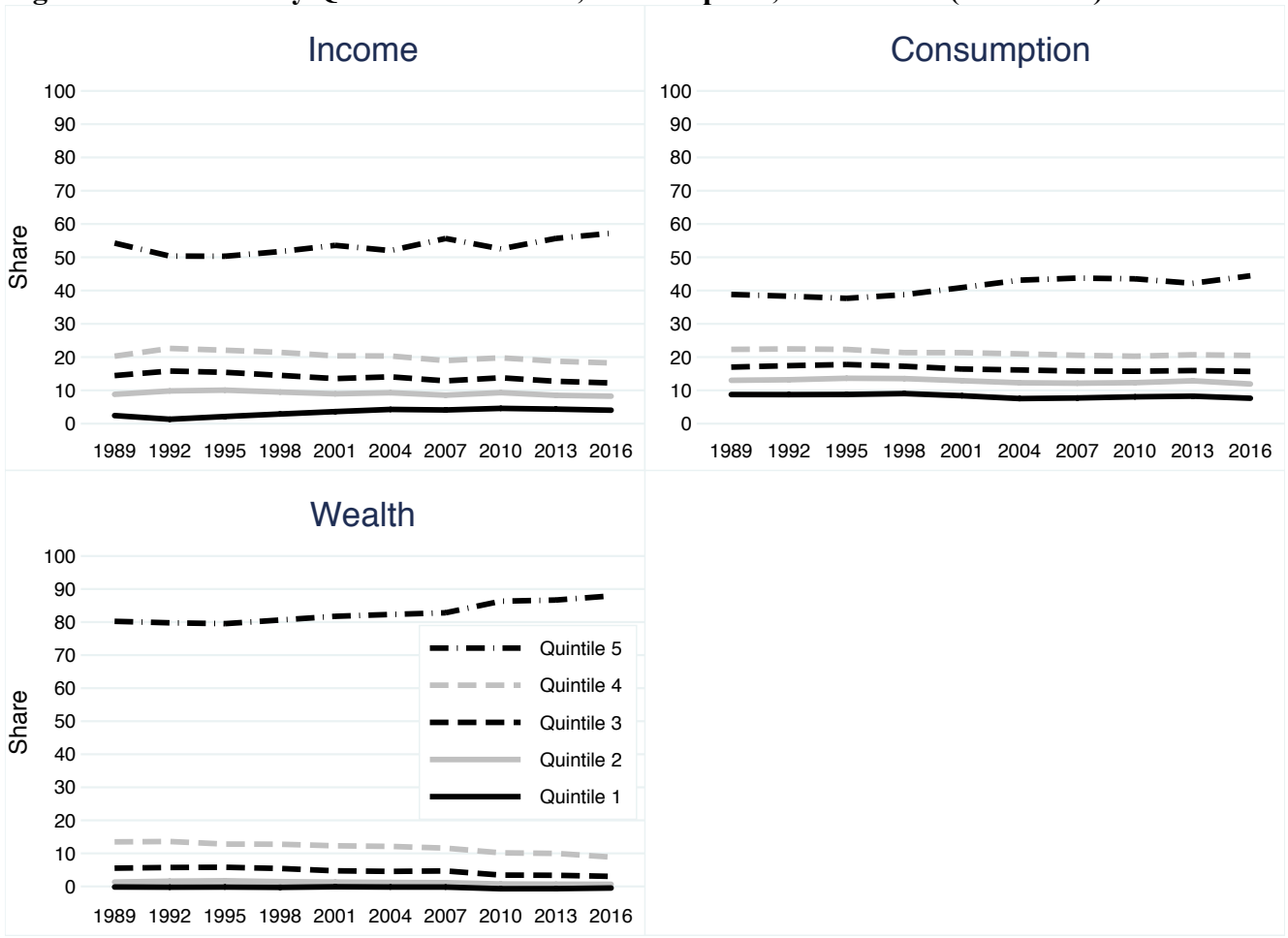
Notes: The top-left panel shows the share of income held by the top 5% of the income distribution, the top 5% of the consumption distribution, and the top 5% of the wealth distribution. The top-right panel shows the share of consumption of the top 5% of the three distributions. The bottom-left panel shows the share of wealth of the top 5% of the three distributions.

