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Decomposing Trends in Income Volatility: The 'Wild Ride' at the Top and Bottom

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Abstract: We provide a detailed accounting of the trend increase in family income volatility in recent decades by quantifying the contributions of household head earnings, spouse earnings, non-transfer non-labor income, transfer income, and tax payments (inclusive of the refundable Earned Income Tax Credit), along with covariances among the income components. Using two-year matched panels in the Current Population Survey from 1980 to 2009, we find that the volatility of family income, as measured by the variance of the arc percent change, doubled over the past three decades. The increase in volatility was most pronounced among the top 1% of the income distribution; however, in any given year the level of volatility among the bottom 10% exceeds that of the top. The variance decompositions indicate that increased family income volatility comes directly from the higher volatility of head and spouse earnings, and other nonlabor income, as well as from substantially reduced covariance between these three income sources with the tax system. This suggests that the current tax code is less effective in mitigating income shocks than in previous decades. Among lower income households, a larger share of volatility is driven by transfer income. In the absence of the increased negative covariance between the volatility of head earnings with non-transfer other income, overall volatility would be much higher.

By most accounts income volatility for the typical family in the United States has been on the rise since the early 1970s, with estimates ranging from 10 percent to a doubling (Gundersen and Ziliak 2003; Dynan, et al. 2008; Hacker and Jacobs 2008; Gottschalk and Moffitt 2009; Winship 2009; Dahl, Deleire, and Schwabish 2011). Understanding the sources of rising volatility is important because of the possibility that changes in labor supply and public policies may have shifted more idiosyncratic and business cycle risk onto families, which could have negative welfare consequences if it falls predominantly on those that face liquidity constraints and are less able smooth income shocks (Kniesner and Ziliak 2002; Blundell, et al. 2008; Hacker and Jacobs 2008; Gottschalk and Moffitt 2009; Parker and Vissing-Jorgenson 2009). Our aim in this paper is to provide a detailed accounting of the trend increase in family income volatility by quantifying the contributions of household head earnings, spouse earnings, non-transfer non-labor income, transfer income, and tax payments (inclusive of the refundable Earned Income Tax Credit), along with covariances among the income components.

The initial interest in volatility among labor economists focused on earnings of male heads of household in an effort to better understand whether the rise in wage inequality represented temporary shifts or structural changes in the labor market (Gottschalk and Moffitt 1994; Haider 2001). This spawned a series of additional studies, with the consensus being that earnings instability among men peaked in the 1980s and stabilized thereafter (Dynarski and Gruber 1997; Keys 2008; Shin and Solon 2008; Celik, et al. 2009; Dahl, DeLeire, and Schwabish 2011; Ziliak, Hardy, and Bollinger 2011). The earnings instability of women also stabilized in the late 1980s, but unlike men, actually fell from peaks in the early 1970s as more women entered full time employment. Not well known, however, is whether there have been changes in the correlation of earnings shocks between husbands and wives that might contribute to the trend

rise in income volatility. The canonical added worker hypothesis (Lundeberg 1985) stipulates that earnings shocks of husbands and wives are negatively correlated—a fall in husband earnings due to unemployment is offset by a rise in earnings of the wife—but if there is assortative matching in the marriage market and both spouses work in similar industries/occupations then it is possible that earnings shocks are positively correlated (Shimer and Smith 2000). If the added-worker phenomenon dominates then spousal labor supply should attenuate trends in income volatility, while if assortative matching dominates then we might expect volatility exacerbated.

In addition to secular changes in labor supply of families, there have been dramatic changes to the U.S. tax and transfer system. For example, in 1996 the most fundamental reform to the U.S. welfare system was passed, and it in conjunction with expansions in the EITC in 1993, led to dramatic increases in the labor supply of low-skilled single mothers (Meyer and Rosenbaum 2001). However, because of the clawback in welfare benefits after the reform, due both to mechanical responses (because benefits are means-tested and thus fall with rises in earnings) and behavioral responses, the level of after-tax income after welfare reform actually fell (Bollinger, Gonzalez, and Ziliak 2009). With restricted access to the safety net it is possible that these families face greater income risk, especially during the recessions of 2001 and 2008.

At the other end of the distribution, the tax reforms of the 1980s greatly reduced marginal tax rates among high-income families. Ziliak and Kniesner (2002) showed that these reforms reduced implicit income and consumption insurance to families. That is, the more progressive the tax system the smaller the decline in after-tax income when before-tax income falls, and thus the move to a flatter tax system resulted in reduced implicit insurance and greater ex ante after-tax income risk among high-income families. Indeed, Parker and Vissing-Jorgenson (2009, 2010) found that the cyclicality of incomes at the top of the income distribution far surpassed

that facing the typical household, leading Frank (2011) to characterize this trend as "the wild ride of the 1%." The Parker and Vissing-Jorgenson result that cyclicality at the top of the distribution dominates that of the typical family assuages concerns over negative welfare consequences of volatility assuming that liquidity constraints are not binding at the top, but their use of tax return data does not allow a detailed analysis of lower-income households because many do not file returns. It thus remains an open question whether the volatility at the top exceeds that at the bottom, and one that we address. The combination of welfare reform and tax reform suggests that examining changes in volatility sources across the income distribution is important.

In order isolate whether rising after-tax income volatility is explained by an increase in the variance of earnings on the one hand, or a (absolute value) decrease in the covariance of earnings and tax payments on the other hand, we employ a variance decomposition of income volatility into its component parts of spousal earnings, transfer income, other non-transfer income, less net tax payments.[1] A key advantage of the variance is that once we weight each of the income components by their respective shares in (two-year) average income, total volatility is the sum of the volatility of the individual income sources plus the covariances across sources. For our measure of volatility we use the arc percent change in income, which is advantageous over the point percent change because it is symmetric, it is more robust to large swings in incomes, and it easily admits zero (or negative) incomes.

In constructing the weighted variance of the arc percent change we treat the individual income shares and volatility terms as random variables, and use the exact decomposition techniques of Bohrnstedt and Goldberger (1969) for the products of random variables. We also

[1] Our study is most similar to Dynan, et al. (2008), who examine trends in earnings, cash transfers, and other nonlabor income using data from the Panel Study of Income Dynamics. Our paper differs in that we examine both the variances and the covariances across income sources via our exact variance decomposition, we include taxes and in-kinds transfers, and we use much larger CPS data to analyze volatility across the distribution.

differ from the literature by exploiting a little used feature of the Current Population Survey (CPS) that permits linking of the same individual across annual waves to create a series of two-year panels (Gittleman and Joyce 1996; Cameron and Tracy 1998; Ziliak, Hardy, Bollinger 2011). The advantage of the CPS relative to datasets such as the Panel Study of Income Dynamics is the large sample sizes that permit more robust examination of trends across the distribution. The CPS is also the workhorse dataset for research on income inequality, and since volatility is a potential contributor to inequality, it is useful to examine volatility in the CPS.

Our results show that overall family income volatility more than doubled from 1980 to 2009, and while the increase in volatility was most pronounced among the top 1% of the income distribution, in any given year the level of volatility among the bottom 10% exceeds that of the top, suggesting the potential for substantial welfare losses among the poor facing liquidity constraints. Overall, the variance decomposition indicates that increased family income volatility comes directly from the higher volatility of head and spouse earnings, other income, and a reduced covariance between these three income sources with the tax system, suggesting that the current tax code is less effective today in mitigating income shocks. We present evidence that after 1990 the covariance of spousal earnings switched from negative (or zero) to positive, consistent with assortative matching, and that leads to modest upward pressure on overall income volatility. Although transfers intercede to dampen family earnings volatility among lower income households, there is less smoothing from this source in recent years. Decomposition analysis also shows volatility among higher income families is driven by earnings and other income, and that within this relationship, an increasing covariance between earnings and other income occurs – suggesting other income offsets earnings shocks in a way similar to the tax system.

II. A Decomposition of Income Volatility

In modeling the extent to which disposable incomes fluctuate from one year to the next, and the attendant channels that generate those fluctuations, we highlight five sources of income for a family: the wages of the head (*h*), the wages of the spouse (*s*), non-transfer other income (*o*), transfer income (*tr)*, and tax payments (*tx*). This leads to a specification of disposable family income for family *i* in time *t* as

$$(1) \qquad y_{it} = y_{it}^{h} + y_{it}^{s} + y_{it}^{o} + y_{it}^{tr} - y_{it}^{tx},$$

where the first four terms are generally positive and expand family resources, while taxes reduce resources. We note, though, that with refundable credits such as the EITC tax payments may be negative, and thus resulting in higher after-tax income than before-tax.

