

Inequality of Income *and* Consumption:
Measuring the Trends in Inequality from 1985-2010 for the Same Individuals

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“The year 2011 will be remembered as the year when the idea of income inequality migrated from seminar rooms in colleges and think tanks to Zuccotti Park and main streets across America.”

Senior Fellow Isabel Sawhill, The Brookings Institution, April 2012

“What is making people sit up now is recent evidence that the richest 1 percent of American families appears to have reaped most of the gains from the prosperity of the last decade and a half.”

Columnist Sylvia Nasar, *The New York Times*, March 1992

I. Introduction: Income and Consumption

The *2012 Economic Report of the President* stated: “The confluence of rising inequality and low economic mobility over the past three decades poses a real threat to the United States as a land of opportunity.” This view was also repeated in a speech by Council of Economics Advisors Chairman, Alan Krueger (2012). President Obama suggested that inequality was “...the defining issue of our time...” As suggested by Isabel Sawhill (2012), 2011 was the year of inequality.

While there has been an increased interest in inequality, and especially the differences in trends for the top 1 percent vs. the other 99 percent, this increase in inequality is not a new issue. Twenty years ago, Sylvia Nasar (1992) highlighted similar differences in referring to a report by the Congressional Budget Office (CBO) and Paul Krugman introduced the “staircase vs. picket fence” analogy (see Krugman (1992)). He showed that the change in income gains between 1973 and 1993 followed a staircase pattern with income growth rates increasing with income quintiles, a pattern that has been highlighted by many recent studies, including the latest CBO (2011) report. He also showed that the income growth rates were similar for all quintiles from 1947-1973, creating a picket fence pattern across the quintiles.

Recent research shows that income inequality has increased over the past three decades (Burkhauser, et al. (2012), Smeeding and Thompson (2011), CBO (2011), Atkinson, Piketty and Saez (2011)). And most research suggests that this increase is mainly due to the larger increase in income at the very top of the distribution (see CBO (2011) and Saez (2012)). Researchers, however, dispute the extent of the increase. The extent of the increase depends on the resource measure used (income or consumption), the definition of the resource measure (e.g., market income or after-tax income), and the population of interest.

This paper examines the distribution of income and consumption in the US using data that obtains measures of both income and consumption from the same set of individuals and this paper develops a set of inequality measures that show the increase in inequality during the past 25 years using the 1984-2010 Consumer Expenditure (CE) Survey.

The dispute over whether income or consumption should be preferred as a measure of economic well-being is discussed in the National Academy of Sciences (NAS) report on poverty measurement (Citro and Michael (1995), p. 36). The NAS report argues:

“Conceptually, an income definition is more appropriate to the view that what matters is a family’s ability to attain a living standard above the poverty level by means of its own resources.... In contrast to an income definition, an expenditure (or consumption) definition is more appropriate to the view that what matters is someone’s actual standard of living, regardless of how it is attained. In practice the availability of high-quality data is often a prime determinant of whether an income- or expenditure-based family resource definition is used.”

We agree with this statement and we would extend it to inequality measurement.¹ In cases where both measures are available, both income and consumption are important indicators for the level of and trend in economic well-being. As argued by Attanasio, Battistin, and Padula

¹ Borooah and McGregor (1992) suggest that consumption should be used as a measure of the standard of living and that income should be used as a measure of the level of resources. Others may argue that net worth is an equally important measure of well-being. For an attempt to capture the flow value of net worth and income but not consumption, see Smeeding and Thompson (2011).

(2010) “...the joint consideration of income and consumption can be particularly informative.”

Both resource measures provide useful information by themselves and in combination with one another. When measures of inequality and economic well-being show the same levels and trends using both income and consumption, then the conclusions on inequality are clear. When the levels and/or trends are different, the conclusions are less clear, but useful information and an avenue for future research can be provided.

We examine the trend in the distribution of these measures from 1985 to 2010. We show that while the level of and changes in inequality differ for each measure, inequality increases for all measures over this period and, as expected, consumption inequality is lower than income inequality. Differing from other recent research, we find that the trends in income and consumption inequality are similar between 1985 and 2006, and diverge during the first few years of the Great Recession (between 2006 and 2010). For the entire 25 year period we find that consumption inequality increases about two-thirds as much as income inequality. We show that the quality of the CE survey data is sufficient to examine both income and consumption inequality. Nevertheless, given the differences in the trends in inequality, using measures of both income and consumption provides useful information. In addition, we present the level of and trends in inequality of both the maximum and the minimum of income and consumption. The maximum and minimum are useful to adjust for life-cycle effects of income and consumption and for potential measurement error in income or consumption. The trends in the maximum and minimum are also useful when consumption and income alone provide different results concerning the measurement of economic well-being.

Our analysis differs from the most recent studies of consumption inequality (Heathcote, et al. (2010), Perri and Steinberg (2012), Attanasio et al. (2012), and Meyer and Sullivan (2009))

by not restricting the sample to specific demographic groups, by using a more complete measure of consumption, and by using measures of income and consumption that are consistent with each other, where both income and consumption are taken from the same households in a single survey. Previous studies (e.g., Attanasio, et al. (2012) and Heathcote, et al. (2010)) restrict their samples to the working age population and use only a subset of consumption, and Meyer and Sullivan (2009) remove health care and education from consumption. Our study contributes to the literature by providing a more complete measure of consumption without sample restrictions that is better linked to disposable income, in order to more fully capture the levels and trends in the distribution.

The paper is organized as follows. The second section of the paper evaluates the issues associated with choosing a measure of economic well-being to assess the level of and trend in inequality and examines the recent literature on inequality measurement. Section three presents our methodology, our measures of income and consumption, and a description of the CE Survey data. The fourth section presents the levels of and trends in inequality and the fifth section discusses the implications for measurement error. Next we present our maximum and minimum approach designed to bound inequality measures. The final section concludes this paper.

II. Recent Literature on Consumption and Income Inequality

Most inequality studies use annual income data (e.g., Burkhauser, et al. (2012), CBO (2011), Atkinson, Piketty, and Saez (2011), Karoly (1993), Thompson and Smeeding (2012), Smeeding and Thompson (2011), Gottschalk and Smeeding (1997)). There is agreement that inequality increased using various measures of income, but the magnitude of the increase depends on the income measure used and the unit of observation. For example, the Census Bureau estimates that the inequality, using the Gini coefficient, of pre-tax cash income for

households (adjusted for family size) increased 19 percent between 1979 and 2010. CBO (2012) estimates an increase of 21.6 percent for market income inequality (between 1979 and 2009) and a 19.0 percent increase in the inequality for after-tax-and-transfer income. Finally Saez (2012), using the share of taxable income obtained by the top 1 percent, shows that the share of income obtained by the top 1 percent doubled between 1979 and 2009.

A difficulty with using annual income to measure inequality is that if everyone goes through a life-cycle current-income path in which income is low when young, higher in middle age, and low again when old, then annual snapshots of income would suggest greater inequality than that which actually exists in permanent income. It could be that all visible differences in the level of and trend in inequality may be attributable to demographics alone.² In addition, people may experience many transitory changes in income that would cause the distribution of annual income to indicate more inequality than actually exists. Gottschalk and Moffitt (2009) find that about one-half of the increase in income inequality during the 1980s resulted from changes in transitory income.³ Thus, annual income may be a poor proxy for permanent income.

Economists have suggested that consumption may be a more appropriate indicator of permanent income (see Slesnick (1994), Cutler and Katz (1991), Johnson and Shipp (1997), Johnson, Smeeding and Torrey (2005), and Krueger and Perri (2006)). Slesnick (2001), Cutler and Katz (1991), and Danziger and Tausig (1979) were among the first to show different trends in income and consumption inequality. The two former studies demonstrated that consumption inequality was lower than income inequality, and that the increase in both income and consumption inequality was similar during the 1980s. Krueger and Perri (2006) identify the

² Deaton and Paxson (1994) discuss the importance of life-cycle effects in inequality measurement.

³ They show that while the increase in transitory variance explains about a quarter of the increase in inequality between 1974-1990, during the 1990s the permanent variance falls, and hence, between 1974 and 2000, the increase in transitory variance explains about 60% of the increase in inequality.

divergent trends in income and consumption inequality during the 1990s.⁴ Most recent research shows that consumption inequality is less than income inequality, and its increase is less than the increase in income inequality (see Krueger and Perri (2006), Heathcote, Perri and Violante (2010), Blundell, Preston, and Pistaferri (2008), Petev, Pistaferri and Eksten, (2011), Meyer and Sullivan (2009), Johnson and Shipp (1997)). A key similarity among these studies is that much of the increase in consumption inequality occurred in the early 1980s. Heathcote, Perri and Violante (2010) find that between 1980 and 2006, income inequality increases about twice as much as consumption inequality. However, restricting the data to the change between 1985 and 2005 yields similar increases in inequality.

Three studies find similar increases in consumption and income inequality by adjusting the CE Interview Survey data, which is used by most research on consumption inequality, or by using an alternative data source. First, Attanasio, et al. (2006) use the CE Diary Survey (a weekly record of expenditures) to calculate inequality, and find that consumption inequality rises much more rapidly than that using the standard CE Interview Survey. Second, Aguiar and Bils (2011) adjust the expenditure data in the CE Interview Survey for underreporting by using the Engel curves estimated using the 1972-73 CE Interview Survey and obtain larger increases in inequality, with consumption inequality increasing about the same rate as income inequality between 1980 and 2007. Third, Attansio, et al. (2012) estimate consumption in the Panel Study of Income Dynamics (PSID) using various methodologies and find that consumption and income inequality rise by about the same percentage between 1980 and 2010.

In addition to finding similar increases in income and consumption inequality, these three papers claim that the CE Interview Survey data are flawed. Attanasio, et al. (2012) claim that the

⁴ Research shows that this pattern holds across countries – permanent shocks translate into consumption changes, while transitory shocks do not (see Brugiavin and Weber (2011)).

CE Interview Survey suffers from “serious non-classical measurement error” and that the increase in consumption inequality is under-estimated. Aguiar and Bils (2011) make a similar claim and both papers attempt to adjust the data by changing the expenditure patterns between low and high income households. Both suggest that the decline in the ratio between CE and the Personal Consumption Expenditures (PCE) is the result of increased underreporting at the higher end of the distribution. Bee, Meyer, and Sullivan (2012) conduct a validation study of the CE Survey and state that “[t]he Interview Survey does quite well in terms of a high and roughly constant share of expenditures relative to the national accounts for some of the largest components of consumption.” Even if it was agreed that the consumption data were problematic, to properly compare the adjusted consumption data to the income data, the income data would also need to be adjusted (see Fixler and Johnson (2012)).

As with income, there is no agreed upon definition of consumption and no agreed upon unit of observation. Johnson, Smeeding and Torrey (2005) and Meyer and Sullivan (2010) use total consumption, including the service flows from vehicles and owned homes. Other studies measure non-durable spending, but there is no consistent definition of non-durable spending. For example, Heathcote, et al. (2006) include medical care while Attanasio, et al. (2012) excludes medical care. Most, but not all, research limits the sample to urban households and to those that are considered complete income reporters by the CE Survey.

III. Methodology and Data

Given the different definitions of income and consumption in the literature, it is important to use a consistent theoretical framework to define these measures. It is also important to account for potential measurement error in income and consumption, not just one or the other. This section describes how we define income and consumption, how we deal with potential

measurement error in both, and how we use the CE Survey data, but first we provide justification for looking at both income and consumption.

Why income and consumption?

The *Report by the Commission on the Measurement of Economic Performance and Social Progress* (or Stiglitz (2009) report) stated: “Income and its distribution are meaningful ways to assess living standards. Another candidate is consumption and its distribution among individuals. While correlated with income, consumption and its distribution are not necessarily identical to income and several reasons account for this.” The report continues, “Empirical research has repeatedly shown that the distribution of consumption can be quite different from the distribution of income. Indeed, 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.”

Which measure is “best” depends mostly on how economic well-being is viewed and the purpose for using the measure. Economic theory suggests that a household’s well-being (as measured by the household’s utility) depends on the household’s characteristics and its consumption levels. The life-cycle/permanent-income hypothesis (LCPIH) suggests that the household’s well-being depends on the current-income stream that occurs over the household’s lifetime. The LCPIH assumes households can smooth consumption through personal savings or credit markets. As a consequence, households should change their consumption plans in response to permanent shocks to income and they should only react to the annuitized value of transitory shocks. At the other extreme, assuming that households have access to complete markets in which they are able to completely insure against any shocks, then consumption should not react to either permanent or transitory income shocks. If households have access to some

insurance mechanism (formal or informal), they will be able to smooth out, at least in part, income shocks. According to the LCPIH, a household smooths consumption over the household's lifetime so that even if income varies significantly over the life-cycle, consumption is less variable than income from year to year. This suggests that consumption data should be used as the preferred measure of permanent income and household well-being.

In a world of perfect information, with liquid assets and no borrowing constraints and with accurate cross-sectional surveys that measure both income and consumption, the best measure of permanent income would be consumption. Because foresight is imperfect, borrowing constraints exist, and perfect surveys do not exist, both annual income and consumption are needed to obtain an approximation of economic well-being. Neither measure alone captures the economic well-being of all households.

As stated by the NAS report, "In practice the availability of high-quality data is often a prime determinant of whether an income- or expenditure-based family resource definition is used." Our view is that both income and consumption are needed to determine accurately the trend in inequality and economic well-being. If income and consumption inequality trends agree, then we can have more confidence in the conclusion and if the trends diverge, then we have directions for further research.

Two additional reasons to use income and consumption are the hump-shaped age-income profile and potential measurement error in income and consumption. First, the hump-shaped income and consumption profile reflects the LCPIH, with income rising until middle age and then falling, and consumption following a similar, although less pronounced, hump-shaped pattern. With these patterns, younger ages have consumption greater than annual income (and greater than the average lifetime income), which suggests that consumption is a better proxy for

unobserved permanent income. Similarly, older ages consume more than their annual income, again suggesting that consumption is a preferred measure. Second, if there is measurement error in income, for example, for the self-employed, consumption may be a better proxy for permanent income at all ages (assuming no measurement error in consumption). However, if consumption is underreported, for example, among the high income households (that motivates the methodology of Aguiar and Bils (2010) and Attanasio, et al. (2012)), then income may be a better proxy for permanent income assuming there is no measurement error in income.

Appendix A provides examples that show the importance of income and consumption in measuring economic well-being. That appendix also provides examples that show that the choice of income or consumption as a proxy for permanent income depends both on the circumstances of the household and on the quality of survey data. A problem with using cross-sectional data is that the data do not reflect the lifetime pattern of either income or consumption, but reflect rather an annual snapshot of either (or both).