Figure VII: Top 5% Shares in Three-Dimensions (1989-2016)



Notes: The top-left panel shows: the share of income held by the top 5% of the income distribution and the share of income held by those in the top 5% of both consumption and wealth. The other two panels show similar results but using the share of consumption or the share of wealth.

Figure VIII: 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.

Figure IX: Shares by Quintile in Two Dimensions (1989-2016)

Bottom Quintile

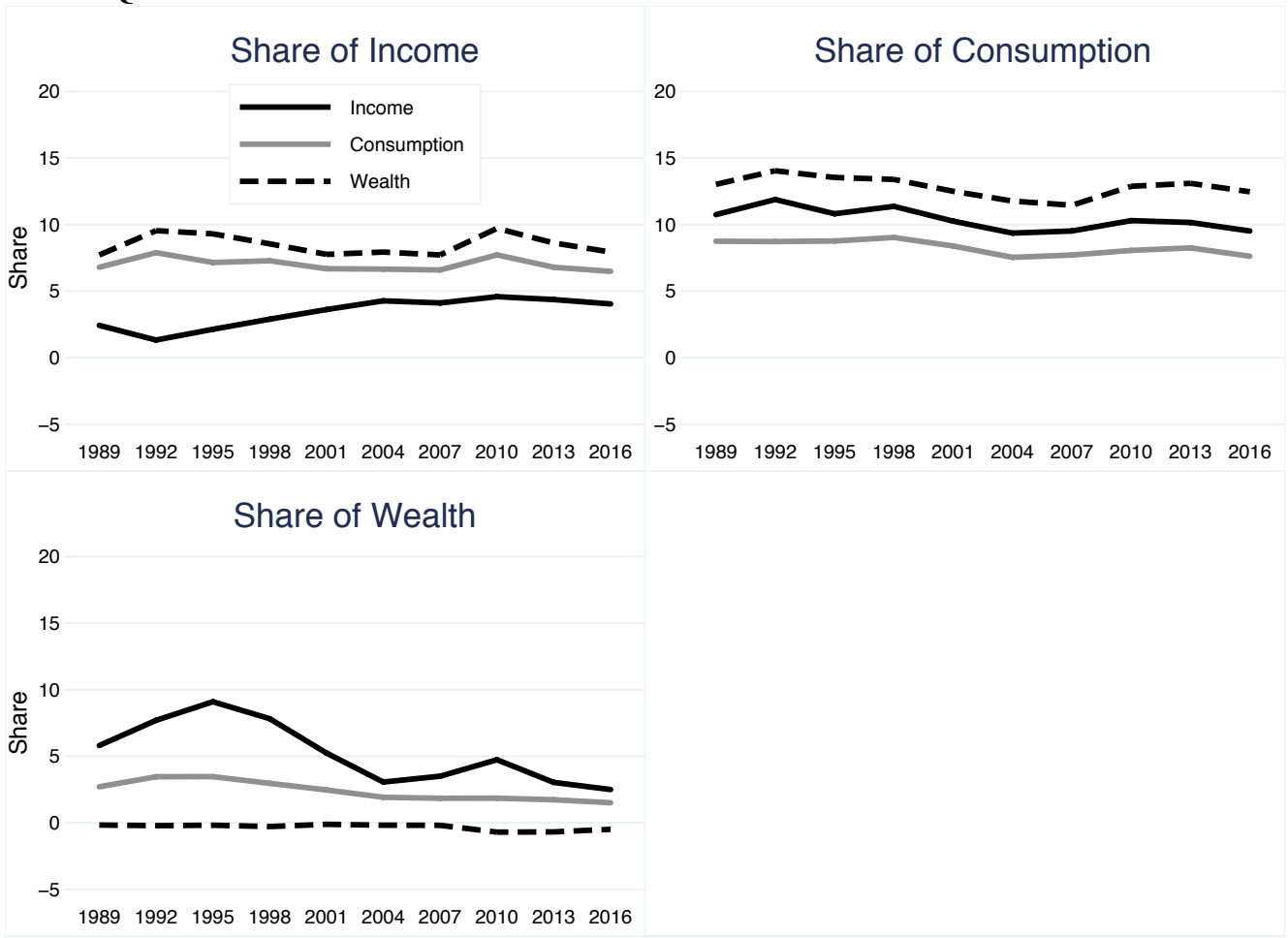


Figure IX continued: Shares by Quintile in Two Dimensions (1989-2016)