We measure disposable income volatility, v_{it}, as the variance of the arc percent change

$$(2) \qquad v_{it} = V\left\{\frac{y_{it}-y_{it-1}}{\bar{y}_i}\right\},$$

where $V\{\ \}$ is the variance operator, and $\bar{y}_i = \frac{y_{it}+y_{it-1}}{2}$ is the person-specific time mean across the pair of years.[2] The use of the time-mean in the denominator helps reduce the influence of extreme swings of income across years, and with the added feature that this measure is symmetric and bounded below by -200 percent and above by +200 percent. Dynan, et al. (2008), Dahl, et al. (2011), and Ziliak, et al. (2011) measure volatility with the standard deviation of the arc percent change. We use the variance because it is additively separable in subcomponents whereas the standard deviation is not.

[2] In a sensitivity analysis where negative incomes are permitted owing to business losses we use the absolute value of income in time *t* and *t*-1. The volatility measure in equation (2) still retains its symmetry property in this case. We find that including negatives has negligible impacts on the trend in disposable income volatility, so we do not show trends including negative values. In addition, we note that it is possible for a person to have income that is equal but opposite in sign across years, and instead of averaging to zero our measure reports the average as the absolute value of one of the years. In practice we find that this is not an issue and we do not lose any observations.

To identify the contribution of each income source to total volatility, we apply the arc percent change to equation (1) as

(3) $$\frac{y_{it}-y_{it-1}}{\bar{y}_i} = \frac{\bar{y}_i^h}{\bar{y}_i}\left\{\frac{y_{it}^h-y_{it-1}^h}{\bar{y}_i^h}\right\} + \frac{\bar{y}_i^s}{\bar{y}_i}\left\{\frac{y_{it}^s-y_{it-1}^s}{\bar{y}_i^s}\right\} + \frac{\bar{y}_i^o}{\bar{y}_i}\left\{\frac{y_{it}^o-y_{it-1}^o}{\bar{y}_i^o}\right\} + \frac{\bar{y}_i^{tr}}{\bar{y}_i}\left\{\frac{y_{it}^{tr}-y_{it-1}^{tr}}{\bar{y}_i^{tr}}\right\} - \frac{\bar{y}_i^{tx}}{\bar{y}_i}\left\{\frac{y_{it}^{tx}-y_{it-1}^{tx}}{\bar{y}_i^{tx}}\right\},$$

where the arc percent change of each income source is weighted by its share of mean income across each pair of two years. Taking the variance of both sides results in

(4) $$v_{it} = \sum_{j=1}^{5} V(\rho_i^j a_{it}^j) + \sum_{k=1}^{5}\sum_{j=1}^{5} C(\rho_i^j a_{it}^j, \rho_i^k a_{it}^k),$$

where the left hand side is total volatility as in equation (2), $\rho_i^j = \frac{\bar{y}_i^j}{\bar{y}_i}$ is the share of component *j* income to the total, $a_{it}^j = \frac{y_{it}^j - y_{it-1}^j}{\bar{y}_i^j}$ is the arc percent change, and *j* = *h*, *s*, *o*, *tr*, and *tx* (corresponding to 1,..,5 in the summation). Equation (4) implies total volatility consists of five variance terms (*V*(.)) and ten unique covariance terms (*C*(.)). We treat both ρ_i^j and a_{it}^j as random variables, and use results of Borhnstedt and Goldberger (1969) to compute exact variances and covariances of the product of random variables as

(5) $$V(\rho_i^j a_{it}^j) = E^2(\rho_i^j)V(a_{it}^j) + E^2(a_{it}^j)V(\rho_i^j) + E\left[(\Delta\rho_i^j)^2(\Delta a_{it}^j)^2\right]$$
$$+2E(\rho_i^j)E\left[(\Delta\rho_i^j)(\Delta a_{it}^j)^2\right] + 2E(a_{it}^j)E\left[(\Delta\rho_{it}^j)^2(\Delta a_{it}^j)\right]$$
$$+2E(\rho_i^j)E(a_{it}^j)C(\rho_i^j, a_{it}^j) - C^2(\rho_i^j, a_{it}^j)$$

and

(6) $$C(\rho_i^j a_{it}^j, \rho_i^k a_{it}^k) = E(\rho_i^j)E(\rho_i^k)C(a_{it}^j, a_{it}^k) + E(\rho_i^j)E(a_{it}^k)C(a_{it}^j, \rho_i^k)$$
$$+E(a_{it}^j)E(\rho_i^k)C(\rho_i^j, a_{it}^k) + E(a_{it}^j)E(a_{it}^k)C(\rho_i^j, \rho_i^k)$$
$$+E\left[(\Delta\rho_i^j)(\Delta a_{it}^j)(\Delta\rho_i^k)(\Delta a_{it}^k)\right] + E(\rho_i^j)E\left[(\Delta a_{it}^j)(\Delta\rho_i^k)(\Delta a_{it}^k)\right]$$
$$+ E(a_{it}^j)E\left[(\Delta\rho_i^j)(\Delta\rho_i^k)(\Delta a_{it}^k)\right] + E(\rho_i^k)E\left[(\Delta\rho_i^j)(\Delta a_{it}^j)(\Delta a_{it}^k)\right]$$

$$+ E\left(a_{it}^{k}\right)E\left[\left(\Delta\rho_{i}^{j}\right)\left(\Delta a_{it}^{j}\right)\left(\Delta\rho_{i}^{k}\right)\right] - C\left(\rho_{i}^{j}, a_{it}^{j}\right)C\left(\rho_{i}^{k}, a_{it}^{k}\right),$$

where $\Delta x = x - \bar{x}$ is the deviation from mean for $x(= \rho, a)$, and $E(\ )$ is the expectations operator. This decomposition implies that family income changes can arise directly from one of the five sources, or from the covariances of the income sources. For example, if husband and wife labor supply decisions are substitutes, then a negative shock to head's earnings could result in an offsetting increase in the volatility of wife earnings, leaving total volatility of the family little changed. Below we calculate total volatility and the contribution of the 15 variances and covariances for each year over the past three decades.

III. Data

The economic and demographic information on families comes from the Annual Social and Economic Supplement of the Current Population Survey (CPS) for calendar years 1980-2009 (interview years 1981-2010). With the exceptions of Dahl, et al. (2011) and Parker and Vissing-Jorgensen (2009, 2010), the literature on income volatility has relied exclusively on longitudinal data from the Panel Study of Income Dynamics (PSID). The PSID is the longest running panel of families available, and is well suited for research on volatility, but the survey was redesigned in 1992 and 1993, and thus papers using the PSID have arrived at different results depending on how they handle the redesign years. Another reason for different results from PSID-based papers is with the treatment of families reporting zero earnings or income. Because much of the literature reports the variance of log earnings or income, person-years with zero earnings/income are dropped from the analysis, which can understate measured volatility because labor-force dropouts are ignored. Although as noted below we observe at most one-half of the CPS sample across two-years, this is sufficient for our arc percent change volatility measure, and given the

large samples in the CPS, we are able to estimate income volatility trends with precision for detailed subgroups, as well as across the income distribution.

Our sample consists of family heads ages 25 to 60, where a family is defined as two or more persons related by birth, marriage, or adoption. As specified in equation (1) the focal variable is disposable income, which is the sum of head and spouse earnings, non-transfer other income, transfer income, less net tax payments. Earnings of the head (and spouse if present) is defined as the sum of wage and salary income, non-farm self employment, and farm self employment. Other non-transfer income consists of labor income of other relatives beside the head or spouse; rent, interest, and dividends; alimony; child support; private pensions; and gift income.[3] Transfer income consists of Social Security and Disability Insurance; Supplemental Security Income; Unemployment Insurance; Workers Compensation; Veterans Payments; Aid to Families with Dependent Children (and after 1996, Temporary Assistance for Needy Families); General Assistance; food assistance such as food stamps (called Supplemental Nutrition Assistance Program after 2008) along with school breakfast and lunch; and housing assistance from public housing and Section 8 vouchers. Tax payments are the sum of federal, state, and payroll taxes that are estimated for each family in each year using the NBER *TAXSIM* program in conjunction with basic information on labor income, taxable nonlabor income, dependents, and certain deductions such as property tax payments and child care expenses.[4] The federal and state taxes include the respective EITC code for each tax year and state, thus allowing for the possibility of negative tax payments. We assume that the family bears only the employee share

[3] As a sensitivity check, we also conduct the volatility analyses with simulated data on capital gains produced by the Census Bureau. The measure was discontinued as of 2010 due to data irregularities and poor quality. The general trends and results are not significantly affected by its inclusion.