We show that both income and consumption provide information about the distribution of household resources and the trend in inequality over time. The maximum amount of income and consumption may provide an upper bound on household resources and both the maximum and minimum may provide bounds on the “true” level of economic resources and its distribution. If all four measures demonstrate similar trends, then one can be more confident of the actual trend in inequality.

What are income and consumption and how are they measured?

To compare well-being using income and consumption measures and to use them together in our maximum and minimum approach, income and consumption must be constructed using a consistent framework. The most comprehensive concept of income and consumption is

drawn from the suggestions of Haig and Simons. Haig (1921) stated that income was "the money value of the net accretion to one's economic power between two points of time," and Simons (1938) defined personal income as "the algebraic sum of (1) the market value of rights exercised in consumption and (2) the change in the value of the store of property rights between the beginning and end of the period in question."

Economists have used the equation that income (Y) equals consumption (C) plus the change in net worth (ΔW) as the working definition of Haig-Simons income. In an attempt to relate all three components, the new Canberra Group Handbook on Household Income Statistics (2011) states, "Household income receipts are available for current consumption and do not reduce the net worth of the household through a reduction of its cash, the disposal of its other financial or non-financial assets or an increase in its liabilities." Similarly, the Systems of National Accounts defines household income as "...the maximum amount that a household or other unit can afford to spend on consumption goods or services during the accounting period without having to finance its expenditures by reducing its cash, by disposing of other financial or non-financial assets or by increasing its liabilities." However, no studies use this definition to the fullest extent.⁵ No household survey has the necessary variables to create a full measure of Haig-Simons income. Most studies of income include the money income but do not examine changes in asset values and only a few examine the impact of capital gains (e.g. CBO (2011), Piketty and Saez (2003), and Smeeding and Thompson (2011)).

Using the equation, $Y = C + \Delta W$, income and consumption are directly related; the measurement of income depends on the extent to which it is used for current consumption. Once income is determined using the Haig-Simons definition, consumption can be obtained as income

⁵ Smeeding and Thompson (2011) discuss the Haig-Simons income measure and construct a "More Complete Income" measure that attempts to account for the realized and unrealized returns on asset income.

less the change in net worth. Incomplete measure of income and wealth, however, can make measuring consumption difficult.

While consumption is usually measured with observed expenditures (with adjustments for the service flows from housing and durable goods), the change in wealth is composed of changes in observed wealth (as in changes in savings, interest, etc.) and unobserved wealth (unrealized capital gains, stock price gains, and house value gains). Increases in observed wealth could yield increases in income and/or consumption. If the observed changes are not included in income (e.g., capital gains), then the residual changes in consumption will not match the changes in income. This measurement error is only magnified with unobservable changes. While interest, dividends, rents and royalties are measured, many other items (e.g., capital gains, imputed returns on retirement assets) are not included, and depletions in (or additions to) savings are also excluded.⁶

Perri and Steinberg (2012) provide the following example: “Consider two households with the same income but very different shocks to the value of their wealth. Looking only at income would not inform us about distributional changes between them, but looking at consumption would, as the households would adjust their consumption in response to changes in their net wealth. More concretely, when housing prices fall, households feel less wealthy and spend less—even when their salaries and other income streams do not change.” Alternatively, increases in house prices can have a wealth effect causing households to increase spending.⁷

As a result, measured consumption can become uncorrelated with measured income, and fluctuations in consumption can be independent of fluctuations in income. If income and

⁶ Smeeding and Thompson (2012) attempt to measure a “More Complete Income” by imputing the value of interest received on wealth, as well as include both realized and unrealized capital gains.

⁷ Lovenheim (2011) finds strong evidence that the increases in home values in the mid-2000s led to much higher expenditures on education.

consumption are consistently and completely measured, then the difference between income and consumption will be the change in wealth, and deviations in $Y-C$ will be given by the unmeasured changes in wealth. If income and consumption are measured with error, then the changes in wealth can exacerbate this measurement error.

Our goal is to have measures of disposable income and consumption that are accurate and as closely linked as possible (given the data limitations) to compare their annual changes and distributions and to obtain a resource measure that best reflects the annual level of the economic well-being of households. While there may be reasons to exclude education, medical care or durable goods from the measurement of consumption, removing these items from consumption distorts the relationship between income and consumption. Removing these items from consumption, while leaving income unadjusted, especially distorts the relationship between income, consumption, and the change in net worth. It may also bias the measurement of consumption in equality if high income households are more likely to spend on durables such as expensive automobiles or home electronics or spend large amounts on elective medical procedures or college education for their children.

The CE Survey Data

We use the only data set in the United States that contains both income and consumption-expenditure information, the CE Interview Survey data, to compute measures of consumption and income inequality. The CE survey has been a continuing quarterly survey since 1980. Data are collected from consumer units⁸ five times over a 13-month period. The second through fifth interviews are used to collect expenditures for the previous three months; for example, a

⁸ A consumer unit comprises members of a household who are related or share at least two out of three major expenditures--housing, food, and other living expenses. A person living alone is a single consumer unit. While the terms consumer unit and households are used interchangeably in this paper, there are households consisting of more than one consumer unit; approximately 3 percent more consumer units than households.

consumer unit that is visited in March reports expenditures for December, January and February.⁹

We begin our analysis in 1985 as this is the first year with the most consistently comparable data over time. Although the continuous CE Survey began in 1980, all variables were not consistently collected between 1980 and 1984 (e.g., rental equivalence) and the sample excluded rural households in 1982 and 1983. In addition, as mentioned above, much of the increase in consumption inequality occurs in this early 1980-1984 period, which could be the result of the changes in the CE Survey.

We examine four different resource measures: income, disposable income, expenditures, and consumption. Income is the money income from employment, investment, government transfers, and inter-household transfers of money. Disposable income is money income, plus the value of food stamps and federal tax credits less the cost of federal and state income taxes and FICA taxes. Expenditures are spending on all goods and services for current consumption, but excluding life insurance, pensions, and cash contributions. Consumption is total expenditures minus the purchase price of vehicles minus the expenditures for home-ownership plus the service flow from vehicles plus the reported rental equivalence of home-ownership plus the value of federal government rental assistance. As with other research on consumption, we do not include goods obtained through barter, home production, or in-kind gifts from other households or organizations. In contrast to other research, however, our measure of consumption includes all other components of consumption-expenditures that are used for current consumption, and does not exclude education, health care expenses or other durable goods. The specific techniques used to create our consumption and income measures are discussed in appendix A.

⁹ The first interview is used to “bound” the interview and prevent reporting of expenditures in the wrong time period. Data reported in the first interview are not released nor used in any estimation.

Although our measures of income and consumption do not use the complete Haig-Simons definition, we provide a more complete measure of consumption than previous research that is better linked to disposable income in order to more fully capture the levels and trends in the distribution. These measures include the income used to purchase current consumption, excluding only capital gains and the depletion of savings, and the consumption measure attempts to capture all current consumption. As a result, disposable income and consumption are in balance and in the spirit of the Haig-Simons identity.

To match the income and consumption for each household and obtain annual measures of consumption, we only use those consumer units who participated in the survey for all four expenditure-interview quarters. In this manner, we obtain the income and consumption for the same 12-month period. We do not restrict our sample by age, tenure or income reporting status. Previous papers restricted their samples to “complete income reporters” as defined by the CE Survey. Fisher (2006) finds that incomplete income reporters have lower consumption than complete income reporters, which may affect any conclusions about the level of and trend in inequality.

The CE Survey began imputing income in 2004 but did not impute previous years. We replicate the BLS methodology as closely as possible and impute all income for 1985-2010, and therefore, we do not restrict our sample by income reporter status. See Appendix B for a detailed description of the imputation methodology.¹⁰ We present evidence below comparing the distribution of our imputed income to the CPS.¹¹ By imputing income, we treat the income data the same way the consumption data are treated, as the consumption data are also imputed in the

¹⁰ We impute five implicates. At the moment we use the mean of the five implicates as our estimate of income. Using mean income lowers the level of inequality but the trend in inequality is the same if we used the five implicates and adjusted the measure for multiple imputation following Rubin (1987).

¹¹ See figure A5 for a comparison to the income distribution in CPS.

CE Survey; while previous research has removed incomplete income reporters, no previous research has removed incomplete consumption reporters.

As the households who remain in the sample for four quarters are more likely to be homeowners and older households, we follow the procedures in Sabelhaus (1993) and Fisher and Johnson (2006) to re-weight the sample to represent the quarterly sample. For after-tax income we use the National Bureau of Economic Research's (NBER) TAXSIM program (see Feenberg and Coutts (1993))¹² to estimate federal, state and FICA taxes and tax credits such as the Earned Income Tax Credit. All values are equivalized using the square root of household size (see Buhmann, et al. (1988)) and the weights are adjusted to reflect person weights. Finally, all values are adjusted to 2010 dollars using the CPI-U-RS.¹³

Table 1 shows the means for these resource measures over time, which shows that they all increase during the 1985-2010 period. As Table 1 indicates, there is a convergence between income and disposable income, which suggests a decrease in the average tax rate (ATR) during this period. Similarly, the increased gap between disposable income and consumption indicates a falling average propensity to consume (APC). The fact that consumption is almost always lower than expenditures suggests that the service flow from vehicles and the rental equivalence value of home-ownership are lower on average than the spending on these items (and the imputed value of subsidized housing has a relatively minor impact on the overall means). The main impact of using consumption is that it produces a tighter distribution and lower inequality than using expenditures.

IV. The levels and trends in inequality

¹² <http://www.nber.org/taxsim/>. See Appendix C for a description of how taxes were estimated using TAXSIM.

¹³ Others suggest that this is an over-estimate of inflation (see Meyer and Sullivan (2011) and Broda and Romalis (2009), Gordon and Dew-Becker (2009) and Johnson (2004)).

Figure 1 shows the staircase pattern of changes in the income and consumption distributions between 1985 and 2005. All measures demonstrate an increase in inequality, with the top quintile obtaining the largest increase in all resources during the 1985-2005 period. As the figure shows, however, the CPS income shows a larger step for the top quintile than the other quintiles (and hence, indicates a larger increase in inequality). Turning to the most recent five years, we find a slightly different pattern. While all of the income measures show a negative staircase pattern (all quintiles experienced decreases in resources, with the top quintile experiencing the smallest decrease), consumption is more stable across quintiles and reflects the picket fence pattern.

To obtain a summary measure of these changes in inequality, we use the Gini index. The Gini index is the most commonly used measure of inequality and satisfies all of the key properties of an inequality index, including the important principal of transfers (see Sen (1997)). Many previous studies use the variance (or standard deviation) of logs; however, this measure does not satisfy the principal of transfers; it is a consistent measure of inequality only for log normal distributions.

Similar to previous work and consistent with the LCPIH, the levels of consumption inequality (using the Gini) are slightly lower than those for income (and as shown in figure A3 the distribution of consumption dominates (in the second order) that for income). The trends, however, are similar during the 1985-2010 period.

Figure 2 shows the Gini index for income, disposable income, expenditures, and consumption and compares these to the Gini obtained using income from the CPS.¹⁴ As shown,

¹⁴ The CPS data changed the collection methodology in 1994 to computer-assisted data collection and adjusted the income reporting limits. To account for these changes, following Atkinson, et al. (2011) and Burkhauser, et al. (2012), the Gini coefficient for 1993 is set equal to that in 1992 and all previous years are adjusted by the same factor.

the CE income Gini shows similar trends as the Gini index for income in the CPS data, with fairly close end points in 1985 and 2010. While the Gini for income using CPS data increases 7.5 percent between 1985 and 2010, the CE income Gini increases 11.2 percent; however, the CE income Gini is more volatile because of the smaller sample size in the CE survey (as compared to CPS).

Figure 2 and Figure 8 show that disposable income inequality and consumption inequality track each other between 1985 and 2005 (and for all years between 1997 and 2006), but diverge during the past five years. Between 1985 and 2005, consumption inequality increases 9.4 percent, while disposable income inequality increases 7.5 percent. Over the entire 25-year period, however, disposable income inequality increased 9.9 percent, while consumption inequality increased 6.6 percent (about two-thirds of the increase in income). Due to the smaller sample sizes in the CE, however, these estimates are highly volatile and the standard errors are large.¹⁵ But note also that one can obtain different summary results depending on the years chosen as starting or end points.

Inequality in the Great Recession

An interesting aspect of Figure 2 is the behavior of the inequality around the period of the Great Recession, from 2005 to 2010. As was demonstrated above in Figure 1, consumption inequality is basically unchanged over the past 5 years, and the Gini coefficients confirm this result. Prior research focused on the period from 2006-2009 and showed a fall in consumption inequality coupled with a rise in income inequality, and no change in disposable income inequality. Heathcote, Perri and Violante (2010) extend their previous results to 2008, and find

¹⁵ Because of the small sample size in each year, the standard errors are large. We construct a moving average of data (using years of data for each year, e.g., all households in 1990 and 1991 for the 1991 calculations). This method yields similar levels and trends in inequality, and standard errors that provide significant changes between 1985 and 2005 (calculations are available from the authors). Future work will bootstrap the standard error of the Gini coefficient and provide confidence intervals for all estimates.

that consumption inequality peaks in 2005 and then steadily falls in 2006, 2007 and 2008. Petev, Pistaferri, and Eksten (2011) also find that inequality falls during 2007 and 2008, and Attanasio, et al. (2012) find a fall between 2005 and 2010. Finally, Perri and Steinberg (2012) find that inequality changed very little from 2006 to 2010 using two measures, the ratio of the 95th to the 50th percentile and the ratio of the 50th to the 20th percentile.

Heathcote, et al. (2010) claim that their paper "...reveals surprising dynamics for consumption. The reason why consumption inequality declines, is a substantial fall in spending at the top of the consumption distribution, while spending at the bottom increases." And they point to Parker and Vissing-Jorgenson (2009) who state "Given the large exposure of high income and high consumption households to movements in aggregate income and consumption, we expect recent poor aggregate economic performance to reduce inequality." Similarly, Dynan (2012) finds that consumption fell more for higher income households during the Great Recession, and Hurd and Rohwedder (2011) finds similar falls for stock holders, who are largely high income households.

Figure 2 similarly shows a fall in consumption inequality between 2005 and 2008, but then an increase to 2010 back to the 2005 level. This is coupled with a fairly continuous rise in income inequality between 2005 and 2010. As suggested by Heathcote, et al. (2011), it is the increase for the 10th percentile together with the fall for the 90th percentile that drives these changes in consumption inequality between 2007 and 2009 (Table 2 shows the 10th and 90th percentiles). However, these changes must be placed in context of the entire period, which shows consumption inequality fluctuating (mainly due to small sample sizes). Figure 2 shows that this downward trend is reversed in 2009 and 2010, with consumption inequality in 2010 returning to the about the same level as in 2005.