Middle Quintile

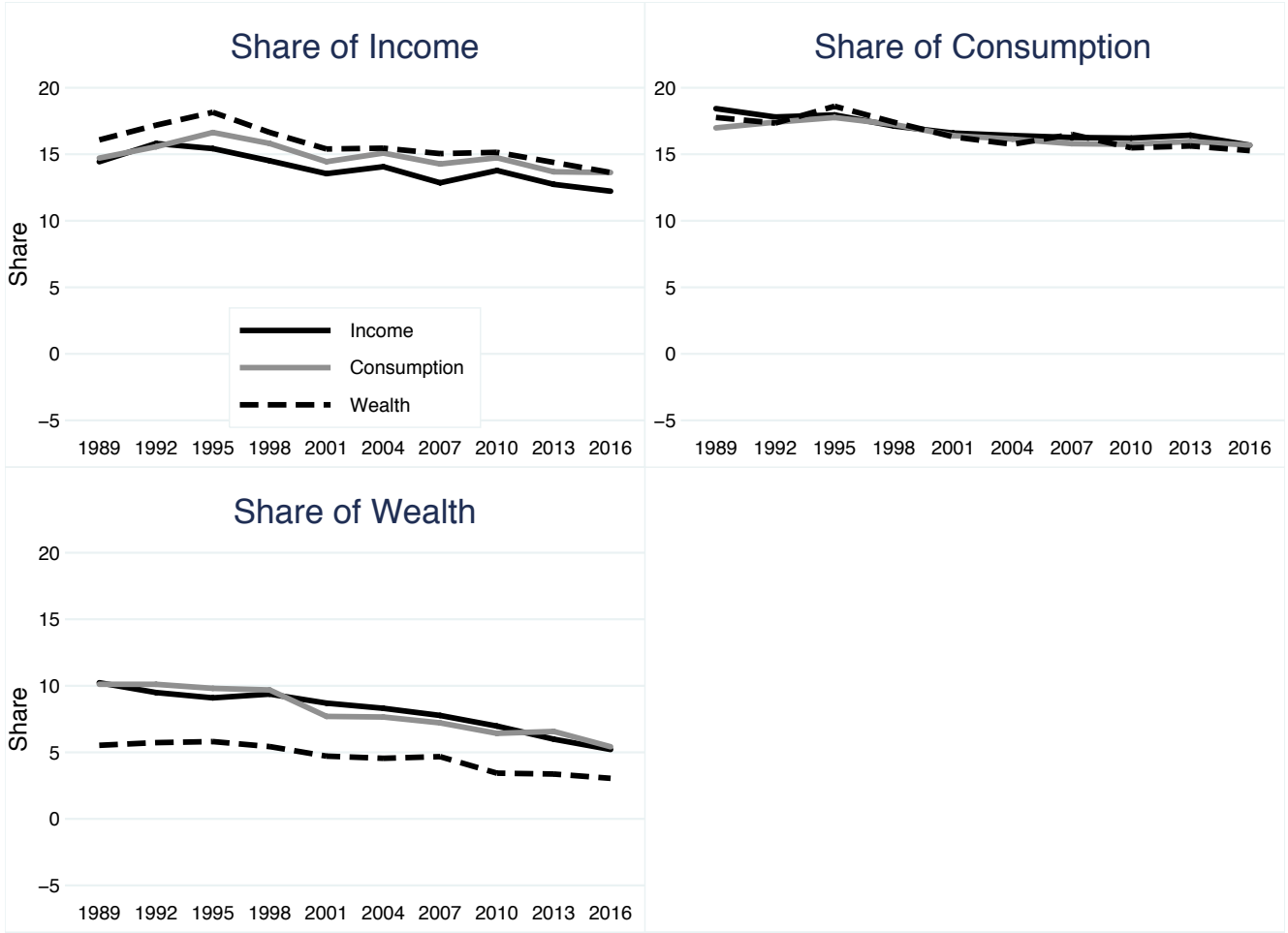