[4] The CPS does not have information on certain inputs to the *TAXSIM* program such as annual rental payments, child care expenses, or other itemized deductions. We set these values to zero when calculating the tax liability..

of the payroll tax rate. Unless noted otherwise all income data are deflated by the Personal Consumption Expenditure Deflator with 2009 base year.

The CPS employs a rotating survey design so that a respondent is in sample for 4 months, out 8 months, and in another 4 months. This makes it possible to match approximately one-half of the sample from one March interview to the next. Following the recommended Census procedure we perform an initial match of individuals on the basis of five variables: month in sample (months 1-4 for year 1, months 5-8 for year 2); gender; line number (unique person identifier); household identifier; and household number. We then cross check the initial match on three additional criteria: race, state of residence, and age of the individual. If the race or state of residence of the person changed we delete that observation, and if the age of the person falls or if it increases by more than two years (owing to the staggered timing of the initial and final interviews), then we delete those observations on the assumption that they were bad matches.

Prior to matching across years, we delete those observations with imputed income as recommended by Bollinger and Hirsch (2006), and we adopt the consistent set of income top codes constructed by Larrimore, et al. (2009) to mitigate the influence of changes in Census top code procedures starting in the mid 1990s. Burkhauser, et al. (2012) find that using the consistent top code method results in CPS measures of income inequality tracking those from proprietary tax return data better than (unadjusted) public-use CPS data, and Ziliak, et al. (2011) find the use of the consistent top codes to be important in documenting trends in earnings volatility. There were major survey redesigns in the mid 1980s and mid 1990s so it is not possible to match across the 1985-1986 waves and the 1995-1996 waves. This yields an interrupted time series across 29 years with gaps in calendar years 1984-1985 and 1994-1995. As indicated in Appendix Table 1, we have 14,466 observations in an average year when a match is

possible, for a total of 433,981 matches. Appendix Table 1 also summarizes the number and rate of matches for each year, indicating that we match approximately 49 percent across survey years on average. The declining match rate after the mid 1990s reflects in part a rise in allocation within the CPS after adoption of CATI-CAPI interviewing. In results not tabulated, if we retain individuals with allocated earnings and income then we match just over 62 percent across years.

A possible concern with declining match rates is with sample attrition affecting our volatility series. Under the assumption that the probability of attrition is unobserved and time invariant (i.e., a fixed effect), then differencing the variable will remove the latent effect (Ziliak and Kniesner 1998; Wooldridge 2001). If there is a time-varying factor loading on the unobserved heterogeneity then differencing will not eliminate potential attrition bias, though if the loading changes slowly over time then differencing will mostly eliminate bias. A conservative interpretation, then, is that data from matched CPS provides estimates of volatility among the population of non-movers. Even if this is true it is still not clear a priori whether potential time-varying attrition affects overall trends in volatility as moves can be accompanied by downward or upward movements in income, or no change at all. Our measure of volatility described above involves first differencing income, and thus under the maintained assumption that attrition is person-specific and time invariant, we believe potential attrition bias will be attenuated.

For most of our analyses we restrict attention to family heads with nonnegative disposable incomes, resulting in a reduced pooled sample size of 238,275. This means that in our baseline series we include families with zero disposable income, which is possible if taxes exactly offset income, or more likely, if the family depends on non family members such as a cohabiting partner for support. There are 1,300 observations, or 0.55 percent of stable family

heads, that report zero income in one of the two years, and 151 heads, or 0.06 percent, that report zero disposable income in both years. The arc percent change measure of volatility accommodates zero income in one of the periods with no adjustment necessary, but when income is zero in both years, the arc percent change is not defined. Because 'volatility' in practice is zero when income is zero both years, we retain these observations and set volatility to zero.[5] In all cases the family head is restricted to be the same across years, and for the subsamples of married couples and female heads, the additional restriction of constant marital status is imposed. Basic summary statistics are provided in Appendix Table 2.

IV. Trends in Income Volatility

We begin in Figure 1 by presenting the trend in after-tax income volatility across all families (i.e. the series represented by the '♦'). In any given year, the figure presents the year 2 value of volatility so that 1981 refers to families matched across 1980 and 1981, 1982 refers to 1981-1982 matches, and so on. The figure shows a strong secular rise in income volatility, which peaked in 2001, and subsequently stabilized for the remainder of the last decade. By 2009 income volatility increased 108 percent since the early 1980s, suggesting much heightened instability facing the average American family.

[Figure 1 here]

In the figure we examine the sensitivity of our volatility trend to excluding zeros, including capital gains and losses, and including an adjustment factor for higher income families. Figure 1 shows that when we drop observations with zero income in one (or both) years, the level of volatility falls in every year, and the trend increase is lower but still a substantial 78

[5] Blank (2012) also discusses the issue of zero family income in the March CPS and comes to a similar conclusion that these are legitimate observations and retains them in her analysis.

percent increase. On the other hand, when we include the simulated values of capital gains and losses computed each year starting in 1980 by the Census Bureau (but eliminated in 2009), the level of volatility is slightly higher and trend increase nearly identical to the base case (102 percent increase). Finally, we estimate trend volatility with an additional adjustment factor over and above the Larrimore, et al. (2009) consistent top code that accounts for the censoring of top incomes within the CPS. This interpolation technique, based on the Pareto distribution (Piketty and Saez 2003), does not affect either the level or trend of our main volatility series in Figure 1.

[Figure 2 here]

Figure 2 demonstrates that the rise in disposable income volatility cuts across race and family structure. In any given year, the volatility of families headed by black person, or families headed by a single mother, are substantively higher than the volatility among white families or married families. However, the rise in volatility among white families and married families was actually larger (112% and 134%, respectively) than the other two groups (79% and 62%, respectively). Because the trends are common across major demographics groups, for ease of presentation in most of the ensuing analysis we focus our discussion on the pooled sample of all families unless otherwise noted.

In Figures 3 and 4 we examine the underlying components of rising disposable income volatility based on the decomposition in equations (4)-(6). Figure 3 presents the five weighted variance terms from equation (5), along with the total volatility among all families from Figure 1. We see here that the level of volatility in any given year is strongly influenced by the volatility of head and spouse earnings, as well as non-transfer other income. However, volatility increased across all variance components, rising about 87 and 84 percent respectively for head and spouse earnings, 55 percent for other income, about 20 percent among tax payments.

Although the level is low, transfer payment volatility increased 160 percent, especially in the last few years with the onset of the Great Recession.

[Figures 3 and 4 here]

In Figure 4 we depict the ten weighted covariance terms based on the formula in equation (6). It is important to recall that these are not covariances across levels of income sources, but rather the covariance of income volatilities. Covariances that are positive, or that become less negative from one year to the next, lead to upward pressure on total volatility, while those that are negative or become less positive from one year to the next put downward pressure on total volatility.

Figure 4 shows that in the first half of the sample period the covariance of head and spouse earnings volatility was negative, or zero, whereas over the past decade it has become positive (i.e. the series represented by the '♦'). This suggests that husbands and wives now have positively correlated earnings shocks, which makes it more difficult to smooth family income volatility. At the same time, Figures 3 and 4 make clear the importance of the tax code in smoothing income shocks. For example, as head and spouse earnings volatilities were peaking in the 2000-2001 period, the negative covariances of head wages with taxes (the series represented by the '×'), coupled with the negative covariance of spouse wages with taxes (the '+' series), attenuated substantially the growth in total volatility. Whereas the tax system appears to be fairly responsive in mitigating volatility from earnings and other income sources, the covariances between head or spouse earnings with transfers has been little changed over the three decades (the '∆' and '∘'). Indeed, aside from the tax system, over the past decade total family income volatility was largely kept in check by the growing negative covariance of other non-transfer income volatility with earnings volatility of the head (the '■' series).