Higher income households are expected to have better tools, and sufficient wealth (or “buffer” wealth), to smooth their consumption during periods of lower income; however, during the Great Recession, they lost a large fraction of their wealth. Hence, to restore their buffer wealth, these individuals may have needed to save more, which would decrease their consumption growth. Further research will examine the impact of the recession and the resulting period following the recession on these outcomes.

Comparison to previous research

Finally, we can compare our results to recent estimates of Heathcote, et al. (2010), Meyer and Sullivan (2009), Attanasio, et al. (2012), Coibion, et al. (2012) and Hassett and Mathur (2012). In all cases, our estimates of their consumption measures demonstrate increases in consumption inequality that are similar to our results in Figure 2. Figure 3 shows that our measure of non-durable consumption matches the measure in Heathcote, et al. (2010) and increases 10.2 percent between 1985 and 2005 compared to their increase of 12 percent.¹⁶ However, using our data to replicate the measure of core consumption in Meyer and Sullivan (2009) yields an increase in the ratio of the 90th and 10th percentiles of 15 percent between 1985 and 2005, compared to a 2 percent fall in their measure (and compared to an increase of 21.6 percent for our consumption measure; see Figure 4).¹⁷

Attanasio, et al. (2012) find that the inequality of non-durable expenditures increases only slightly in the CE Interview Survey, but increases much more so using the CE Diary Survey (similar to the results found in Attanasio, et al. (2006)). They find that between 1985 and 2005, the variance of the log of non-durable consumption increases about 3.5 percent in the CE

¹⁶ The Gini coefficients for Heathcote, et al. (2010) are obtained using their data set posted at <http://ideas.repec.org/c/red/ccodes/09-214.html>

¹⁷ Core consumption is defined as food at home, rent plus utilities, transportation, gasoline, the value of owner-occupied housing, rental assistance, and the value of owned vehicles. Note that the changes between 1990 and 2008 show a similar fall of 7%.

Interview data, and about 9 percent using CE Diary data (basically 0.02 and 0.07 log points).¹⁸ Using a measure of non-durable spending in Heathcote, et al. (2010), we find an increase in inequality of about 12 percent between 1985 and 2005 (using the variance of log inequality measure). Attanasio, et al. (2012) also claim that income inequality from the Panel Study of Income Dynamics (PSID) increases about 20 percent and that non-durable consumption from the CE Interview Survey increases about half that amount. They use the variance of the log difference between food at home and entertainment expenditures to better reflect changes in the consumption of these items. Using this alternative measure, the increase using the Interview data is closer to the increase using the Diary data. However, as with our measures, all of their estimates show a smaller increase in consumption inequality than in income inequality.

Coibion, et al. (2012) use a measure of quarterly consumption to examine the volatility of inequality. Their Figure 1 shows that the Gini for after-tax income increases about 6.0 percent between 1985 and 2005, while the Gini for consumption increases 5.4 percent. Finally, Hassett and Mathur (2012) claim that consumption inequality has remained stable for the past 25 years. However, their Figure 1 and Figure 4 show a slight increase in consumption inequality between 1985 and 2005. By approximating the data in their Figure 4, we find that consumption inequality (at the Consumer-Unit Level) increased about 8.5 percent between 1985 and 2005.

V. Measurement Error

Many recent studies demonstrate the presence of underreporting of both income and consumption in household surveys. BLS, in their cooperation with CNSTAT to conduct a panel on redesigning the CE survey, stated: “From 1984 until the present, the ratios of aggregate expenditure estimates from the CE compared with Personal Consumption Expenditures (PCE) estimates from the National Accounts show a declining trend for a large number of spending

¹⁸ Changes are from Figures 6, 9, 11a, 11b in Attanasio, et al. (2012)

categories, serving as evidence of underreporting.” Garner, et al. (2006) find that the ratio of CE to PCE expenditures fell from 88 percent to 84 percent between 1997 and 2002, and published tables by Passero (2011) that find the ratio remained fairly constant between 2003 to 2008.

Similarly, the results in Bee, et al. (2012) suggest a slight fall in the ratio of comparable items from 82 percent in 1986 to 79 percent in 2010.¹⁹ They state that “...over the past three decades there has been a slow decline in the quality of reporting of many of the mostly smaller categories of expenditures....” They also suggest that the CE Interview survey “...does quite well in terms of a high and roughly constant share of expenditures relative to the national accounts for some of the largest components of consumption.” In contrast, Attanasio, et al. (2012) claim that the “...Interview survey is plagued by some serious measurement problems.” However, their conclusion is based on the same evidence presented in Bee, et al. (2012), along with their results of the different inequality trends obtained using the CE Interview and CE Diary surveys .

As shown in Bound, et al. (2001) and Gottschalk and Huynh (2010), if measurement error is classical, independent of income (or consumption), then an increase in error will increase inequality. Gottschalk and Huynh (2010) generalize this result to non-classical measurement error, which could cause a decrease in inequality. They show that the impact of measurement error on inequality can be represented by the sum of the covariance between the error and the resource and the variance of the resource. They find that the difference between the variance of mismeasured log earnings (or income or consumption) and the variance of actual log earnings depends both on the variance of measurement error and the covariance of measurement error and

¹⁹ This ratio is calculated by aggregating the comparable items in Table 1b in Bee, et al. (2012)

earnings. They state: “While larger variance of measurement error will unambiguously lead to an upward bias in inequality, this will be offset by mean reversion in measurement error.”²⁰

Hence, increased measurement error can imply an increase or a decrease in inequality of the reported resource measure. According to Gottschalk and Huynh (2010) “...increases in inequality will be overstated if the variance of the measurement error is increasing or if mean reversion in measured earnings [or income] is declining.” If the measurement error is correlated with income, such that higher income households are increasingly likely to underreport their income (or consumption), then mean reversion in measurement error is increasing. If the variance of the error is not increasing, the increase in measurement error can suggest that the increase in inequality in the survey data is not overstated. It could imply that the increase in inequality of the reported measure is even higher than the true measure of inequality.

This is the hypothesis made about consumption inequality in Attanasio, et al. (2012) and Aguiar and Bils (2011). They suggest that higher income households are increasingly likely to underreport their expenditures relative to lower income households, implying an increase in mean reversion for expenditures (or consumption). They use an adjustment that causes expenditures for high income (or expenditure) households to increase more over time, and they find a larger increase in consumption inequality using their adjusted consumption than the increase that occurs with the reported data. By using all individuals who have both income and consumption, our results show that the CE Interview Survey provides evidence of a significant increase in inequality in both income and consumption.

Even if these adjustments were justified, there is substantial evidence that underreporting also exists in income (see Sabelhaus, et al. (2012)). Meyer, et al (2008) state: “We find that underreporting is common and has increased over time... There is substantial variation across

²⁰ And this can be applied to the Gini properties (see Yitzhaki and Schechtman (2011)).

surveys, with the CE Survey typically having the lowest reporting rate and the SIPP having the highest rate for most programs.”²¹ It is not clear how underreporting in both consumption and income will impact the trend in inequality, or the relationship between income and consumption inequality.

While Attanasio, et al. (2012) and Aguiar and Bils (2011) adjust consumption, they do not attempt the same adjustment for the increase in income inequality. If underreporting is present for both income and consumption, then comparably adjusted (or unadjusted) series must be used to compare the trends in consumption and income inequality. As a result, in order to compare the trends in consumption and income inequality in the presence of underreporting, researchers must attempt to adjust both measures.

The Average Propensity to Consume

As stated by the NAS report, one of the main criteria in deciding whether income or consumption provides a better measure of economic well-being lies in the quality of the data. As discussed above, many studies document the underreporting in both income and consumption. The issue is which measure contains more error.

One method to examine the different measurement errors in both income and consumption is to use both in an estimation procedure (as in Gottschalk and Huynh (2010) and Gallup (2010)). The correlation between these resource measures can provide a measure of the difference and it provides a measure of the association between permanent and transitory income. If the LCPIH holds, then higher correlation denotes a higher level of permanent income, while lower correlation suggests more of an impact of transitory changes. As Figure A2 demonstrates, disposable income and consumption have a correlation coefficient between .65

²¹ Burkhauser, et al. (2012) claim, however, that “...users of both CPS and of IRS tax return data should be comforted by our finding that...differences in estimates from the two data sources are relatively minor.”

and .70 each year, and hence, transitory income changes are included in the measure of disposable income.²²

Another way to examine the differences is by looking at the average propensity to consume – the ratio between consumption and disposable income. Figure 5 shows that, as expected, APC falls with income, but this relationship is similar over time (see also Sabelhaus, et al. (2012)).²³ The issue is whether these high APCs at the low end of the income distribution represent underreported income (as in Figure A1d) or whether the high APCs at the other end of the distribution represent underreported consumption (as in Figure A1e). If these are data quality issues, but the data quality is similar over time, then there may not be any implications for the trends in inequality. Alternatively, these APCs may simply reflect the LCPIH (as in Figures A1a and A1b).

Examining the characteristics of the high and low APC households may provide some insight into whether the LCPIH applies or whether there might be measurement error concerns. Table 3 shows some characteristics for these households. About 9 percent of people live in consumer units with low APCs (under 0.5) and 10 percent have high APCs (over 2.0). The high APC households are generally lower income (as seen in the scatter plot in Figure 6 and in Table 3), which include households who have income and consumption relationships that could be similar to the LCPIH pattern. They are more likely to be older and single and could be at either end of the age-profile pattern suggested by the LCPIH (see Figure 1a). In contrast, the low APC households are higher income households and more likely to be other family types. While these characteristics may suggest behavior consistent with the LCPIH, other statistics in Table 3 suggest there may be other issues with the data and the measures of consumption.

²² The Gini correlation (or Gini mobility index) similarly measures the relationship between these resource measures and shows a similar consistency over time.

²³ These results are similar across data sets (as in the PSID and HRS), see Dynan (2012).

Table 3 also shows that it is more likely that the high APC households contain self-employed people who are more likely to underreport their income (see Hurst, et al. (2010) and Harris (1996)). The high APC households are more likely to report a decrease in their asset holdings (checking, savings, and security accounts) and they are more likely to report increases in credit card debt. In addition, these households are more likely to be homeowners without a mortgage.

Developing the Maximum and Minimum measures

The patterns in Figure 5 and Table 3 suggest high levels of savings at higher incomes, which are much higher than other estimates (see Sabelhaus, et al. (2012), and references therein). The large consumption levels for some households with low incomes seem implausible. While some of these can be explained by the characteristics of households, some of these APCs appear too large or too small. As a result, consumption could suffer from a fair amount of mean reversion, as Gottschalk and Huynh (2010) find for income in the Survey of Income and Program Participation (SIPP).

Given the negative correlation between APC and income, the economic well-being of many of the low income households may be more accurately represented by their consumption, which may be consistent with the LCPIH. However, many of the high income households may be more accurately represented by their income.

As we have maintained, both income and consumption provide information about the distribution of resources and trends over time. Hence, using the maximum and minimum of both provides another measure of well-being. As all measures are contaminated by measurement error, additional information is useful. For example, Browning and Crossley (2009) show how two noisy measures provide useful information about the structure of the measurement error.

Gallup (2010) uses both measures to obtain the inequality of permanent income and finds that the inequality of permanent income is lower than either income or consumption inequality.

Using the maximum (as opposed to the average or an integrated regression approach as in Gallup (2010)) provides a simple method that can serve as an upper bound on household resources. The purpose of using the maximum and minimum is that they could be bounds on the true level of economic resources. Underreporting could exist for both income and consumption, which would suggest that the true level of resources lies above both, but if all four measures demonstrate similar trends, then one can be more confident of the actual trend in inequality and years with differences can suggest data or measurement issues or that changes in wealth affected inequality trends.

In evaluating the levels, if consumption Gini is less than the Gini for disposable income, the correlation between income and consumption is positive, and APC decreases with income, then the Gini for the maximum will lie between the Gini coefficients for income and consumption, and similarly for the minimum (see Appendix D). This relationship is shown in Figure 7.

As Figure 7 and Figure 8 show, the Gini for the maximum increases 13.7 percent between 1985 and 2010, and the Gini for the minimum increases 3.6 percent (which bound the increases in income and consumption of 6.6 and 9.9 percent). If increases in mean reversion exist mainly for consumption by high income households, then using the maximum may yield no changes in mean reversion. Hence, the trend in the Gini for the maximum may better reflect the overall increase in inequality.²⁴

VI. Conclusion

²⁴ Again, there is something happening in the later years around the Great Recession. The Gini for the maximum diverges more from the Gini for consumption during this period; this is the subject of future research.

We present evidence on the level and trend in inequality over the last twenty-five years in the U.S. using disposable income and consumption for the same sample of individuals from the CE Survey. Our sample includes all individuals, not just those that live in urban areas or those that are of working age. While consumption inequality is always lower than income inequality, income and consumption inequality increase at approximately the same rate between 1985 and 2005. Over the entire 25-year period, consumption inequality increases by about two-thirds of the increase in disposable income inequality. These results contradict much of the existing research that finds that consumption inequality was relatively flat since the mid-1980s. Three recent papers argue that the increase in consumption inequality mirrored the increase in income inequality, but those papers make significant adjustments to the CE Survey data or impute consumption in other surveys. Our straightforward approach uses the entire CE Survey sample for both income and consumption and takes the consumption data as reported by the households. While we impute income for those households that do not report valid values for all of their components of income, the observed increase in income inequality in the CE matches the level and trend found in the CPS, the standard data set used to measure earnings and income inequality.

Examining income and consumption together using the same sample provides an important contribution to the literature on the economic well-being of individuals. That the trends in the two measures are nearly identical provides even more confidence in the results. We also show estimates of permanent income inequality using the maximum and minimum of income and consumption and find that the trend in inequality is approximately the same as seen using income or consumption by itself.