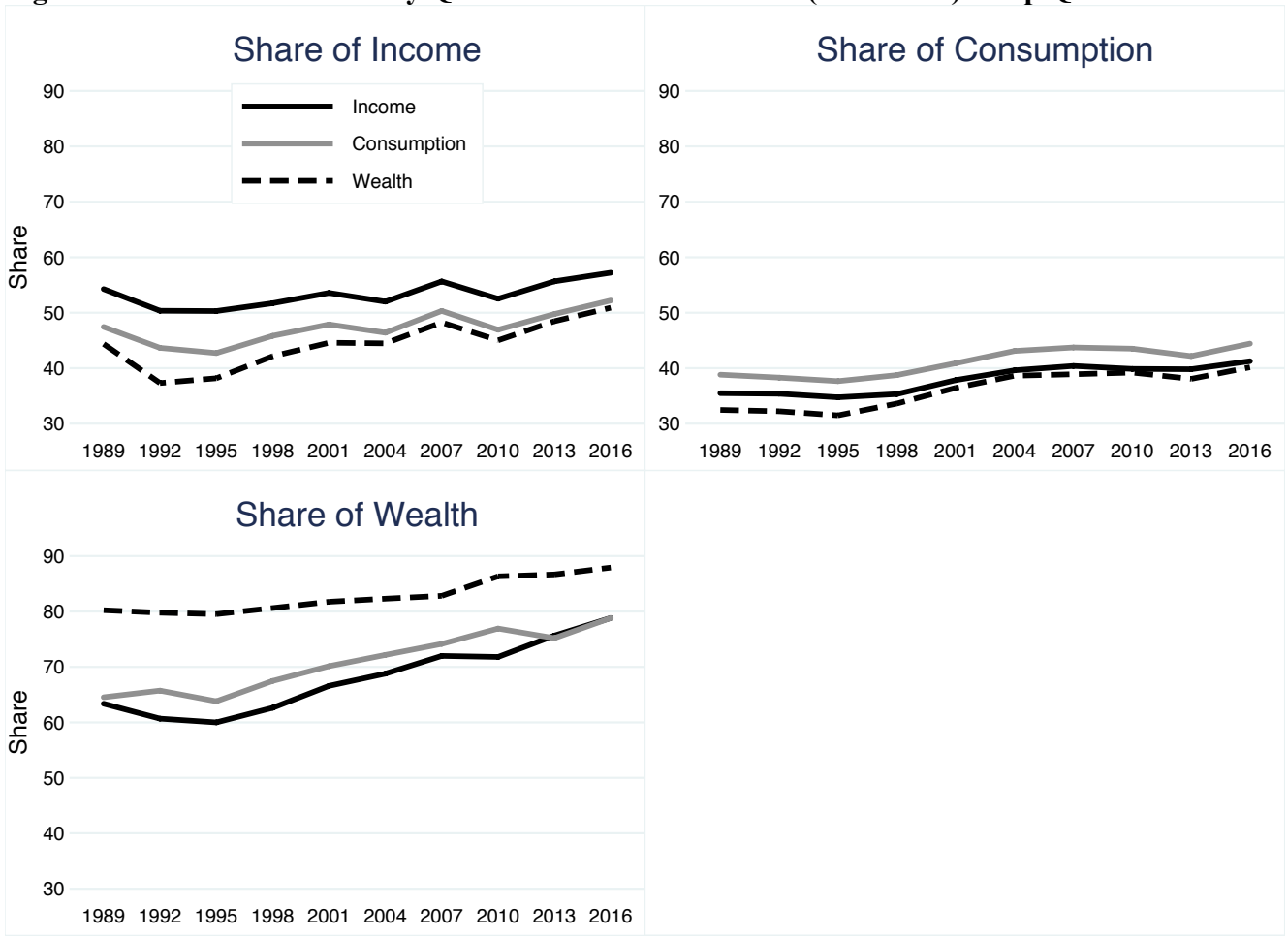