[Table 1 here]

To further illuminate the changing roles of the various income sources over time, in Table 1 we present the share of each of the 15 components in the weighted variance-covariance decomposition to total volatility (along with the estimated total variance in the first column). Table 1 corresponds directly to Figures 3 and 4, but for brevity we tabulate results for every fourth year of the sample (except 1985 which, as described in the Data section, is missing). Each row in the table sums to 1. Comparing the shares in 1981 to those in 2009 in Table 1 we see that in 2009 even though volatility is double, the share from the variance of both head and spouse wages fell, as did that of other non-transfer income and taxes, while the share from the variance of transfers rose modestly. This suggests that the largest upward pressure came from the (absolute value) reduction in the shares from the covariance of the tax system with earnings and other income. That is, the covariance terms of taxes in Figure 4 are larger in absolute value in 2009 than in 1981, but as a share of the total it has declined. Indeed, with the exception of 2009, for most of the past decade the tax code reduced income volatility just under 19 percent, while in the 1980s it lowered it by almost 22 percent. This is consistent with the results of Kniesner and Ziliak (2002) who showed that the tax code prior to the Reagan tax cuts of the 1980s offered more implicit insurance against income shocks.

[Table 2 here]

Because Table 1 (and Figures 3 and 4) pools married and unmarried heads of household, the covariances of head and spouse income are muted as it contains zeros for those with no spouse. In Table 2 we isolate married heads of household where it is clear that we are better able to capture the covariation of spousal income. In 1981 the covariance of husband and wife volatility was -0.03, suggesting that earnings shocks were offsetting as suggested by the added

worker hypothesis, but within a decade the covariance was positive, rising to +0.04 by 2001, and remained above 0 for the remainder of the sample period. The positive covariance is consistent with assortative matching in the marriage and labor markets. Moreover, in Table 2 we see that among married families the weighted variance of head earnings exceeds that of the family overall, and thus there is a greater role of the tax system in any given year to reduce volatility. Again, however, the share of the covariance between head wages and taxes fell more than the head's wage variance, so that the share declined in absolute value resulting in higher volatility overall for married couples (this also came from a substantial decline on the covariance of volatility of other income and taxes).

V. Volatility across the Distribution

In this section we examine what, if any, differences emerge in the relative contribution of earnings, taxes, transfers, and non labor income to family income volatility across income level. As noted in the Introduction, income instability may have non-negligible welfare consequences among households facing liquidity constraints or other barriers to their ability to absorb unanticipated shocks. By looking across the distribution of family incomes, we can determine what differences in exposure to income volatility exist, and the extent to which this exposure has shifted over time.

Figure 5 depicts trends in disposable income volatility as a function of location in the initial year disposable income distribution. Specifically, we place families into one of 8 mutually exclusive categories of initial year disposable income: being in the bottom 1% of the distribution, between the 1st and 10th percentiles of the distribution, the 10th and 25th percentiles, the 25th and 50th percentiles, the 50th and 75th percentiles, the 75th and 90th percentiles, the 90th and 99th

percentiles, and lastly in the top 1%. We then compute volatility among those families in each category. It is important to recognize that income volatility may push families into a higher or lower category in the second year, but for the purpose of this exercise they are placed in the income category of the first year.

[Figure 5 here]

As seen in Figure 5, volatility increased across the distribution over the past few decades, ranging from a 50 percent increase among the bottom 1% to a 185 percent increase among the top 1%. There is little doubt that the top 1% has experienced substantial upward volatility in recent decades, but this is swamped by the extreme short-term volatility of the bottom 1%, and indeed the bottom 10%. For example, from 1996 to 2009 volatility among the bottom 1% rose by 50 percent, and there was an astounding 5-fold increase between 2006 and 2007. Because of small samples, the bottom 1% volatility will be susceptible to outliers. However, among the much larger population in the bottom 10% there is less evidence of year-to-year swings, but in any given year since 1996 the *level* of volatility among the bottom 10% was 59 percent higher than the volatility among the top 1%, and this level nearly doubled since 1981.[6]

[Table 3 here]

In Table 3 we present the variance decomposition of equations (5) and (6) for the 8 different segments of the income distribution. Instead of presenting 16 figures (two for each segment of the distribution akin to Figures 3 and 4), we just present the decomposition for each of four years—two business-cycle peak years (1989 and 1999) and two business-cycle trough

[6] Because volatility before taxes may vary differentially across the distribution, in results not tabulated we calculated before-tax income volatility based on location in the initial year before-tax income distribution. There is strong evidence of increased trend volatility among the top 1%, but again it is swamped by the level of volatility at the bottom 1% and the 1st to 10th percentiles, and it more than doubled in the first decile.

years (1981 and 2009).[7] The first column of the table depicts the total volatility, and here we see the dramatic increase in volatility across the distribution from 1981 to 2009, where it doubled or more for every group except the 10th to 25th percentile. The remaining columns are the shares of the total volatility, and thus sum to 1 as in Tables 1 and 2. The share of volatility owing to head's earnings fell for every group over the period, except for the top 1%. Piketty and Saez (2003) document the rise of labor earnings as a major reason for the rising inequality in the top 1%, and our results here underscore the parallel rise in earnings volatility at the top. We also see that the share attributable to wife earnings fell in the bottom half of the distribution, but increased in the top half. Across the distribution, other nonlabor income volatility and tax payment volatility each fell as a share of the total, while transfer income volatility rose for all groups except the very top. In terms of the covariances, notable is the increased smoothing offered by transfers to changes in head earnings, especially in the middle of the distribution in the depth of the Great Recession, and by the increased negative covariance of other non-transfer income and head earnings in the top half of the income distribution. The decreased share of volatility from the covariance of the tax code with head earnings and with other income is offset to some extent by the increased share (in absolute value) between spousal earnings and tax payments. The trend toward more positive covariance of earnings shocks among spouses earnings appears most strong in the bottom 90 percent of the distribution, potentially exposing the middle class to less income insurance through assortative matching.

VI. Income Volatility and Income Cyclicality

Parker and Vissing-Jorgensen (2009, 2010) find that the rise in income inequality at the top of the distribution is associated with a rise in the cyclicality of incomes at the top. As

[7] Figures containing annual estimates are available from the authors upon request.

reported above we find that the volatility of incomes increased fastest at the top of the distribution. Our focus is more on trend volatility, and not the cyclicality of incomes per se. However, with two-year percent changes it is clear that our measure of volatility captures aspects of the overall business cycle, and thus in this section we report the results of regression models akin to those in Parker and Vissing-Jorgenson. Specifically, for each income group *i* in the CPS we estimate models of the form

(7) $\Delta \ln (y) = \alpha + \beta \Delta \ln(NIPA) + \varepsilon,$

where $\Delta \ln (y)$ denotes the 1 year change in log disposable per capita family income and NIPA represents the 1 year change in log NIPA income. The 'beta' coefficient reflects the elasticity of per capita income with respect to changes in aggregate income, i.e. the cyclicality of income.[8] These results are independently of interest because Parker and Vissing-Jorgenson focused on the top of the income distribution since they used the tax return data in Piketty and Saez (2003), whereas with our CPS data we better capture the low end of the income distribution.

[Table 4 here]

We present the results of the regression models in Table 4. The beta coefficients range between 0.418 and 0.649 within percentiles 10 and 99, but there is no clear monotonic pattern across these groups. The highest degree of cyclicality occurs at the very top of the income distribution. The estimate of 2.97 says that for a 1 percent increase in NIPA income, income among persons in the top 1% increase 2.97. We do find a very large estimate of 6.15 among the bottom 1%, but it is not statistically different from zero, and the estimate for the 1^{st}-10^{th} percentiles is a small and insignificant 0.097. In results not tabulated we also re-estimated equation (7) where instead of using NIPA income we used aggregate consumption as the

[8] Note that the change in log income for the dependent variable is approximately equal to the point percent change. This differs from our earlier analysis of arc percent changes, the latter of which use mean income in the denominator rather than initial period income.

measure of the business cycle. Here again we find statistically zero effects at the bottom of the distribution, and large positive effects at the top. These results corroborate those of Parker and Vissing-Jorgenson. The relatively muted response at the bottom of the distribution likely owes to the greater reliance on transfer income (e.g. cash welfare, disability insurance), which is perhaps less responsive than labor market income, which accounts for the bulk of income at the top.