Tables and Figures

Figure 1: Percentage change in resource measure, 1985-2005 and 2005-2010

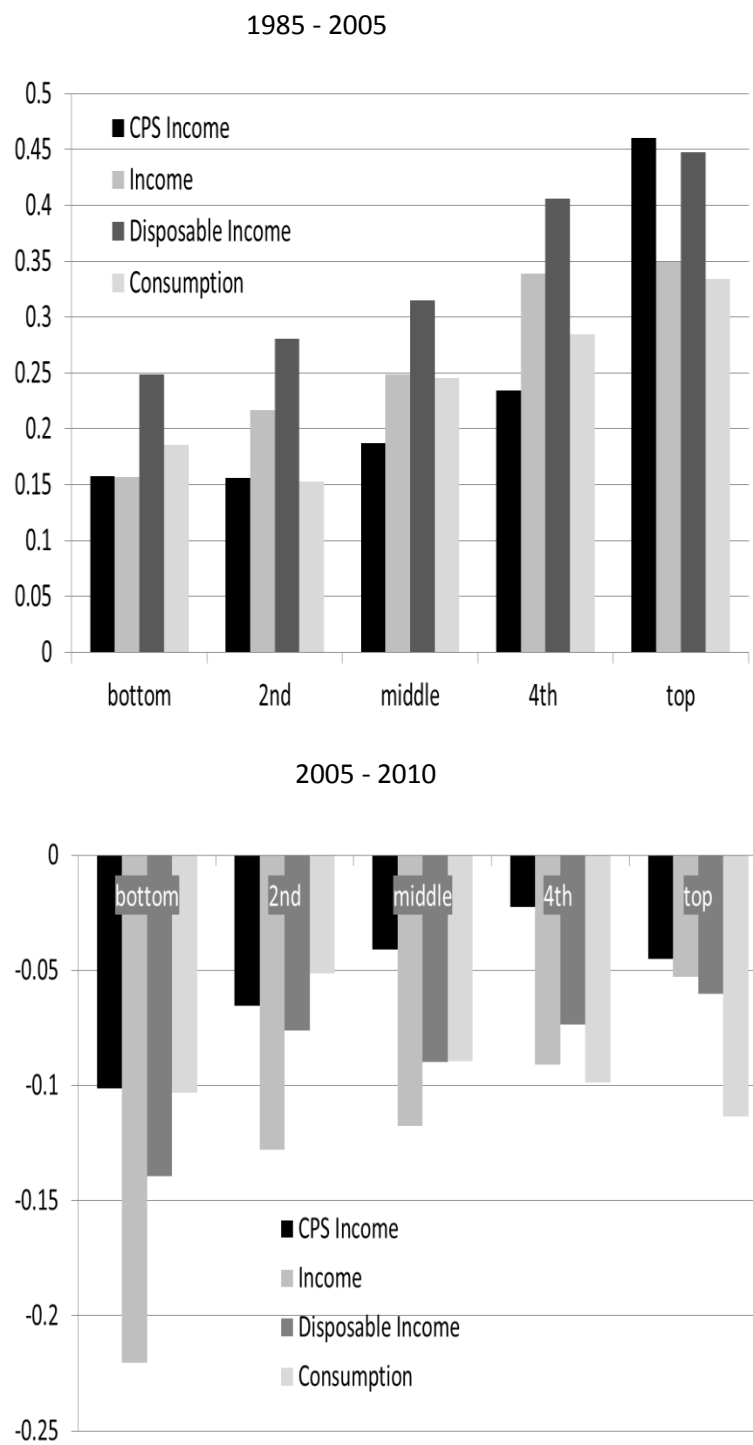


Figure 2: The trends in income and consumption inequality using the Gini coefficient

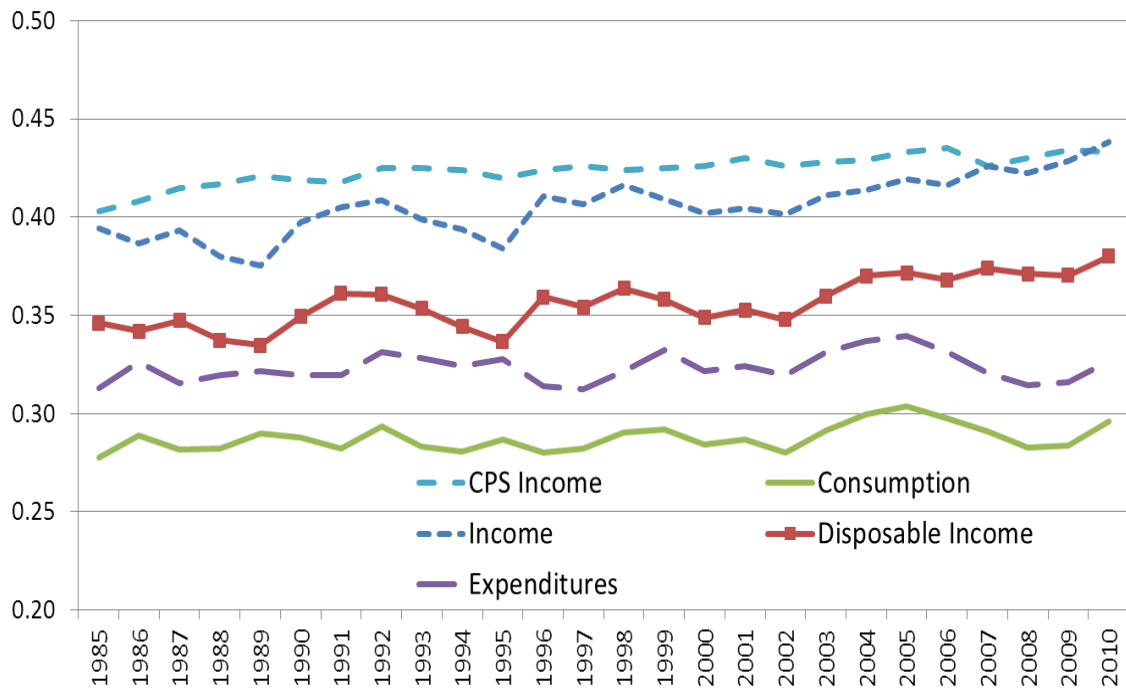


Figure 3: Comparing Heathcote, et al (HPV) (2011) measure of non-durables using Gini coefficient

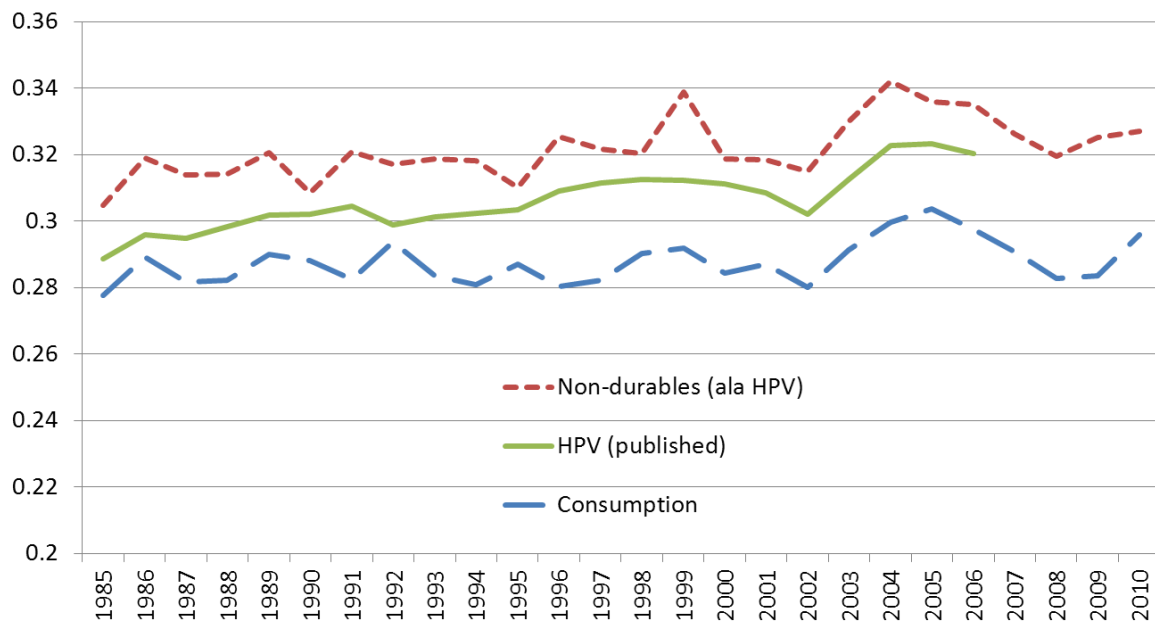


Figure 4: Comparing Meyer and Sullivan (2009) measure of core consumption, using P90/P10 ratio

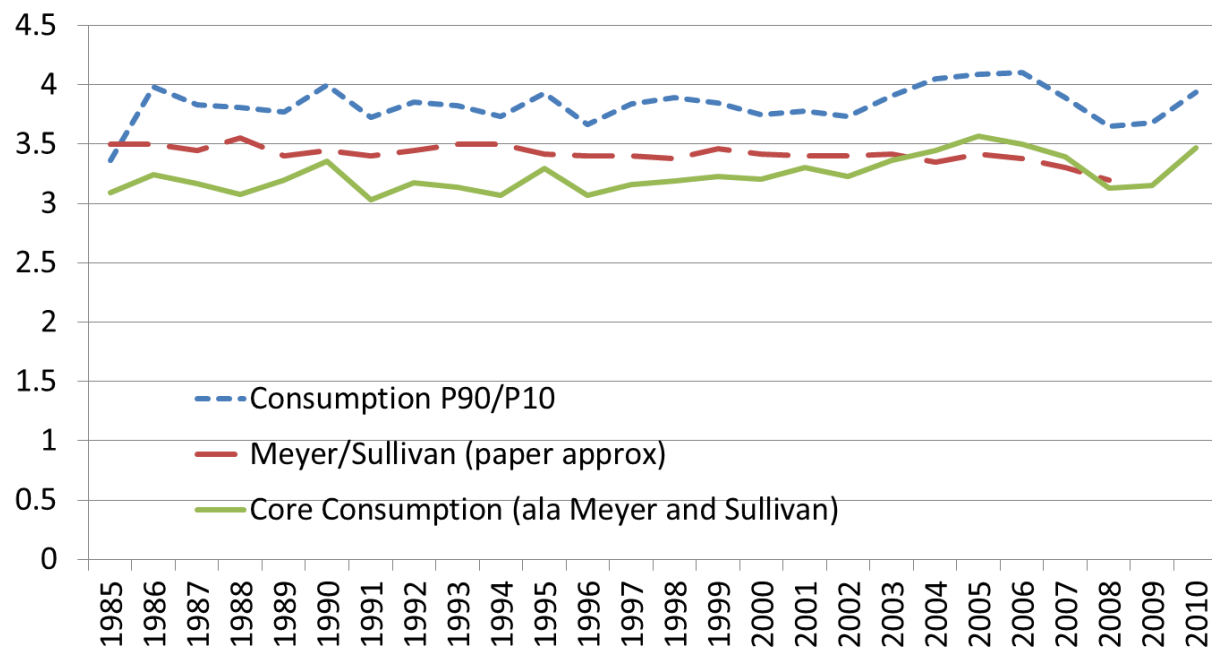


Figure 5: Average Propensity to Consume by disposable income level, 1990, 2000, 2005 and 2010