Figure IX continued: Shares by Quintile in Two Dimensions (1989-2016) - Top Quintile



Notes: The top-left panel shows 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

Table I: Income, Consumption, and Wealth at the 10th, 50th, and 95th Centiles (1989-2016)

Pre-tax income	1989	1992	1995	1998	2001	2004	2007	2010	2013	2016
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	896,325	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

Table II: Mean Income, Consumption, and Wealth for Top 5% of Various Distributions
Panel A: After-Tax

Income	In Top 5 by:			
	Income	Consumption	Wealth	Wealth & 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	In Top 5 by:			
	Income	Consumption	Wealth	Wealth & 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 In Top 5 by:

	Income	Consumption	Wealth	Income & 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

Appendix on Imputation Methodology for Inequality in 3-D

We impute only the components of consumption not already asked in the SCF. The Survey of Consumer Finances (SCF) includes spending questions every year for vehicles and housing. Since 2004, the SCF also asks about spending on food. We refer to the components of consumption that are included in the SCF as reported consumption. The consumption items that are reported in the SCF account for 47 percent of total 2016 consumption in the Consumer Expenditure (CE) Survey. We use a multiple imputation approach to consumption, following the SCF's own multiple imputation approach for missing components of income.

We do not impute the level of consumption. Instead we impute the ratio of reported consumption to total consumption. In the CE, we create this ratio and use the ratio as the dependent variable in our imputation model. We use the coefficients from the CE to predict the share of total consumption that is reported in the SCF. We then use reported consumption in the SCF and divide it by the imputed share to arrive at total imputed consumption.

We impute using the ratio of reported consumption to total consumption instead of imputing the level of consumption directly because consumption levels rise very sharply as we climb to the top parts of the income distribution. The levels of observed consumption are dramatically higher at the top of the distribution in the SCF than they are in the CE (Figure IIa). By contrast, the share of total consumption allocated to those categories observed in both surveys is more stable even up to the very highest part of the distribution (Figure AI).

The independent variables include a suite of demographic (e.g., age, race, education, marital status, household size, and numbers of children and elderly) and geographic characteristics (urban status and Census division). The log of income and an indicator for location within thirds of the income distribution are included, along with indicators for whether the household reported: negative income, receiving government transfer income, receiving wage or salary income, receiving positive capital income (e.g., interest and dividends), and receiving negative capital income. The consumption components available in the SCF are also included as independent variables.

One aspect of the SCF we utilize in our imputation is the series of questions regarding spending relative to income. The SCF asks: "over the past year, would you say that your spending exceeded your income, that it was about the same as your income, or that you spent less than your income?" Respondents are asked to exclude any investments made and to treat the net pay down of debt as spending less than income. For those that purchased a home or automobile in the previous year, they are asked to leave aside those expenses in answering the question.

The CE does not ask a similar question. Instead we create the variable in the CE to match the SCF weighted totals. We take the observed percentage of households in each group from the SCF and assign the same approximate percentage of CE households. In practice, this means that any household reporting consumption being less than 80% of after-tax income is classified as spending less than income. Those that spend more than income are those reporting consumption at least 120% of income. Those spending about the same as income are those spending between 80% and 120% of income.

Separate imputation equations are estimated for the three spending-to-income groups. Imputed consumption in the SCF is not constrained to be within these specific bands. In this way, we use the spending-to-income groups as noisy indicators of consumption rather than as strict limits. Mean and median spending relative to income is higher in the SCF group that reported spending is larger than income, but there is overlap in the distribution of spending-to-income among the three groups.

The SCF question about spending relative to income has only been in the survey since 1992. During all years of the survey, however, there is a different variable that asks about saving behavior, whether people save regularly, only on occasion with no plan, or do not save at all. The saving question is distinct from, but highly correlated with the direct spending-to-income variable (Table AI). For the trends in imputed consumption and inequality in the various figures and tables in the paper the 1989 SCF consumption values are based on imputations using the savings behavior variables. Imputation results are similar if we use the savings behavior variable for all years instead of just for 1989.