VII. Conclusion

Our results indicate that the variance of income changes more than doubled since 1980, and this increased volatility cuts across race, family structure, and the income distribution. The analysis corroborates that reported in Frank (2011) and Parker and Vissing-Jorgenson (2009) that the rich have experienced a dramatic secular increase in volatility in recent decades, but on most counts the level of volatility is lower at the top than at the bottom, and importantly volatility at the top is around a mean pre-tax income of $500,000 over the past decade as opposed to a mean pre-tax income of under $10,000 at the bottom 10^{th} percentile. Families at both ends of the income distribution have experienced the "wild ride" of income volatility.

The increase in volatility came from increased volatility of all major income sources—husband and wife earnings, transfer income, other non-transfer income, as well as tax payments. Moreover, in recent years the covariance of spousal earnings volatilities has become positive, suggesting that husbands and wives now have positively correlated earnings shocks and thus making it more difficult to smooth family income volatility. Likewise, the tax code seems to be less negatively correlated with earnings, providing less implicit insurance to the family. In the absence of the increased negative covariance between the volatility of head earnings with other

income, and to a lesser extent with transfer income in the middle of the distribution, overall volatility would be much higher.

These results suggest that there has been a shift in risk toward the family and away from public policies. However, with positively correlated earnings shocks, the family is less able to self insure through the labor market, but instead has come to rely on other forms of nonlabor income to absorb volatility in the labor market. The expansion of the safety net as part of the American Recovery and Reinvestment Act of 2009 seemed to slow down, or even reverse, some of these trends, but with the temporary provisions expiring, the experience of the past decades suggests that families will continue to have to find mechanisms to self insure against volatility.

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Figure 1: Trends in Disposable Income Volatility