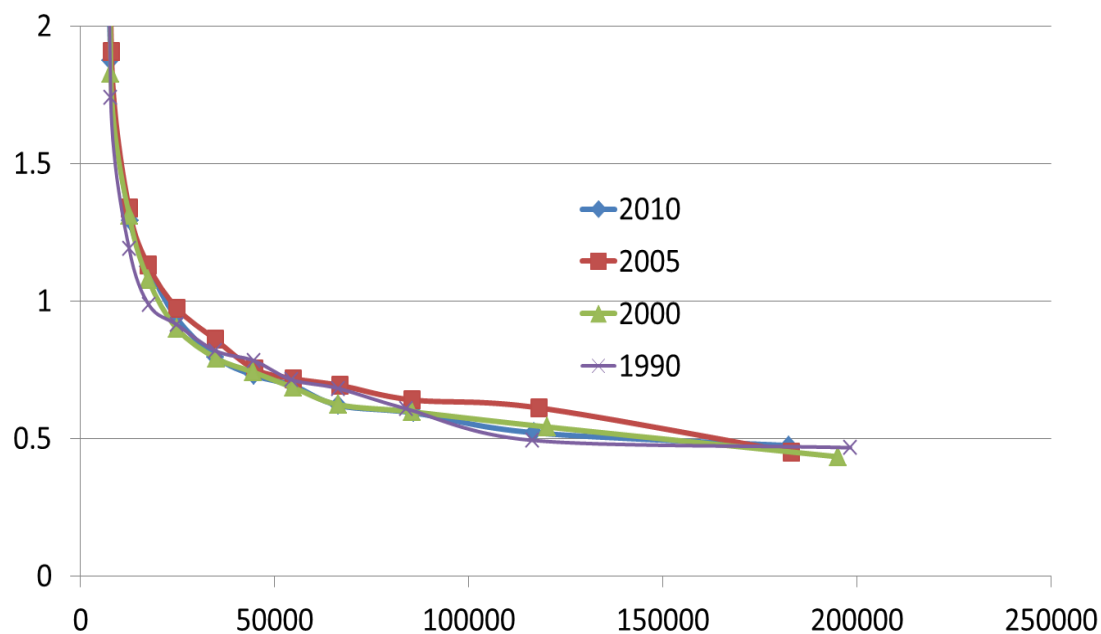


Figure 6: Plot of consumption and disposable income, 2010

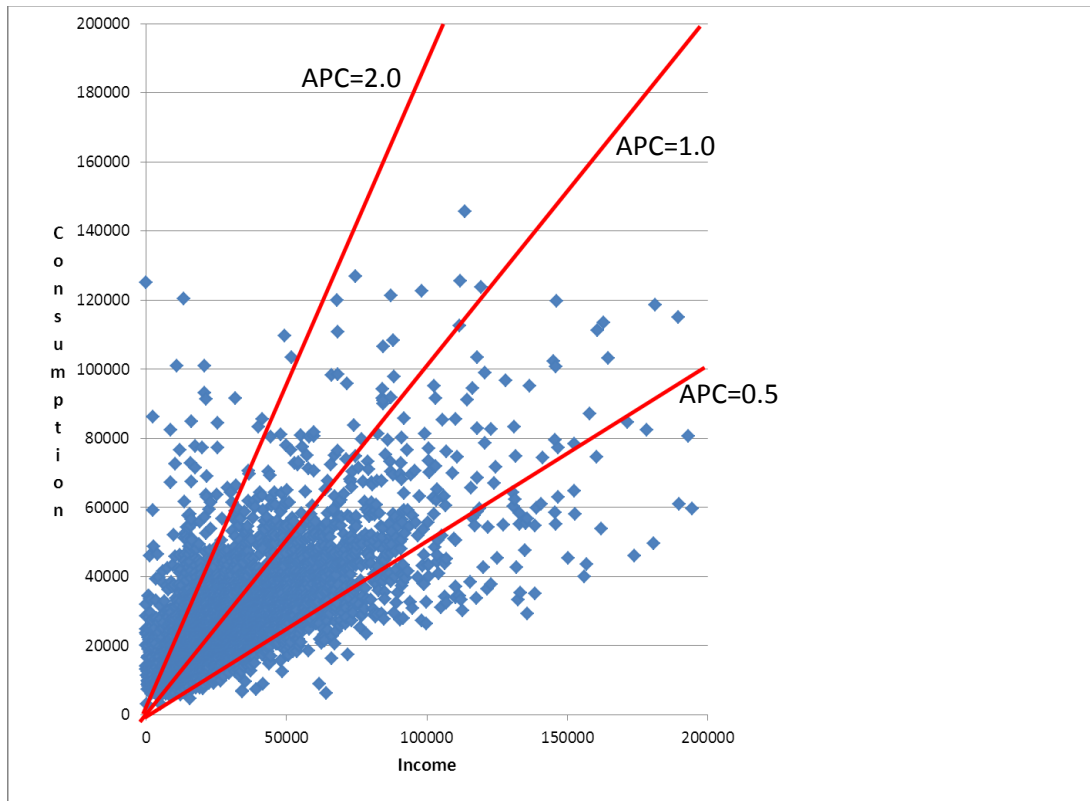


Figure 7: The trends in inequality (Gini) using the maximum and minimum

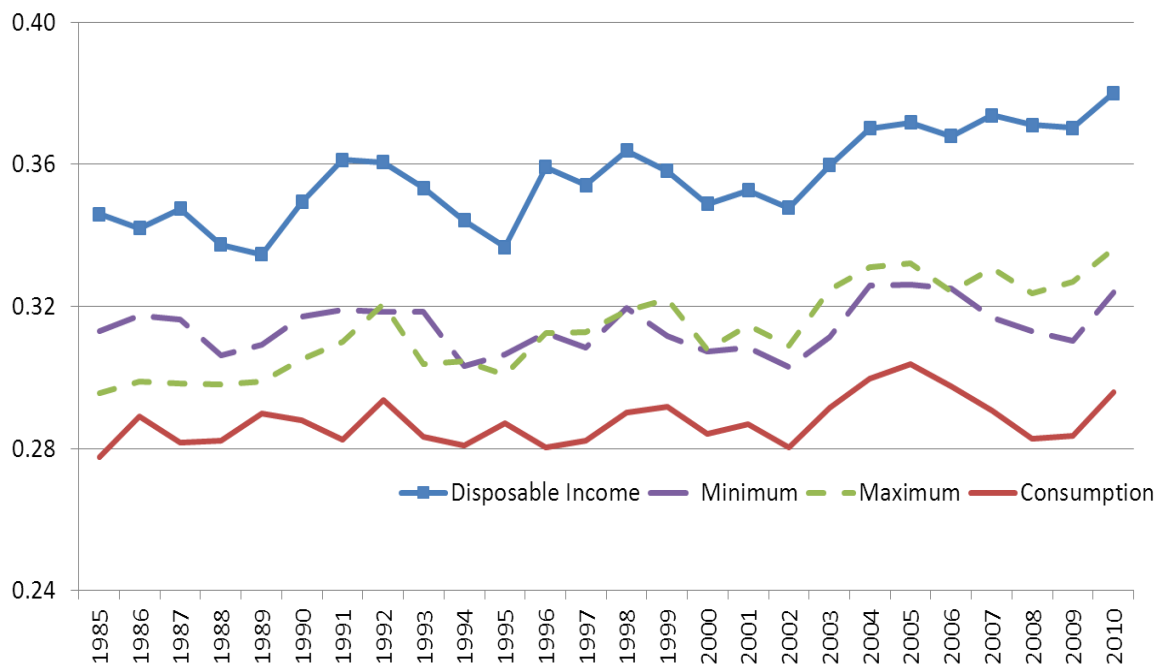


Figure 8: Changes in inequality. Gini indexed to 1.0 in 1985.

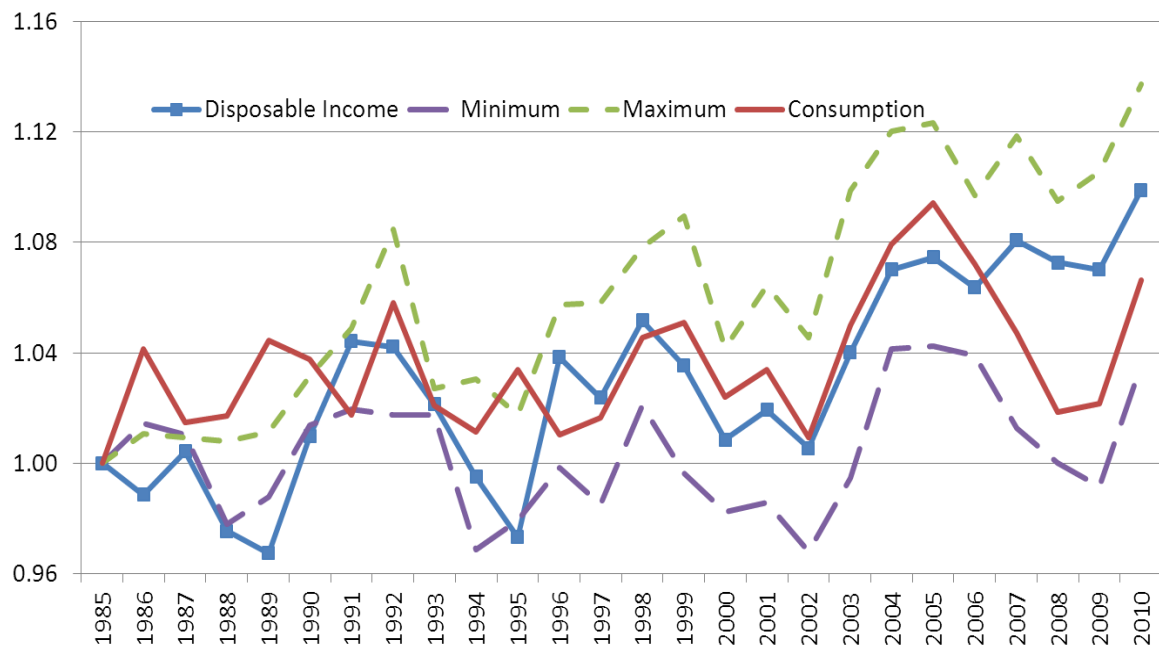


Table 1: Mean and Median Income from CE and CPS, and Mean Disposable Income, Consumption and Expenditures from CE (in 2010\$, using CPI-U-RS and equivalized)

Year	CPS Median Money Income	CPS - Mean Money Income	CE - Median Income	CE - Mean Income	CE Disposable Income	CE Consumption	CE Expenditures
1984	29,039	34,519	27,014	33,768	26,424	22,299	23,335
1985	29,515	35,123	27,746	33,353	26,114	23,461	24,229
1986	30,684	36,474	28,123	33,492	26,890	23,703	25,457
1987	31,571	37,258	28,022	34,030	27,571	23,782	24,730
1988	31,697	37,705	28,490	34,818	28,274	23,919	25,097
1989	32,300	38,499	29,647	36,362	29,334	25,001	26,005
1990	31,535	37,588	28,232	34,219	27,726	24,389	24,663
1991	31,056	36,998	27,511	33,918	27,371	24,425	25,076
1992	31,033	36,970	27,436	33,776	27,455	23,090	24,904
1993	30,523	37,018	27,982	33,967	27,615	24,016	25,458
1994	31,273	37,883	28,917	34,911	28,259	24,368	25,930
1995	32,043	40,841	28,793	34,956	28,392	24,092	25,397
1996	32,518	41,659	29,705	36,653	29,407	24,564	25,653
1997	33,523	43,185	31,151	38,021	30,515	25,697	26,451
1998	34,732	44,567	30,741	38,658	30,970	25,688	26,491
1999	35,632	45,158	32,325	41,106	32,647	26,266	27,378
2000	35,979	46,815	32,729	40,477	32,707	26,480	27,064
2001	35,558	46,506	33,539	41,505	33,560	26,723	27,132
2002	35,133	45,580	34,224	42,242	34,736	27,339	27,681
2003	34,993	45,523	33,084	41,822	34,773	26,995	27,378
2004	34,769	45,408	35,059	44,412	36,955	29,255	29,294
2005	35,104	46,066	34,445	43,711	36,189	29,801	29,352
2006	35,457	47,003	34,950	43,769	35,983	30,717	29,108
2007	35,937	46,470	34,117	43,388	35,632	29,270	28,642
2008	34,744	45,192	32,807	41,980	34,783	28,921	28,362
2009	34,039	44,824	31,717	41,184	34,531	27,895	27,201
2010	33,623	44,052	29,958	39,938	33,501	26,905	25,995

Table 2: Medians, 10th and 90th percentiles for consumption and disposable income (DPI), (in 2010\$, using CPI-U-RS and equivalized)

Year	Consumption - P10	Consumption - Median	Consumption - P90	Disposable income- P10	Disposable income- Median	Disposable income- P10
1984	9,418	20,654	36,500	8,873	22,722	48,546
1985	11,238	20,748	37,775	9,392	23,438	46,542
1986	9,771	21,303	38,910	8,644	23,764	48,976
1987	10,272	21,771	39,338	8,927	23,962	49,456
1988	10,264	21,670	39,106	10,183	24,540	50,330
1989	11,130	21,974	41,990	10,804	25,195	53,766
1990	10,359	21,623	41,386	8,864	23,977	49,732
1991	10,680	21,687	39,828	8,125	23,367	51,258
1992	9,940	20,300	38,333	7,705	23,591	51,165
1993	10,411	21,486	39,832	8,279	24,079	50,787
1994	10,883	21,858	40,644	9,373	24,455	51,148
1995	10,413	21,333	40,918	9,653	24,551	52,157
1996	11,061	21,728	40,564	8,889	24,959	51,814
1997	11,143	22,957	42,796	9,438	26,177	54,989
1998	11,213	22,554	43,609	9,368	26,447	57,491
1999	11,313	23,148	43,503	10,771	27,473	57,403
2000	11,806	23,413	44,269	10,745	28,162	58,267
2001	11,741	23,611	44,330	10,920	28,847	60,874
2002	12,129	24,640	45,282	11,461	30,322	62,161
2003	11,619	23,958	45,368	10,941	29,836	62,953
2004	12,103	25,554	48,984	11,418	30,973	67,494
2005	12,741	25,933	52,082	10,898	30,230	68,382
2006	12,611	27,145	51,784	10,726	30,411	66,028
2007	12,550	25,838	48,825	10,787	29,827	65,314
2008	12,991	25,673	47,381	10,032	28,957	65,146
2009	12,670	24,529	46,604	10,585	28,396	63,048
2010	11,402	23,510	44,882	9,745	27,394	63,329

Table 3: Percent distribution for each APC level (person weighted), 2009-2010

	All	APC<0.5	APC≥2.0
Family type^a			
Married without children	21.7	27.7	14.6
Single person	27.3	14.7	50.6
Other family type	15.6	21.6	13.9
Single Parent	5.8	1.6	10.5
Homeowner^b	66.0	72.5	56.1
with mortgage	41.2	50.8	20.6
without mortgage	24.8	21.7	35.5
Renter	34.0	27.5	44.0
Assets fell in last 12 month			
Checking balance	13.9	11.3	16.8
Savings balance	18.6	15.5	18.1
Securities balance	34.4	29.6	33.4
Credit card debt increased in last 12 months	63.4	62.3	75.7
Age^b			
Less than 35	22.6	20.9	23.4
35 to 45	18.4	19.6	9.5
45 to 55	20.9	23.8	16.6
55 to 65	17.7	22.0	19.4
65 and over	20.3	13.8	32.1
Self employed			
Reference person	10.7	12.0	26.6
Spouse	10.6	12.3	23.0
Disposable Income distribution^b			
Bottom Quintile	21.8	6.6	83.0
2nd	18.7	5.3	12.6
Middle	19.6	8.6	3.6
4th	19.5	17.6	0.5
Top Quintile	20.2	62.0	0.2

Numbers represent the percent of characteristic in each APC level (e.g., 50.6 percent of people in Consumer Units with APC>2.0 are singles).

^a Not all family types are included. Family type does not sum to 100.

^b May not sum to 100 due to rounding.

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Appendix A: Consumption and Income Measurement Issues

Defining Our Measures

To obtain an annual measure of consumption and income, we use consumer units who participate in the survey for all interviews (representing about 75-80 percent of all consumer units). Because young renters are under-represented in the sample of consumer units who remain in the survey for all interviews, we use a procedure presented in Sabelhaus (1993) and Fisher and Johnson (2006) to adjust the weights by age and housing tenure (homeowner/renter) to obtain a better representation of the population. The consumer units are then placed in the quarter in which their last interview occurred and the weights and household demographics are those from the last interview. The data for a particular year are obtained by using all of these four quarter CUs who had their last interview between the second quarter of one year and the first quarter of the following year; for example, the data for 2009 consists of all households who had their last interview between April 2009 and March 2010. Since the expenditures and income are from the previous four quarters, the expenditures and income occurred between April 2009 and February 2010. Determining the years in this manner yields annual data from 1985 to 2010.²⁵

We measure economic well-being by using two definitions of both income and consumption. Similar to the Census Bureau definition of money income, we use pre-tax/post-cash transfer money income; this does not include the value of food stamps or other in-kind transfers.

The Consumer Expenditure (CE) Survey began imputing income in 2004 for those respondents that refused to provide an exact dollar value and for those that did not know the exact dollar value.²⁶ Before 2004 these values are left as missing. We impute income for all consumer units from 1985-2010, following the CE Survey's methodology for imputing income where possible. Appendix B provides the detail on our imputation methodology.

We also use a measure of "disposable income", which is total income minus personal income taxes (net of refunds including the earned income tax credit), personal property taxes and payroll taxes plus the value of food stamps. We estimate income taxes and payroll taxes using NBER's TAXSIM program (Feenberg and Coutts, 1993), and estimate taxes for each of the five income implicates.²⁷ See appendix C for a description of the tax estimation. Figure A2 compares the imputed income series to the CE published income and CPS income.

We use two measures of consumption: expenditures and consumption. Expenditures are defined as the amount that the consumer unit actually spends for current consumption. Spending on items not actually consumed by the consumer unit is not included. Expenditures include expenditures for food, housing,²⁸ transportation,²⁹ apparel, medical care,³⁰ entertainment,³¹ and

²⁵ Since there are only two quarters of data for the 1984 period, we do not include this year in our analysis. The average sample size for each year is about 3000 consumer units.

²⁶ The data CD provided the BLS includes documentation describing the official BLS imputation process.

²⁷ <http://www.nber.org/taxsim/>

²⁸ Housing includes expenses associated with owning or renting a home or apartment, including rental payments, mortgage interest and charges, property taxes, maintenance, repairs, insurance, and utilities. Expenditures for other lodging and household operations are in the miscellaneous items category. Expenditures for principal payments for mortgages are excluded.