Food has been shown in other studies to be vital to understanding and predicting overall consumption (Skinner, 1987; Blundell, Pistaferri, and Preston, 2006; and, Browning, Crossley, and Winter, 2014). Our imputation confirms the importance of food, as it appears to be the single-most powerful variable in predicting the ratio of reported consumption to total consumption. Because it is not present in all years of the SCF, we first impute food consumption when it is not present in the SCF.

The food imputation equation differs from the main consumption imputation. We impute the level of food spending but estimate separate models by the level of income. We found that we achieved the best fit for food across the full distribution by using

different models for the bottom, middle, and top thirds of the income distribution. To provide a consistent food series over time, we impute food even in the years it is reported in the SCF. The resulting imputed food spending matches reported food spending well (Figure AII).

The imputation of food and treating the imputation as reported consumption has only a modest effect on our basic inequality results. Figure AIII shows the trend in the Gini coefficient using reported food spending versus imputed food spending. Gini coefficients for consumption in the SCF using food spending reported by respondents are between one and three percentage points higher (.39 compared to .40 in 2016) than those calculated using predicted food spending in the imputation. The trends in the Gini coefficient, however, are the same for both approaches to food. In the results, we show throughout the paper, we use the imputations that rely on predicted food for all SCF years.

References

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Browning, Martin, Thomas F. Crossley, and Joachim Winter, "The Measurement of Household Consumption Expenditures, *The Annual Review of Economics*, Volume 6 (2014).

Skinner, J. "A Superior Measure of Consumption from the Panel Study of Income Dynamics," *Economics Letters* 23 (1987).