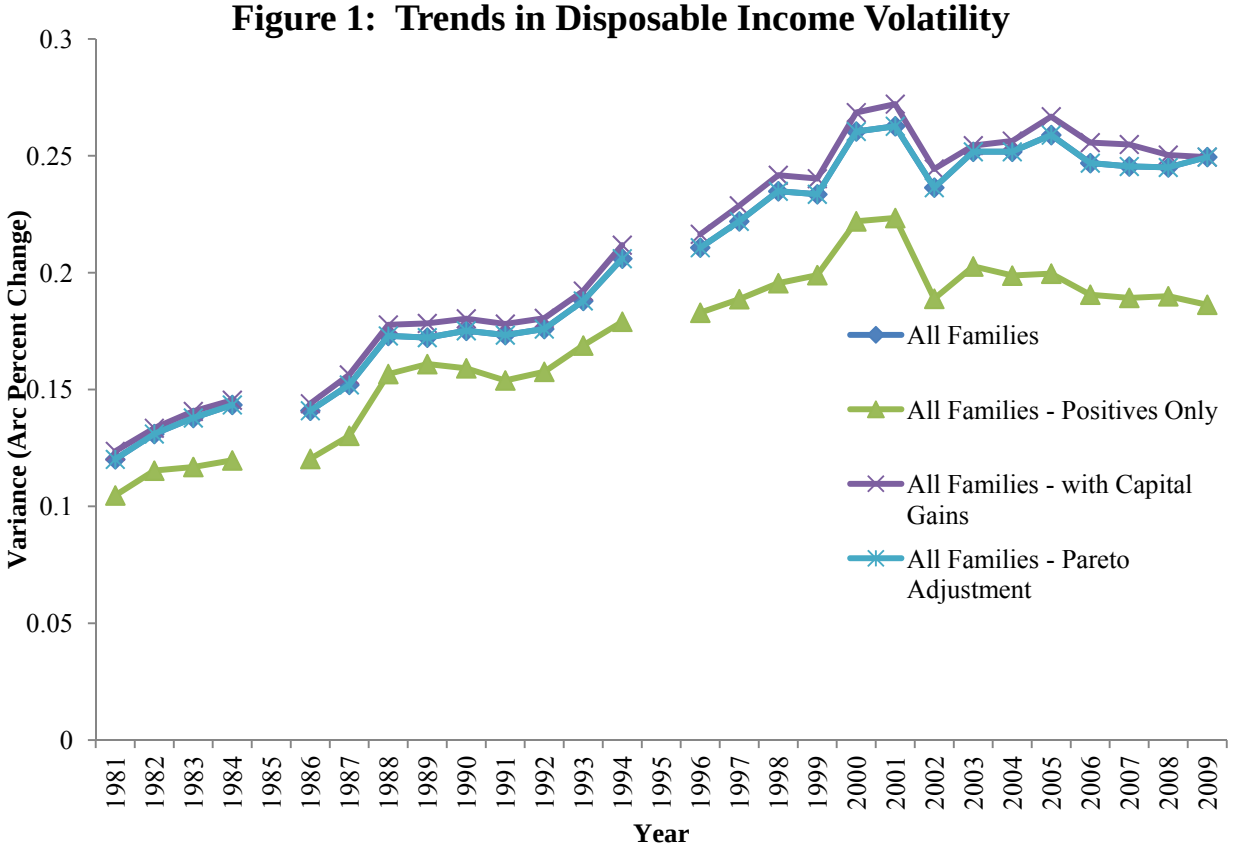

Figure 2: Trends in Disposable Income Volatility by Race and Family Structure

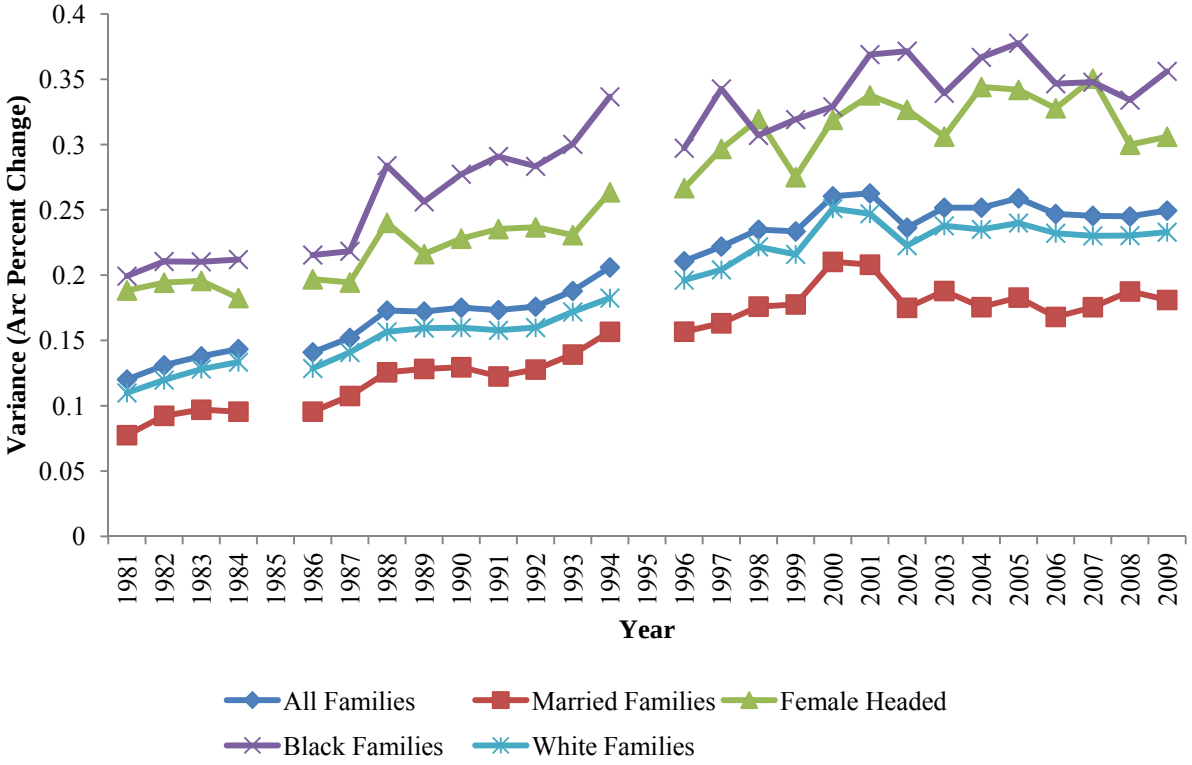

Figure 3. Trends in Variance Components of Disposable Income Volatility

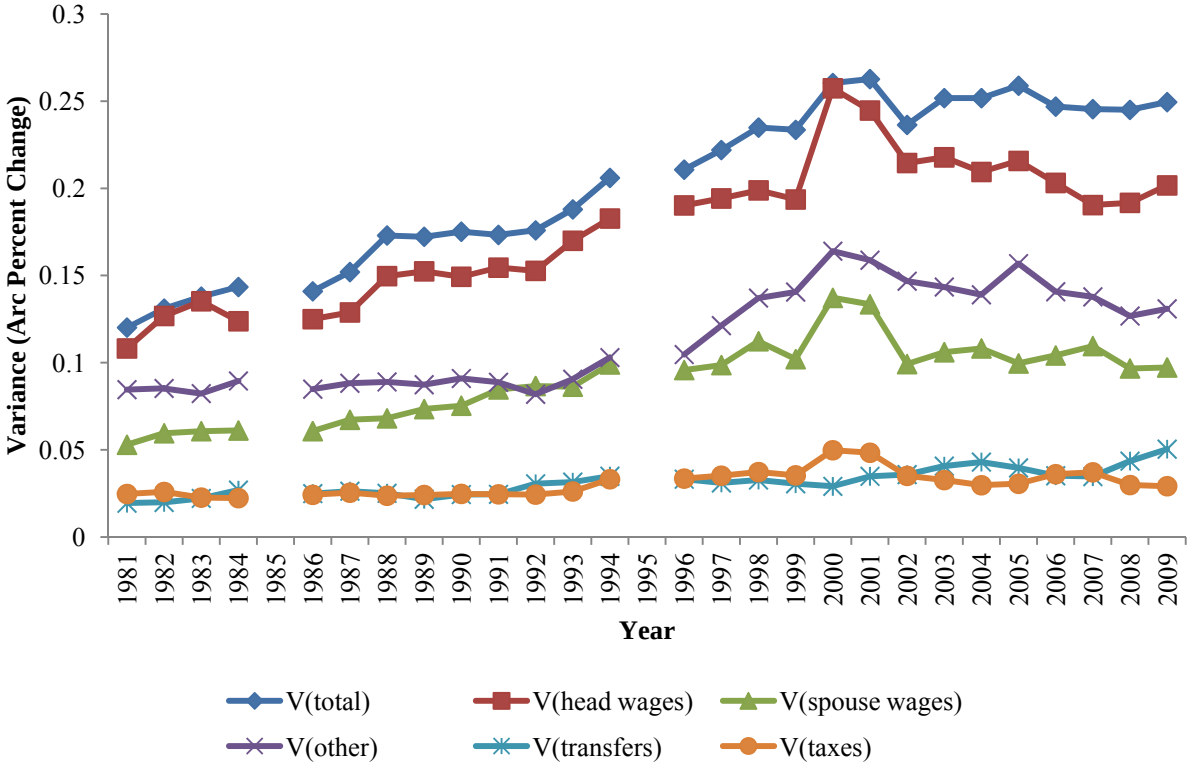

Figure 4. Trends in Covariance Components of Disposable Income Volatility

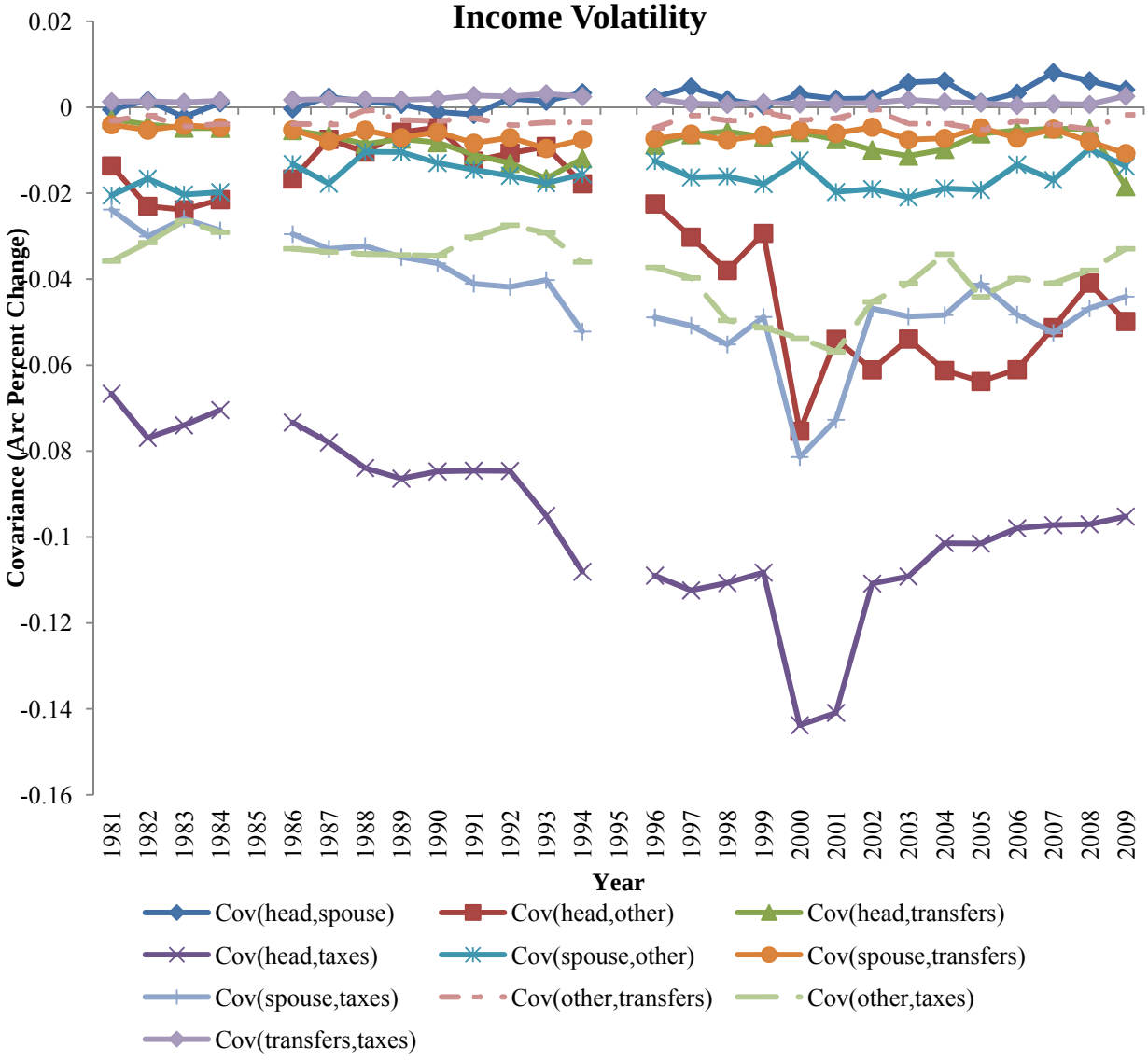

Figure 5. Trends in Disposable Income Volatility by Location in Initial Year Disposable Income Distribution