²⁹ Transportation includes expenditures for the net purchase price of vehicles, finance charges, maintenance and repairs, insurance, rental, leases, licenses, gasoline and motor oil, and public transportation. Public transportation includes fares for mass transit, buses, airlines, taxis, school buses and boats.

miscellaneous items³² for the consumer unit. Excluded are expenditures for pensions and social security, savings, life insurance, principal payments on mortgages, and gifts (of cash, goods and services) to organizations or persons outside the consumer unit. Included are the purchase prices of durable goods other than housing.

As the CE survey changed the method to collect food at home and food away from home, we made some adjustments to insure comparability over time. The CE survey modified the questionnaire between 1982 and 1987 for the collection of food at home. During these years, the CU was asked for usual monthly expenditures on food, and since 1988 the CU has been asked for usual weekly expenditures. As expected, using weekly expenditures and aggregating up to annual expenditures provides larger food expenditures than using monthly expenditures. We follow a procedure similar to Battistin and Padula (2009) and regress food expenditures on CU characteristics (income, tenure, marital status, age and age squared, number of adults and children) and a dummy for the years 1984-1987. We use the dummy to adjust all food expenditures during these years by the same ratio – basically increasing these expenditures by a factor of 1.2198. Similarly, in 2007, the CE changed the questionnaire regarding food away from home. Before the 2nd quarter of 2007, CUs were asked for usual monthly expenditures and currently, the CU is asked for usual weekly expenditures. We use a similar procedure to adjust all food away from home expenditures by the same amount – basically increasing these expenditures by a factor of 1.565 for all years before 2007 (2nd quarter).

To obtain our measure of consumption, we estimate the service flows of homeownership, cars and trucks. For the value of homeownership, we use the reported rental equivalence value obtained from the consumer unit. Consumer units who own their home are asked, “If someone were to rent your home today, how much do you think it would rent for monthly, unfurnished and without utilities.” The annualized value of this is then used for homeownership cost in place of the amount used in the definition of expenditures. In addition, we calculate the imputed value of government rental assistance. Following a procedure similar to Meyer and Sullivan (2008), we regress the rent (in logs) on the characteristics of the rental units, including number of rooms, bathrooms, bedrooms and the squared values, the age (and age-squared) of the unit, whether the unit is detached, a multi-unit building or a mobile unit, whether the unit has a swimming pool, off-street parking, and the state and type of metro area. We estimate this on a rolling sample using three years of data and then use the imputed value for CUs in public housing or rental assisted housing if the imputed rent is higher than the reported rental cost.

For cars and trucks, we follow a process similar to that used in Danziger et al. (1982) and Slesnick (1994) and estimate the service flow of durable goods by the change in the value of the durable. Using the purchase price, P_0 , and the age, s , of the vehicle, the service flow, S , is given by:

$$(1) \quad S_t = (r + \delta) \cdot (1 - \delta)^s \cdot P_0,$$

where r is the interest rate and δ is the depreciation rate. We assume that $r = .05$ and $\delta = .1$. The CE Survey collects data on the ownership of vehicles, including the age and make and/or model type. While the age and model type are asked of all consumer units, the purchase price is asked only of those households who are currently financing their automobile (or who recently

³⁰ Medical care expenditures are for out-of-pocket expenses including payments for medical care insurance.

³¹ Entertainment expenditures are for fees and admissions, televisions, radios, sound equipment, pets, toys, playground equipment, and other entertainment supplies, equipment and services.

³² Miscellaneous expenditures are for personal care services, reading, education, tobacco products and smoking supplies, alcoholic beverages, other lodging, and house furnishings and equipment.

purchased the vehicle). Since many of the consumer units have missing values for the purchase price, we imputed values based on the make and year, whether the vehicle was purchased new or used and whether the vehicle had automatic transmission. Since most of the vehicles had their make reported, we sorted the data by model type and whether the vehicle was new or used and obtained the mean value of the purchase price for each cell. If there were no observations for a particular cell or the type was missing, we then used the mean values by year, based on whether the vehicle was new or used, a car or a truck and automatic or manual transmission. Using these service flows, consumption is given by consumption-expenditures less the purchase of vehicles and major appliances and the costs of homeownership plus the rental equivalence of owned home and plus the service flows from cars and trucks.³³

We use equivalent resource measures by dividing the household resources by the constant-elasticity equivalence scale ((family size)⁵). Inequality is then calculated using the equivalent resources and weighting by family size times the household's sample weight. Figure A3 provides a more detailed picture of the correlation between disposable income and consumption. Table A1 classifies individuals in households by their income and consumption quintile and shows that many households are classified in different quintiles.

Income and Consumption as Complements

The following examples demonstrate the complementary nature of these two measures of economic well-being, consider a standard age-resource profile based on CE data by age (see Figure A1a). Assuming that the unobserved permanent income is simply the average lifetime income, a standard LCPIH situation of either an elderly household who is depleting savings or a young (possibly student) borrower can illustrate the LCPIH. At a young age consumption is greater than annual income (and greater than the average lifetime income). Here, the LCPIH suggests that consumption is a better proxy for unobserved permanent income. A similar situation might occur in old age where again consumption is closer to permanent income than current income. In older ages, although both consumption and current income are below permanent income, consumption still yields a better measure of permanent income. Figure A1b simply shows that the LCPIH suggests that the household will attempt to smooth out short-run fluctuations in income, again suggesting that consumption is a better measure of permanent income.

Figure A1c shows that although the household's income fluctuates, the household becomes accustomed to a certain consumption level. At the particular point in time (shown by the line), this household could be a creditor borrowing heavily from his/her credit cards (or other unsecured debt). Federal Reserve Governor Lindsey (1996) discussed this increase on debt reliance, when he suggested that "households may be adding debt in order to sustain desired consumption levels which cannot be justified by their earnings." Here, consumption is greater than annual income which is greater than (or less than or equal to) permanent income and consumption is not a good measure of unobserved permanent income, but annual income, although not always perfect, is a better measure.

Figure A1d illustrates the common problem of income being underreported in household surveys. Many suggest that income for the self-employed is poorly reported on most household surveys (see Hurst, et al. (2010) and Harris (1996)) and that using annual reported income may

³³ This measure of consumption may still underestimate actual consumption since it does not include all in-kind transfers, gifts received from other households, or the service flows from other durable goods, e.g., televisions, recreational vehicles, and some luxury goods.

not fully reflect the economic well-being of these households. In this example, at the line, consumption is greater than permanent income, which is greater than reported income. As a result, current consumption, rather than reported income, might be a better measure of permanent income.

Figure A1e illustrates a problem with consumption data. Aguiar and Bils (2011) suggest that higher income households underreport their expenditures on “luxury” goods. It could be that with large (and permanent) increases in income, the household underreports their actual consumption.

Figure A1a: Age profiles for disposable income and consumption using CE data

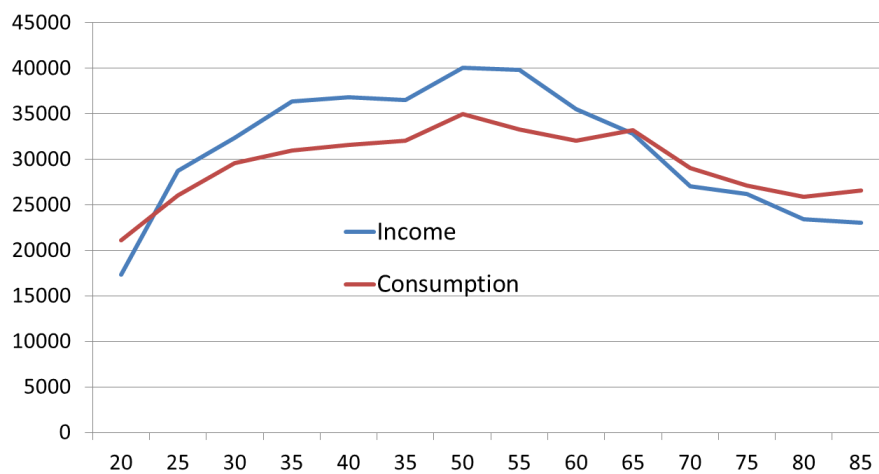


Figure A1b: Smoothing consumption over short-run income fluctuations

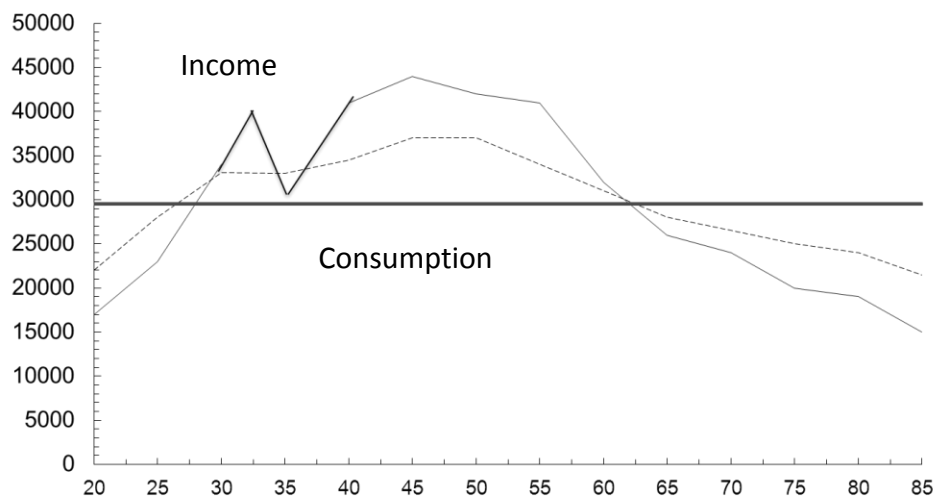


Figure A1c: Excessive consumption in response to falling income

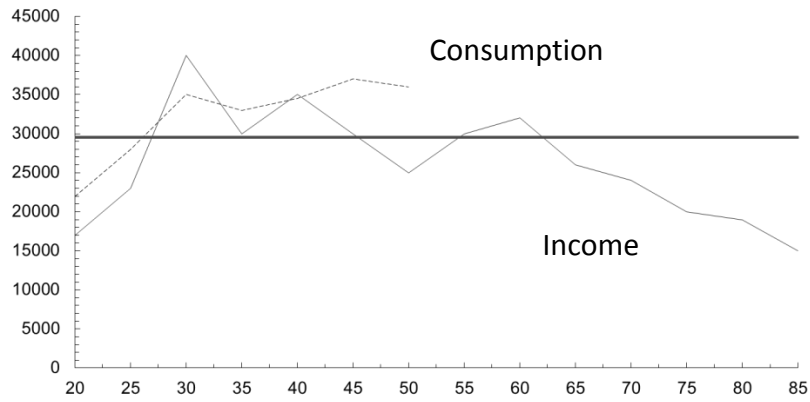


Figure A1d: Income underreporting

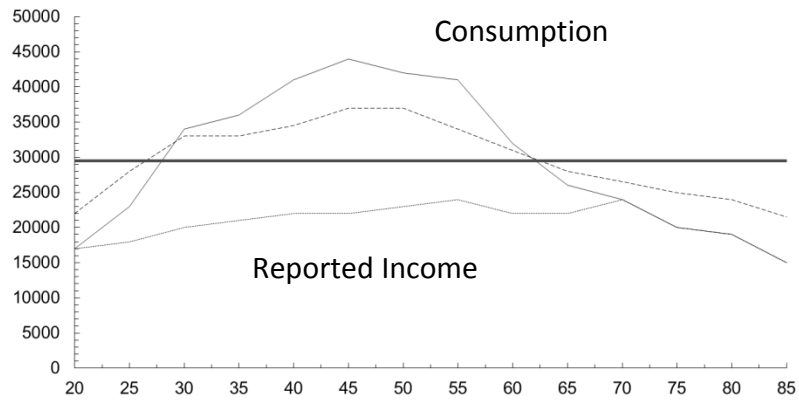
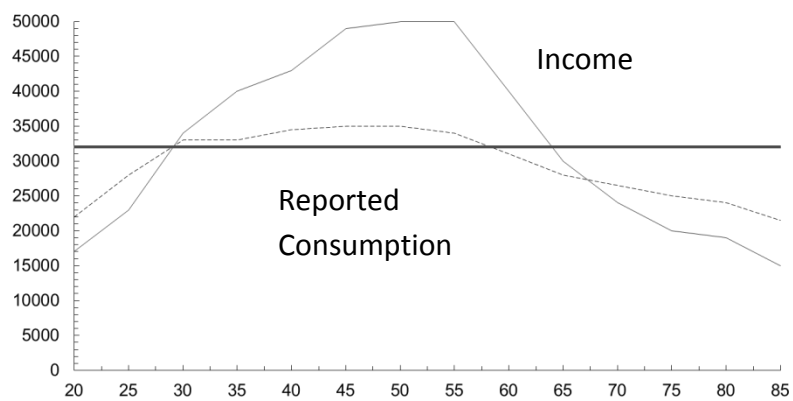


Figure A1e: Consumption underreporting



Appendix B: Imputing Income

We impute income sources for consumer units that reported receiving the income source but failed to provide a valid value. Our imputation methodology follows the CE Survey's methodology as closely as possible. This appendix describes our methodology and where our methodology differs from the methodology used by the CE Survey.

We impute any income variable with an invalid nonresponse flag or a "don't know/refuse" flag. Twelve family-level income variables are imputed: interest income; pensions and annuities; financial income (e.g., dividends and royalties); alimony; child support; lump sum payments; unemployment; food stamps;³⁴ welfare; net income or loss from roomers or boarders; net income or loss from other rental units; and, other income (e.g., cash scholarships and cash stipends). Prior to third quarter of 1993, alimony and child support were combined in one variable. The two sources are treated separately when feasible, given the methodology described below. We impute lump sum income,³⁵ while the CE Survey does not. In the official CE definition of before-tax income, lump sum income is not included, and the CE only imputes the components of before-tax income.

Five member-level income variables are imputed: wage and salary; Supplemental Security Income (SSI) benefits; income or loss from the member's own farm; income or loss from member's own nonfarm business; and, social security and railroad retirement income. We differ from the CE's treatment of social security and railroad retirement income. The CE Survey imputes the last payment received for these items, and whether Medicare premiums were subtracted from the last payment. It then multiplies that amount by the total number of payments received over the previous twelve months, if a valid value is not provided. We instead impute social security and railroad income earned over the previous twelve months. We ultimately are interested in the income over the last twelve months and do not need to know the three intermediate inputs.