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

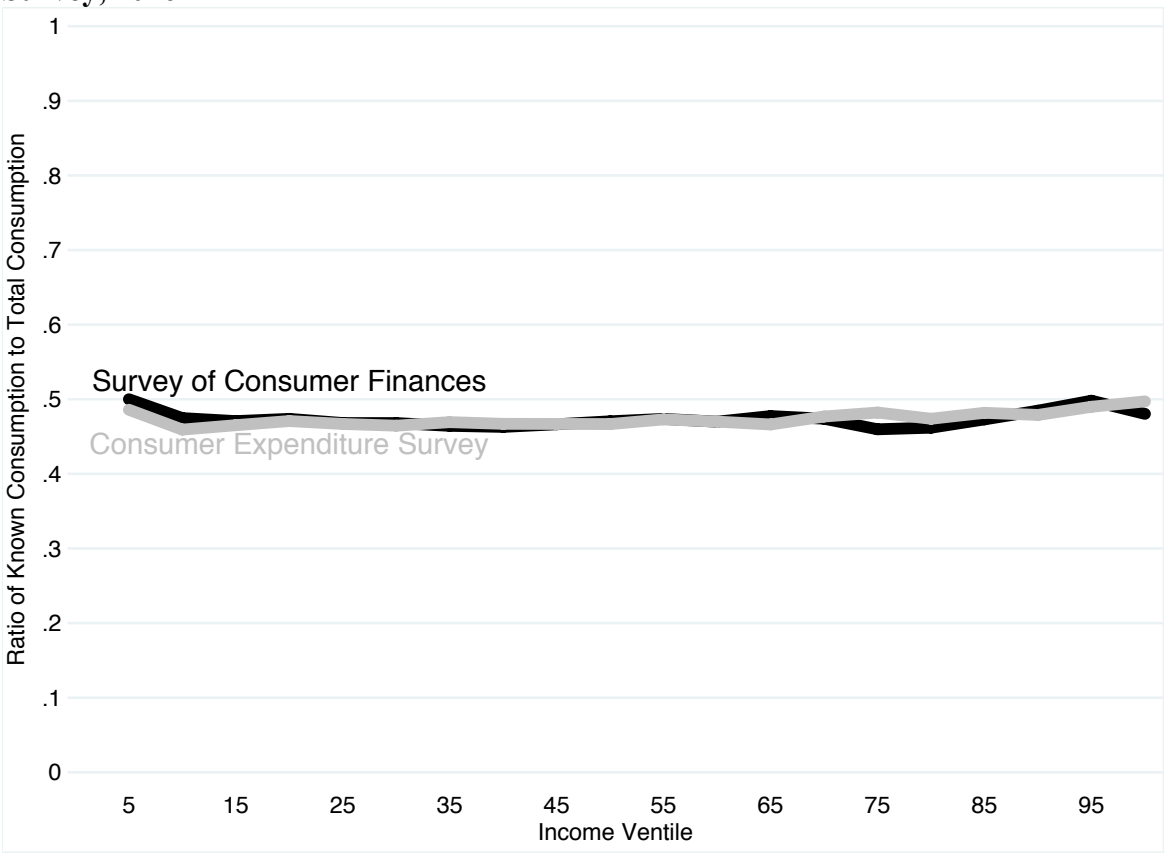

Figure AII: Comparing Reported Food Consumption to Imputed Food Consumption in the Survey of Consumer Finances: 2004 and 2016

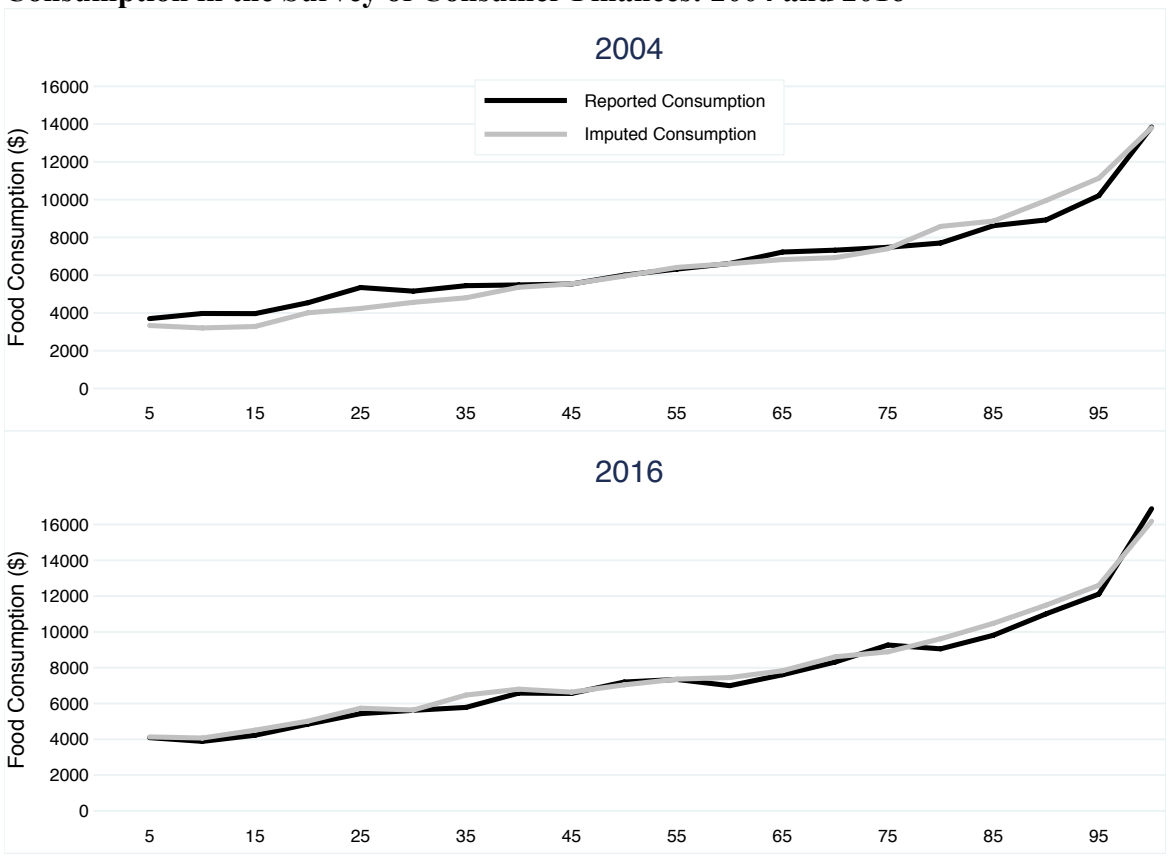

Figure AIII: Comparing the Gini Coefficient when Always Imputing Food Consumption versus Imputing only when Food is not Reported in the Survey of Consumer Finances: 1989-2016