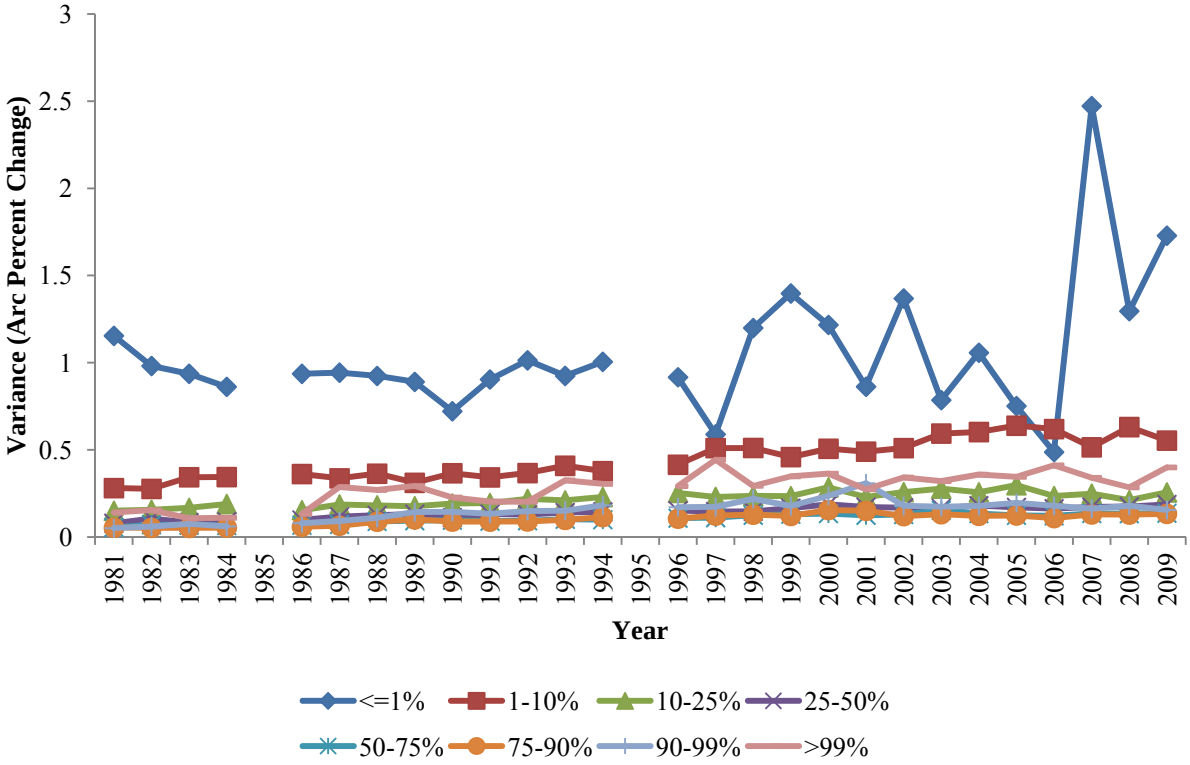

Table 1. Total Variance and Share of Family Income Volatility Decomposition by Component, All Families

Year	Total Var	Var (head wages)	Var (spouse wages)	Var (other)	Var (trans)	Var (taxes)	Cov (head, spouse)	Cov (head, other)	Cov (head, trans)	Cov (head, taxes)	Cov (spouse, other)	Cov (spouse, trans)	Cov (spouse, taxes)	Cov (other, trans)	Cov (other, taxes)	Cov (trans, taxes)
1981	0.12	0.90	0.44	0.70	0.16	0.21	0.00	-0.11	-0.02	-0.55	-0.17	-0.03	-0.20	-0.03	-0.30	0.01
1986	0.14	0.89	0.43	0.60	0.18	0.17	0.00	-0.12	-0.04	-0.52	-0.09	-0.04	-0.21	-0.03	-0.23	0.01
1989	0.17	0.88	0.43	0.51	0.13	0.14	0.00	-0.03	-0.04	-0.50	-0.06	-0.04	-0.20	-0.02	-0.20	0.01
1993	0.19	0.90	0.46	0.48	0.17	0.14	0.01	-0.05	-0.09	-0.51	-0.09	-0.05	-0.21	-0.02	-0.16	0.02
1997	0.22	0.87	0.44	0.55	0.14	0.16	0.02	-0.14	-0.03	-0.51	-0.07	-0.03	-0.23	-0.01	-0.18	0.00
2001	0.26	0.93	0.51	0.60	0.13	0.18	0.01	-0.21	-0.03	-0.54	-0.08	-0.02	-0.28	-0.01	-0.22	0.00
2005	0.26	0.83	0.38	0.61	0.15	0.12	0.00	-0.25	-0.02	-0.39	-0.07	-0.02	-0.16	-0.02	-0.17	0.00
2009	0.25	0.81	0.39	0.52	0.20	0.12	0.02	-0.20	-0.07	-0.38	-0.06	-0.04	-0.18	-0.01	-0.13	0.01

Table 2. Total Variance and Share of Family Income Volatility Decomposition by Component, All Married Families

Year	Total Var	Var (head wages)	Var (spouse wages)	Var (other)	Var (trans)	Var (taxes)	Cov (head, spouse)	Cov (head, other)	Cov (head, trans)	Cov (head, taxes)	Cov (spouse, other)	Cov (spouse, trans)	Cov (spouse, taxes)	Cov (other, trans)	Cov (other, taxes)	Cov (trans, taxes)
1981	0.08	1.46	0.45	0.81	0.08	0.29	-0.03	-0.22	-0.05	-0.91	-0.31	-0.02	-0.19	-0.02	-0.36	0.01
1986	0.10	1.34	0.40	0.68	0.07	0.23	-0.03	-0.20	-0.05	-0.79	-0.18	-0.01	-0.19	-0.02	-0.27	0.01
1989	0.13	1.14	0.37	0.55	0.06	0.16	0.01	-0.07	-0.05	-0.65	-0.12	-0.01	-0.18	-0.01	-0.22	0.01
1993	0.14	1.16	0.39	0.55	0.06	0.17	0.01	-0.05	-0.06	-0.66	-0.13	-0.02	-0.19	0.00	-0.22	0.01
1997	0.16	1.17	0.39	0.56	0.10	0.17	0.02	-0.10	-0.08	-0.67	-0.16	-0.02	-0.18	-0.01	-0.19	0.01
2001	0.21	1.22	0.40	0.70	0.09	0.20	0.04	-0.27	-0.04	-0.70	-0.16	-0.01	-0.22	-0.01	-0.24	0.00
2005	0.18	1.32	0.45	0.79	0.08	0.23	0.03	-0.43	-0.03	-0.75	-0.15	0.00	-0.27	-0.01	-0.26	0.00
2009	0.18	1.25	0.37	0.93	0.08	0.16	0.01	-0.58	-0.03	-0.57	-0.19	0.00	-0.16	-0.02	-0.25	0.00

Table 3. Total Variance and Share of Family Income Volatility Decomposition by Component and Income Group

Year	Total Var	Var (head wages)	Var (spouse wages)	Var (other)	Var (trans)	Var (taxes)	Cov (head, spouse)	Cov (head, other)	Cov (head, trans)	Cov (head, taxes)	Cov (spouse, other)	Cov (spouse, trans)	Cov (spouse, taxes)	Cov (other, trans)	Cov (other, taxes)	Cov (trans, taxes)
Bottom 1% of Initial Year After-Tax Income Distribution																
1981	1.15	0.54	0.32	0.58	0.41	0.08	-0.08	-0.17	-0.16	-0.19	-0.14	-0.06	-0.07	-0.08	-0.03	0.04
1989	0.89	0.73	0.45	0.56	0.42	0.05	-0.13	-0.14	-0.13	-0.27	-0.14	-0.22	-0.04	-0.14	-0.05	0.06
1999	1.39	0.63	0.41	0.64	0.40	0.06	-0.20	-0.20	-0.15	-0.16	-0.14	-0.11	-0.06	-0.10	-0.04	0.03
2009	1.71	0.26	0.20	0.46	0.52	0.05	-0.04	-0.06	-0.08	-0.08	-0.02	-0.08	-0.06	-0.05	-0.02	0.02
1-10% of Initial Year After-Tax Income Distribution																
1981	0.28	0.49	0.46	0.41	0.32	0.06	0.04	-0.09	-0.04	-0.22	-0.08	-0.07	-0.17	-0.06	-0.05	0.01
1989	0.31	0.76	0.45	0.35	0.34	0.08	0.01	-0.09	-0.11	-0.33	0.00	-0.15	-0.16	-0.11	-0.06	0.03
1999	0.46	0.59	0.42	0.31	0.31	0.07	-0.05	-0.04	-0.03	-0.26	-0.02	-0.08	-0.14	-0.02	-0.07	0.01
2009	0.55	0.44	0.24	0.30	0.39	0.05	0.00	-0.03	-0.08	-0.15	-0.03	-0.03	-0.03	-0.04	-0.02	0.00
10-25% of Initial Year After-Tax Income Distribution																
1981	0.15	0.84	0.46	0.64	0.14	0.15	-0.04	-0.04	-0.03	-0.41	-0.08	-0.09	-0.22	-0.06	-0.29	0.02
1989	0.18	0.87	0.51	0.48	0.18	0.11	-0.05	-0.04	-0.04	-0.45	-0.14	-0.07	-0.20	-0.03	-0.12	0.01
1999	0.23	0.64	0.50	0.56	0.16	0.11	-0.01	-0.09	-0.05	-0.30	-0.10	-0.05	-0.21	0.00	-0.16	0.00
2009	0.26	0.67	0.39	0.45	0.26	0.09	0.01	-0.05	-0.14	-0.28	-0.02	-0.14	-0.14	-0.04	-0.10	0.03
25-50% of Initial Year After-Tax Income Distribution																
1981	0.08	1.28	0.53	0.76	0.09	0.23	-0.04	-0.27	-0.04	-0.77	-0.22	-0.03	-0.26	-0.03	-0.25	0.02
1989	0.13	0.95	0.50	0.58	0.05	0.15	-0.05	-0.09	-0.05	-0.52	-0.07	-0.01	-0.25	0.01	-0.21	0.01
1999	0.17	0.98	0.49	0.63	0.07	0.16	0.00	-0.18	-0.06	-0.53	-0.09	-0.03	-0.25	-0.01	-0.22	0.02
2009	0.19	0.96	0.55	0.53	0.12	0.13	0.02	-0.22	-0.14	-0.43	-0.07	-0.05	-0.26	-0.02	-0.14	0.03