The CE Survey introduced income bracket variables in the second quarter of 2001. If the respondent refused to provide an exact dollar value for an income source, the respondent was asked to provide an answer from a bracketed range. From 2001-2003, the respondent was given the mid-point of the bracket as the dollar value for income for that source. Since 2004, the CE Survey imputed the value for the bracketed income responders but restricted the imputed value to be within the bracket. We differ from the CE Survey and continue to use the mid-point of the bracket.

The CE Survey also imputes income for a portion of the consumer units that report valid blanks for each and every income source listed above, excluding lump sum income.³⁶ The CE Survey refers to these consumer units as 'all valid blanks' (AVB). Approximately 2.2 percent of all consumer units are classified as AVB. The income questions are at the end of the survey, and the CE Survey is worried that some respondents may report no income as a way to end the

³⁴ From 2001Q2 on, the food stamp question included food stamps and electronic benefits. The variable changed names as well at that time.

³⁵ Lump sum income includes lump sum payments from estates, trusts, royalties, alimony, prizes, games of chance, and payments from people outside the consumer unit.

³⁶ Before 2001Q2, the food stamp flag did not allow for valid blanks. Instead the consumer units were given a zero for the food stamp variable, and the flag indicated a valid value. We impute for those with a \$0 response for food stamps before 2001Q2 because it is actually missing.

survey. It is believed that some consumer units may truly have no income from any of these sources.

As part of income imputation, the CE Survey imputes whether the AVB consumer units were actually valid blanks. A predicted likelihood of receipt is estimated for each income source.³⁷ Among valid reporters, the dependent variable equals one if the consumer unit or member received the income source and zero otherwise. The same independent variables are used in the AVB process as the imputation process, as described below. After logit estimation among the valid reporters, an out-of-sample likelihood is estimated for each AVB consumer unit or member. Then a random number is generated for each AVB consumer unit or member for each income source. If the predicted likelihood of receipt is greater than or equal to the random number, the valid blank for that source is changed to an invalid blank. All invalid blanks generated from the AVB process are then treated like any other invalid blank and are imputed for that source. An AVB consumer unit could remain AVB, or it could have food stamps imputed and nothing else imputed.

Methodology

The data are multiply imputed following the basic method of Rubin (1987). In brief, coefficients are estimated using the valid reporters. The estimated coefficients are then shocked, and the shocked coefficients are used to estimate a predicted value for the invalid reporters. The predicted value is also shocked to arrive at the final reported value. Five imputates are generated for each income source. In practice we use the Stata *mi impute* command. Rather than use Ordinary Least Squares to generate the coefficients, we use predictive mean matching, which matches the missing value with the mean of its nearest neighbors. All models are weighted. All data are in real 2010 dollars when imputing.

Variables

The dependent variable equals the transformed level of the income source for all valid, non-zero respondents. The CE Survey transforms the income source by subtracting its median from all valid reporters. The variables are transformed before the model is run, and the imputates are untransformed after model estimation.

A large list of independent variables is included in each model. We use the following continuous variables: quadratic in age;³⁸ transformed total expenditures (ERANKMTH);³⁹ and, a

³⁷ The AVB process is not done for wage and salary income, farm income or loss, and nonfarm business income or loss. If someone reports being employed but fails to report wage and salary income, the respondent has an invalid blank. If someone is not employed, the individual has a valid blank. Thus there can be no invalid blanks for wage and salary income. Similar logic applies to farm and nonfarm income.

³⁸ For the family-level variables, the individual-specific (e.g., age, race) demographic characteristics are for the reference person. For the member-level variables, the individual-specific demographic characteristics are for the specific member.

³⁹ The variable is transformed using the same methodology as the transformation of the dependent variables. The variable ERANKMTH does not exist on the public use files before the second quarter of 1994. The CE Survey office provided us with the variable from 1987 to the first quarter of 1994. It also provided us with the values for this variable from 2004-2006 because the value on the file in these years is affected by imputation. From 1984 to 1986, we calculated the value for ERANKMTH from the MTAB file.

quadratic time trend. For the member-level income sources, we also include usual hours worked and weeks worked over the last fifty-two weeks.

We use the following categorical variables in the family-level model: race;⁴⁰ education;⁴¹ urban/rural status; number of earners in the consumer unit;⁴² occupation;⁴³ family type; region; household tenure;⁴⁴ and, a series of dummy variables for receipt of all other individual income sources. When imputing unemployment insurance, welfare benefits, and food stamps, we also include state dummy variables to capture variation in these programs across states. The member-level models also include gender; marital status; and, relationship to the reference person (e.g., spouse, child). The model for wage and salary income also includes whether the member contributed to an IRA/401(k)-type retirement plan in the last twelve months and whether the member's employer or union contributed to a pension plan for the member.

The CE Survey used backward induction to limit the number of independent variables included in the final model. The model runs with all variables, but variables whose coefficient is not statistically significant at the 15 percent level are removed. The model is run again on this limited set of variables. If any variables are no longer statistically significant at the 15 percent level, they are removed. This process continues until all variables remain statistically significant at the 15 percent level. We do not follow this process. We use all variables at all times. Although the variables are not statistically significant at some relatively low level, the variables presumably provide some useful information and are correlated with the dependent variable.

We bottom code at \$1 any income source that is imputed to be negative or zero if the income source is not allowed to be negative.

The Sample

Following the CE Survey methodology, we use the current quarter and the previous nineteen quarters of data to impute. This only becomes a problem in the early years of our data where we do not have nineteen previous quarters available. From 1985Q3-1988Q4, we use the twenty quarters before 1988Q4 to impute income for all of these quarters.

We only use those that appear in the fifth interview, as we are interested in only those consumer units that complete all five interviews. The income questions are also only asked in the second and fifth interviews. The CE Survey imputed by family type (e.g., husband and wife with the youngest child under the age of 6; single males; single females), while we do not. Instead we include family type as an independent variable.

⁴⁰ Member-level race separated Asians from Pacific Islanders in 2003Q1. To remain consistent, we grouped Asians and Pacific Islanders together in all years. Also in 2003Q1, race of the reference person included an additional category for 'multiple races.' This was left as is as there was no way to recode to make the race variables agree.

⁴¹ Five categories were created education: less than high school; high school; some college; college; and, graduate degree.

⁴² Four categories were created for number of earners: 0, 1, 2, and 3+.

⁴³ Additional occupation categories were included starting in 1994. The categories were collapsed to match the earlier data.

⁴⁴ An additional category was added to tenure to create a separate category for those in public housing or subsidized housing. The CE Survey kept public housing and subsidized housing as separate categories.

Figure A2: CE and CPS published income and CE published expenditure data (2010\$) compared to our imputed income and expenditures

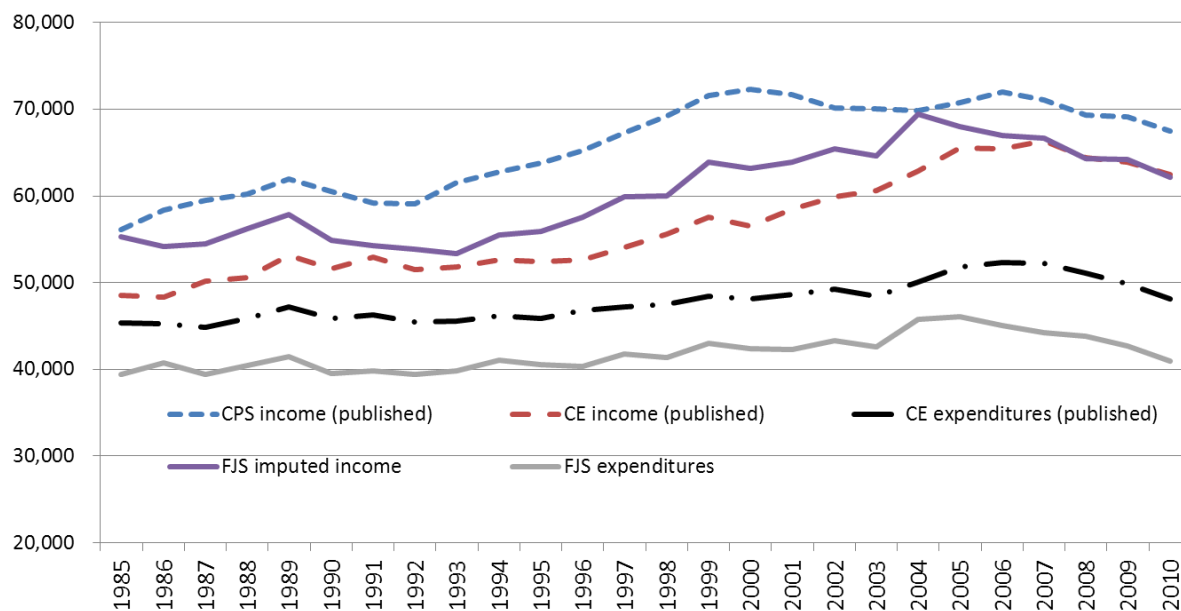


Table A1: Transition Matrix, Disposable Income and Consumption, 2010

		Income				
Consumption	2010	Bottom	2nd	Middle	4th	Top
	Bottom	59%	29%	8%	3%	1%
	2nd	23%	34%	30%	10%	2%
	Middle	10%	21%	31%	30%	8%
	4th	5%	10%	21%	36%	28%
	Top	3%	5%	10%	20%	62%

Figure A3: Correlation between disposable income and consumption, and sample size

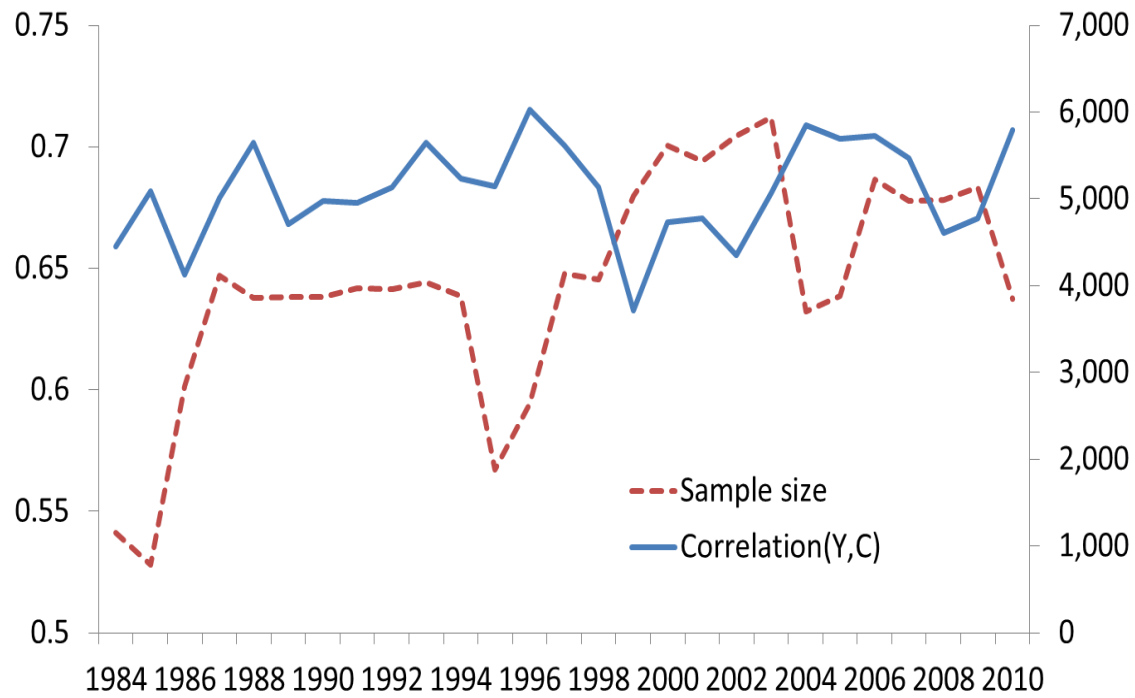


Figure A4: Density functions for income and consumption, 2010

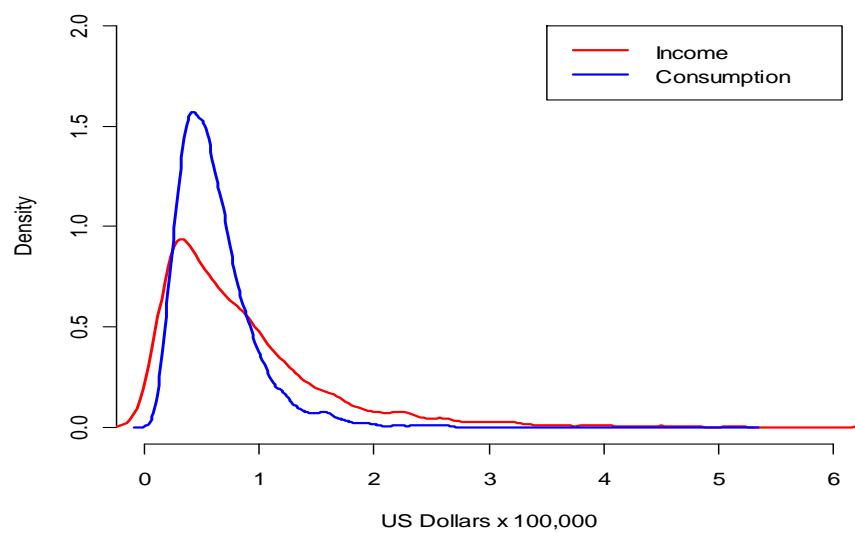
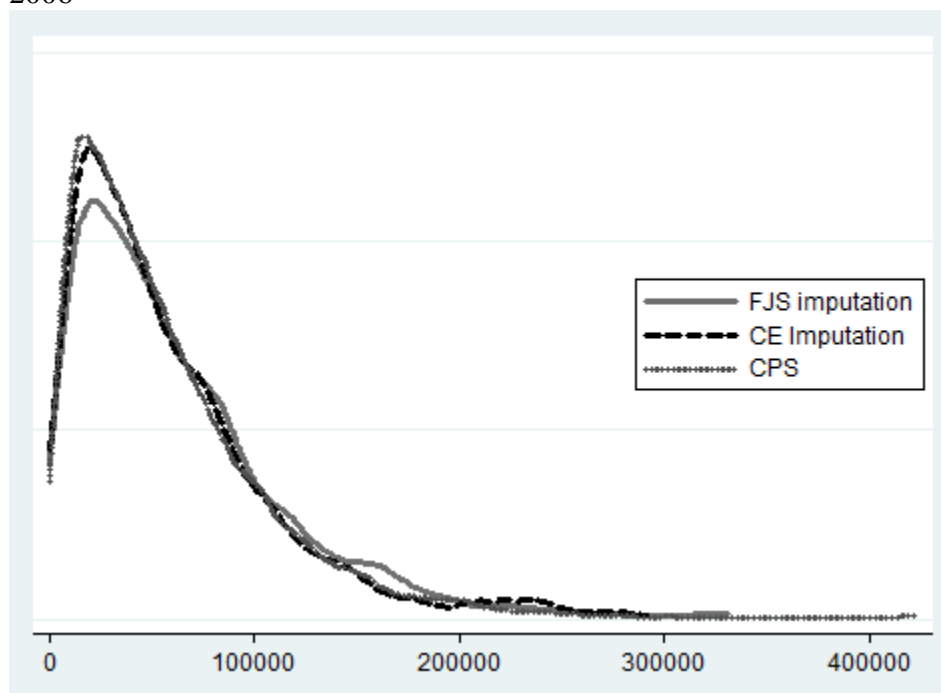


Figure A5: Comparison of the distribution of CE income, our imputed income, and CPS income, 2006



Appendix C: Estimating Income Taxes

Income taxes are estimated for all consumer units, even those that report valid values for some or all of their income taxes. Response rates to the tax variables are low. It is also assumed that the amount withheld is correct in the sense that it assumes that the exact amount withheld is correct and that the employer withheld the exact correct amount: did not over-withhold or under-withhold. Finally, all that is asked is how much was withheld in your last paycheck. This amount is divided by gross pay last paycheck to estimate a tax rate. This estimated tax rate is applied to total salary earnings in the twelve months. The constant tax rate assumption works well for someone continuously employed and receiving about the same rate of pay over the past twelve months. The assumption is less valid for other situations such as those that receive a positive or negative wage shock. Overall even the reported values can only be considered rough approximations to income taxes for the minority that actually report taxes.