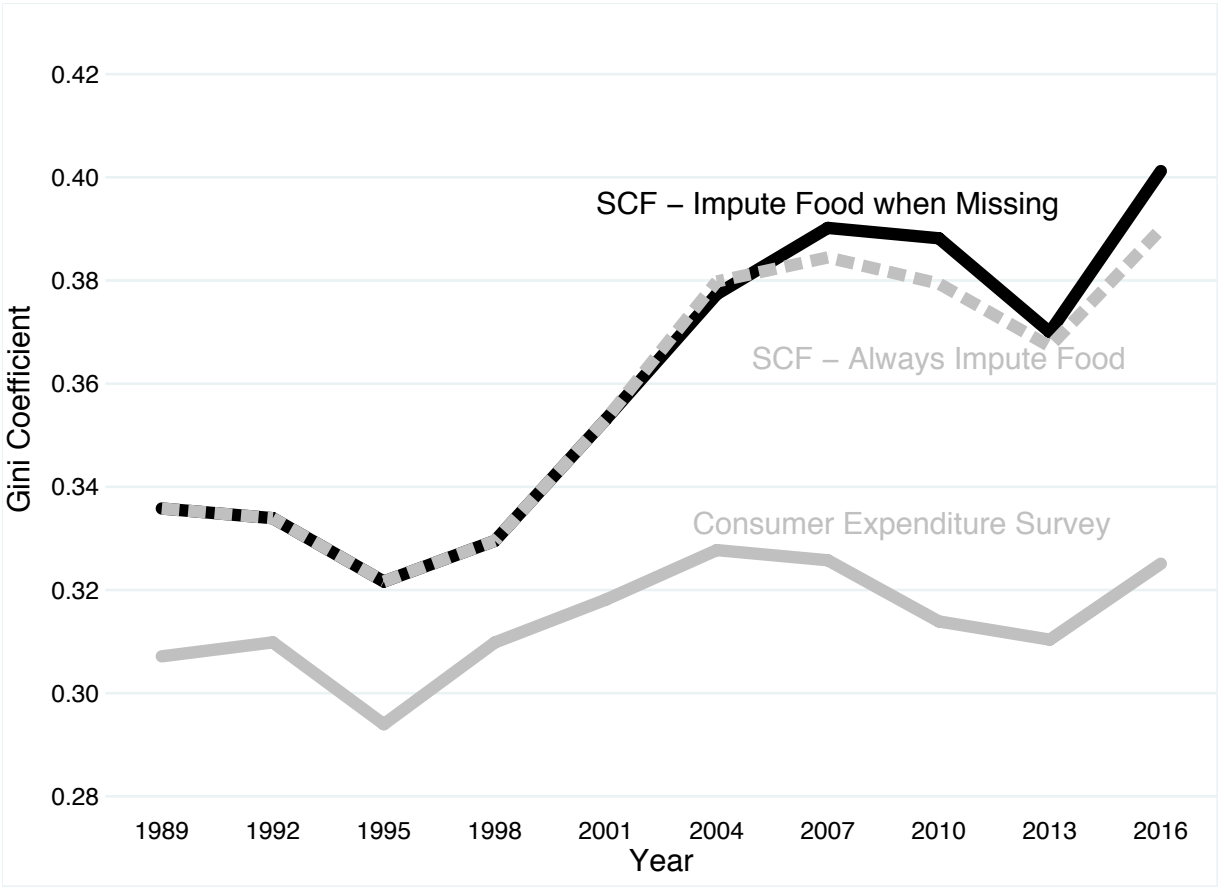

Table AI: Distribution of Households by Different Spending-to-Income and Savings Categories (2016)

	Saving behavior			
Spending-to-income category	Regular Saving	No plan, occasional saving	No Saving	Total
Spending is less than income	31.0%	13.2%	1.9%	46.1%
Spending is same as income	11.5%	13.7%	11.3%	36.5%
Spending is more than income	4.5%	5.2%	7.7%	17.5%
Total	47.0%	32.1%	20.9%	100.0%

Source: Survey of Consumer Finances