Table 3 Continued

Year	Var (Total)	Var (head wages)	Var (spouse wages)	Var (other)	Var (trans)	Var (taxes)	Cov (head, spouse)	Cov (head, other)	Cov (head, trans)	Cov (head, taxes)	Cov (spouse, other)	Cov (spouse, trans)	Cov (spouse, taxes)	Cov (other, trans)	Cov (other, taxes)	Cov (trans, taxes)
50-75% of Initial Year After-Tax Income Distribution																
1981	0.06	1.36	0.64	1.12	0.06	0.33	-0.06	-0.30	-0.04	-0.89	-0.44	0.00	-0.30	0.00	-0.46	0.01
1989	0.09	1.11	0.51	0.62	0.04	0.21	0.01	-0.05	-0.06	-0.68	-0.13	-0.02	-0.29	0.01	-0.29	0.02
1999	0.13	1.18	0.56	0.87	0.06	0.21	-0.07	-0.37	-0.03	-0.64	-0.18	-0.02	-0.28	-0.01	-0.29	0.01
2009	0.14	1.27	0.52	0.90	0.08	0.18	0.01	-0.51	-0.13	-0.61	-0.19	-0.05	-0.27	0.00	-0.25	0.03
75-90% of Initial Year After-Tax Income Distribution																
1981	0.05	1.30	0.57	1.31	0.03	0.44	-0.09	-0.10	0.00	-1.00	-0.45	0.00	-0.24	0.00	-0.79	0.00
1989	0.10	1.17	0.54	0.75	0.02	0.21	-0.06	-0.14	-0.03	-0.69	-0.22	0.00	-0.26	0.02	-0.31	0.00
1999	0.12	1.08	0.57	1.20	0.05	0.27	0.06	-0.40	-0.01	-0.66	-0.31	0.00	-0.31	-0.02	-0.51	-0.01
2009	0.13	1.26	0.51	0.96	0.08	0.20	-0.01	-0.57	-0.05	-0.62	-0.15	-0.04	-0.28	0.02	-0.30	-0.01
90-99% of Initial Year After-Tax Income Distribution																
1981	0.05	2.09	0.55	1.54	0.01	0.83	0.09	-0.31	0.00	-1.95	-0.52	0.00	-0.34	0.00	-0.99	0.00
1989	0.14	1.28	0.36	0.73	0.01	0.25	-0.04	-0.09	-0.01	-0.83	-0.02	0.00	-0.21	0.00	-0.41	0.00
1999	0.18	1.18	0.47	0.99	0.01	0.30	-0.03	-0.17	0.00	-0.82	-0.15	0.00	-0.27	0.01	-0.51	0.00
2009	0.16	1.49	0.62	0.85	0.02	0.26	0.03	-0.63	-0.02	-0.85	-0.13	-0.01	-0.38	-0.01	-0.25	0.01
Top 1% of Initial Year After-Tax Income Distribution																
1981	0.15	2.08	0.22	2.05	0.00	0.82	-0.27	-0.56	-0.02	-1.49	-0.20	0.00	0.02	0.00	-1.67	0.01
1989	0.30	1.32	0.24	0.95	0.00	0.25	0.04	-0.30	0.01	-0.82	-0.07	0.00	-0.15	-0.03	-0.45	0.01
1999	0.36	2.60	0.60	0.88	0.00	0.46	-0.57	-0.80	-0.02	-1.51	0.02	0.00	-0.29	0.00	-0.39	0.01
2009	0.41	2.16	0.83	0.59	0.00	0.33	-0.62	-0.59	0.01	-1.14	0.05	-0.02	-0.37	0.00	-0.23	0.00

Table 4. Income Cyclicality Models using NIPA Chain-Weighted Per Capita Aggregate Income

Δ(log Per Capita Disposable CPS Income)	Bottom 1%	1-10%	10-25%	25-50%
Δ(log Aggregate NIPA Income)	6.151	0.097	0.418**	0.626***
	(3.984)	(0.378)	(0.205)	(0.127)
Observations	1,542	20,119	33,776	56,441
R-squared	0.0015	0.0000	0.0001	0.0004

Δ(log Per Capita Disposable CPS Income)	50-75%	75-90%	90-99%	Top 1%
Δ(log Aggregate NIPA Income)	0.393***	0.430***	0.649***	2.973***
	(0.106)	(0.128)	(0.216)	(1.018)
Observations	56,495	33,900	20,352	2,247
R-squared	0.0002	0.0003	0.0004	0.0038

Note: Log aggregate NIPA income is measured as personal per capita income excluding current transfer receipts in chained 2005 dollars from the National Income and Product Accounts (NIPA).

Appendix Table 1: Number and Rate of Merges by 2nd Year of CPS. CY 1981-2009

Year	# Merged CPS Observations	# CPS Observations	Merge Rate
1981	14,353	26,300	54.57%
1982	15,825	27,478	57.59%
1983	15,742	27,302	57.66%
1984	14,702	27,095	54.26%
1985			
1986	15,162	27,208	55.73%
1987	16,752	32,020	52.32%
1988	18,222	29,985	60.77%
1989	18,619	32,732	56.88%
1990	20,102	33,471	60.06%
1991	19,854	32,981	60.20%
1992	19,678	32,360	60.81%
1993	14,329	32,830	43.65%
1994	12,560	30,303	41.45%
1995			
1996	15,119	25,820	58.56%
1997	14,864	25,305	58.74%
1998	13,970	24,248	57.61%
1999	13,205	27,372	48.24%
2000	12,575	38,388	32.76%
2001	15,009	38,805	38.68%
2002	14,790	38,766	38.15%
2003	15,478	38,473	40.23%
2004	13,113	37,795	34.70%
2005	14,092	37,754	37.33%
2006	14,924	38,019	39.25%
2007	15,104	37,871	39.88%
2008	15,421	38,911	39.63%
2009	15,951	39,196	40.70%
Average # of Matches	14,466	Average % Matched	48.90%

Appendix Table 2. Summary Statistics by 2nd Year

Variables	Mean	Standard Deviation
Pre-Tax Income		
All Families ($)	70,817	58,875
Arc % Change	0.015	0.508
White Families ($)	83,442	61,488
Arc % Change	0.012	0.429
Black Families ($)	65,839	46,927
Arc % Change	-0.003	0.504
Female-Headed Families ($)	37,053	32,878
Arc % Change	0.012	0.585
Disposable Income		
All Families ($)	54,345	37,964
Arc % Change	0.017	0.448
White Families ($)	63,833	39,110
Arc % Change	0.015	0.374
Black Families ($)	52,286	30,855
Arc % Change	0.001	0.441
Female-Headed Families ($)	30,299	21,698
Arc % Change	0.011	0.515
Demographics		
Age	42	9.5
% Female	54	49.8
No. of Persons in Family	3.1	1.5
% Less Than High School	14	34.3
% High School	36	47.8
% More Than High School	50	49.4
% White	86	34.5
% Black	9	28.7
% Other	5	21.3
% Married	72	44.7
Number of Observations = 238,275		

Note: Income data are adjusted for inflation using the 2009 personal consumption expenditure deflator