Therefore we estimate taxes for all consumer units using the National Bureau of Economic Research's (NBER) TAXSIM program (see Feenberg and Coutts, 1993).⁴⁵

The first step in estimating taxes is defining a tax filing unit. The unit of observation in the CE Survey is a consumer unit. A consumer unit may have more than one tax filing unit within it. Any person in the CU that was not the reference person or spouse of the reference person that had earned income⁴⁶ above the standard deduction for a single person would be her own tax filing unit.⁴⁷ Starting in 1985, there is a higher standard deduction for those 65 years or older, and this value was used for those 65+. In 2011, the standard deduction was \$5,800, and it was \$7,250 for individuals ages 65+.

Any person that was not his/her own tax filing unit was assumed to be a member of the primary tax filing unit. There may be two adults in the consumer unit that were not the reference person or spouse. We did not attempt to discern whether these two other adults might be married. There is no way to guarantee that these two individuals are married. An aunt and uncle living in the home could be married or could be brother and sister. Similarly we did not attempt to assign any individual under the age of 19 who was not the child or adopted child of the reference person as a dependent of a separate tax filing unit because it is impossible to know with certainty who could claim this child as a dependent. There may be an adult child and a grandchild under the age of 19 in the home but that the grandchild is not the child of the adult child. There is little or no benefit in attempting to assign these individuals to a secondary tax filing unit.

With the filing units defined as above, the next step is to create the 22 input variables allowed by the TAXSIM model. These are discussed in the order shown in the Internet interface for TAXSIM.

- 1) **ID** is a variant of the consumer unit identification variable.
- 2) **Tax year** is defined off of the interview month and year. If the interview took place in June or earlier, the tax year is the year before the interview year. If the interview took place in July or later, the tax year is the year of the interview.
- 3) **State** is defined as state of residence. State taxes are not estimated after 2008 in TAXSIM. To estimate states taxes after 2008, we use the 2008 tax rates for the given

⁴⁵ <http://www.nber.org/taxsim/>

⁴⁶ Earned income is the sum of wage and salary income, non-farm self-employment income, and farm income. All three variables are measured at the individual level in the CE Survey.

⁴⁷ The values of the standard deduction were found here in February 2012

<http://www.taxpolicycenter.org/taxfacts/displayafact.cfm?DocID=171&Topic2id=30&Topic3id=39>.

state. More detail is given below about the state because the CE Survey suppresses or re-codes some states.

- 4) **Marital status** can be single, joint, head of household, or dependent taxpayer. For those reference persons that are single with no children in the consumer unit, we assume the person filed as single. We do not know if the person had a child living outside his consumer unit for which he could claim as a dependent. We assume all married couples file jointly. Any secondary tax filing unit in the consumer unit is treated as filing as single.
- 5) A child is counted as a **dependent exemption** if the child is younger than 19 and is a relative of the reference person. A child ages 19-24 years old is counted as a dependent if the child is a relative and the child is in college full-time.
- 6) **The number of taxpayers over age 65** references the ages of the reference person and spouse only. TAXSIM requires this variable to be equal to 0, 1, or 2.
- 7) **Wage and salary income of the taxpayer** equals the earned income of the reference person. Earned income is the sum of wage and salary income, non-farm self-employment income, and farm income. We subtract off pension contributions made by the individual out of his/her paycheck. These contributions are assumed to be tax deductible, and it is assumed that the contributions are at or below the statutory maximum. Pension contributions share one of the problems we had with reported taxes – the question regarding pension contributions addresses the most recent paycheck.
- 8) **Wage and salary income of the spouse** equals the earned income of everyone in the consumer unit except the reference person, if present. We also subtract off pension contributions of these other CU members. The only reason TAXSIM creates a different for the spouse is to calculate the marginal tax rate with respect to the taxpayer's earnings and with respect to the spouse's earnings, which is important for the analysis of the effect of taxes. We are only interested in total taxes paid, not the marginal tax rates.
- 9) The variable **Dividends** includes regular income from dividends, royalties, estates, and trusts. These income sources cannot be separated in the CE Survey.
- 10) **Other property income** is the sum of interest income, net income or loss from roomers and boarders, net income or loss from other rental units, alimony received, other money income such as cash scholarships and fellowships and money received for being a foster parent, and lump sum income such as income from estates, trusts, royalties, or games of chance.
- 11) **Taxable pensions** equal the sum of pension and annuity income.
- 12) **Gross social security benefits** represent social security and railroad retirement income before deductions for medical insurance and Medicare.
- 13) **Other non-taxable transfer income** is the sum of public assistance and welfare income, regular child support payments received, lump sum child support payments received, and food stamp/SNAP benefits.
- 14) **Rent paid** equals total rental payments excluding rent received as pay.
- 15) **Real estate property taxes** are the sum of all property taxes paid.
- 16) The components of **other items** are not available in the CE Survey, and the variable is set to zero.
- 17) **Child care expenses** are the sum of all child care expenses.
- 18) **Unemployment compensation** represents all unemployment compensation income in the last year.

- 19) **Number of dependents under age 17** is the count of people under age 17 in the consumer unit.
- 20) **Deductions not included elsewhere** include mortgage payments, cash contributions, and out-of-pocket health expenditures.
- 21) **Short-term capital gains** are not available in the CE Survey and are set to zero.
- 22) **Long-term capital gains** are not available in the CE Survey and are set to zero.

Variables 5, 6, 8, and 9-20 only get assigned to the reference person and spouse. All secondary tax filing units are assigned a zero dollar value for these variables.

State identifiers

To protect the confidentiality of some respondents, the CE Survey suppresses some state identifiers. For example, in the 2011 CE Survey any respondent living in Arkansas, Mississippi, Montana, North Carolina, or South Dakota has a missing value for the state identifier. Other states, such as Ohio, only have a portion of its respondents suppressed.

The CE Survey also re-codes some state identifiers. The state variable may be reported but the respondent may be re-coded as living in another state. Someone living in Minnesota may be re-coded as living in Wisconsin.

The suppression and re-coding of states is important because we estimate state income taxes and because tax filers can deduct state income taxes on the federal income tax return. States can have vastly different income tax rates.

The CE Survey documentation indicates what states have been suppressed and/or re-coded, and it lists the states that are recipients of re-codes as well. We use this information along with the region of residence (Northeast, Midwest, South, and West) to identify the potential states a consumer unit lives in. For example in 2011 if region was equal to Northeast and state was missing, the CE documentation indicates that only residents of Maine and New York were suppressed. Thus we know that the consumer unit lived in either Maine or New York. For these consumer units, we create two observations, one for the CU living in Maine and one for the CU living in New York. Taxes are calculated using both states, and then the weighted average of taxes is estimated using the state's population in each year as the weight.

The suppression and re-coding patterns change with each sample redesign based on the new Decennial Census of Population. The CE redesigns were in 1986, 1996, and 2005.

Finally from 1984-1995 and from 2006 on, the region variable could be missing. If state is suppressed or re-coded and region is missing, then the possible states the CU lives in is the population of all states that are re-coded or suppressed in the CE Survey in that year.

Appendix D: Proof that Gini for maximum and minimum lie between consumption and income Gini.

Notation:

$\mathbf{y} = \{y_1, \dots, y_n\}$ the vector of income for the population of size n .

$\mathbf{c} = \{c_1, \dots, c_n\}$ the vector of consumption for the population of size n .

$M_i = \max\{y_i, c_i\}$ the maximum of income and consumption for person i .

$m_i = \min\{y_i, c_i\}$ the minimum of income and consumption for person i

$\mathbf{M} = \{M_1, \dots, M_n\}$ and $\mathbf{m} = \{m_1, \dots, m_n\}$.

$I(\mathbf{c}, \mathbf{y})$ the inequality of the vector of consumption and income, hence $I(\mathbf{c}, \mathbf{y}) = I(c_1, \dots, c_n, y_1, \dots, y_n)$

$\mu_c, \mu_y, \mu_M, \mu_m$, are the respective means for c, y, M and m .

$\mu_i = 0.5*(y_i + c_i)$ the average of income and consumption for person i .

Using decomposition techniques,

$$(1) \quad I(\mathbf{c}, \mathbf{y}) = 0.5*I(\mathbf{c}) + 0.5*I(\mathbf{y}) + I(\mu_c, \mu_y).$$

By autonomy, $I(\mathbf{c}, \mathbf{y}) = I(c_1, y_1, \dots, c_n, y_n)$ and by decomposition

$$(2) \quad I(\mathbf{c}, \mathbf{y}) = 1/n \sum_i I(c_i, y_i) + I(\mu_1, \dots, \mu_n)$$

Combining (1) and (2), we have

$$(3) \quad I(\mathbf{c}) + I(\mathbf{y}) = 2*(1/n \sum_i I(c_i, y_i) + I(\mu_1, \dots, \mu_n) - I(\mu_c, \mu_y))$$

For the max and min, by autonomy, $I(\mathbf{c}, \mathbf{y}) = I(M_1, m_1, \dots, M_n, m_n)$.

Using similar techniques given in (1)-(3) yields

$$(4) \quad I(\mathbf{M}) + I(\mathbf{m}) = I(\mathbf{c}) + I(\mathbf{y}) + 2*(I(\mu_c, \mu_y) - I(\mu_M, \mu_m))$$

Since $(I(\mu_c, \mu_y) - I(\mu_M, \mu_m)) < 0$, $I(\mathbf{M}) + I(\mathbf{m}) < I(\mathbf{c}) + I(\mathbf{y})$

Note that $\mathbf{M} = \{c_{z1}, \dots, c_{zj}, y_{zj+1}, \dots, y_{zn}\} = \{\mathbf{C}_1, \mathbf{Y}_2\}$, where $c_{zi} \geq y_{zi}$, for $z_i \leq z_j$.

And $\mathbf{m} = \{y_{z1}, \dots, y_{zj}, c_{zj+1}, \dots, c_{zn}\} = \{\mathbf{Y}_1, \mathbf{C}_2\}$.

Hence $I(\mathbf{M}) = I(\mathbf{C}_1, \mathbf{Y}_2)$ and using (1)

$$(5) \quad I(\mathbf{M}) = z_i/n I(\mathbf{C}_1) + (1-z_i)/n I(\mathbf{Y}_2) + I(\mu_{c1}, \mu_{y2})$$

Similarly,

$$(6) \quad I(\mathbf{c}) = (z_i/n)I(\mathbf{C}_1) + ((1-z_i)/n) I(\mathbf{C}_2) + I(\mu_{c1}, \mu_{c2})$$

$$(7) \quad I(\mathbf{y}) = z_i/n I(\mathbf{Y}_1) + (1-z_i)/n I(\mathbf{Y}_2) + I(\mu_{y1}, \mu_{y2})$$

$$(8) \quad I(\mathbf{m}) = z_i/n I(\mathbf{Y}_1) + (1-z_i)/n I(\mathbf{C}_2) + I(\mu_{y1}, \mu_{c2})$$

Using (7) and (8) and (5) yields

$$(5a) \quad I(\mathbf{M}) = I(\mathbf{y}) + (z_i/n) [I(\mathbf{C}_1) - I(\mathbf{Y}_1)] + [I(\mu_{c1}, \mu_{y2}) - I(\mu_{y1}, \mu_{y2})] \text{ and}$$

$$(5b) \quad I(\mathbf{M}) = I(\mathbf{c}) - ((1-z_i)/n) [I(\mathbf{C}_2) - I(\mathbf{Y}_2)] - [I(\mu_{c1}, \mu_{c2}) - I(\mu_{c1}, \mu_{y2})]$$

Alternatively, using (4) implies that

$$(9) \quad I(\mathbf{M}) = I(\mathbf{y}) + 2*(I(\mu_c, \mu_y) - I(\mu_M, \mu_m)) + \\ z_i/n (I(\mathbf{C}_1) - I(\mathbf{Y}_1)) + \\ I(\mu_{c1}, \mu_{c2}) - I(\mu_{y1}, \mu_{c2})$$

Claim:

$$(10) \quad I(\mathbf{c}) < I(\mathbf{M}) < I(\mathbf{y}) \text{ if}$$

$$(11) \quad \mu_{c2} > \mu_{c1} \text{ and } I(\mathbf{C}_2) < I(\mathbf{Y}_2)$$

Idea of proof: The second term on the RHS of equation (10) is negative. By definition, $\mu_{c1} \geq \mu_{y1}$ and $\mu_{c2} \leq \mu_{y2}$. If we assume that the distribution of y and c are such that it is more likely that $c > y$ for those on the lower end of the distribution, then $\mu_{c2} > \mu_{c1}$ and the last term is negative. And (11) guarantees that the third term is negative, i.e., that $I(C_k) < I(Y_k)$ for “most” groups k .

For example, if $c_i = a + by_i$ ($a \geq 0$ and $0 < b < 1$), then (11) holds. More generally, if $c_i = a + by_i + e_i$ ($a \geq 0$ and $0 < b < 1$), and there is no heteroskedasticity, that is $\mu_{e1} = \mu_{e2} = 0$ and $\sigma_{e1} = \sigma_{e2}$ then (11) holds.