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Income Volatility and Food Insufficiency in U.S. Low-Income Households, 1992–2003

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Abstract

In this paper we investigate changes in monthly income volatility in low-income households in the United States since the early 1990s, as well as the relationship between that volatility and food insufficiency. Drawing on data from the Survey of Income and Program Participation (SIPP), we examine whether negative income shocks increase the chances that a household experiences food insufficiency. We find that monthly income volatility is highest for lower income households, and that it increased substantially between 1992 and 2003. Moreover, the greatest increases in income volatility occurred in households with incomes below the poverty line, and this increase appears to have its roots in the shift of household income away from relatively stable public assistance (AFDC/TANF) benefits and towards earnings. We show that volatility is smoothed considerably by the receipt of food assistance benefits (food stamps and/or WIC) and the receipt of these benefits narrows the income volatility gap between lower- and relatively higher-income households. Nevertheless, the consideration of food assistance benefits does not eliminate the large increases in income volatility observed over the time period. In a logistic regression model, we find that both the level of income and income volatility affect the predicted probability of food insufficiency. The results are consistent with theoretical models in which households face either liquidity constraints or binding constraints in spending associated with contractual nonfood expenditures. Finally, we find some evidence to suggest that the probability that higher income households suffer food insufficiency is not related to income volatility, which is consistent with these households not facing liquidity constraints.

Income Volatility and Food Insufficiency in U.S. Low-Income Households, 1992–2003

I. INTRODUCTION

In this paper we investigate the relationship between income volatility and food insufficiency for low-income households in the United States. In particular, we draw on data from the Survey of Income and Program Participation (SIPP) to examine whether negative income shocks increase the chances that a household experiences food insufficiency. We extend models developed by Gundersen and Gruber (2001) to formalize the relationship among income volatility, liquidity constraints, and food insufficiency, and, using SIPP data, we test the importance of both average and transitory income components in determining food insufficiency. Because recent years have seen rapid change in policy relating to the well-being of low-income families (e.g., welfare reform and changes in food assistance policy), we employ data from both 1992 and 2003 (from the 1991, 1992 and 2001 SIPP Panels) in order to check robustness of results within different policy environments.

While other authors define income volatility in an asymmetric manner focusing on measures such as job loss or negative income shocks, our approach is more general. We measure volatility as the deviation in monthly income from the average over the previous 12 months.[1] We find that income volatility is highest for lower income households, and that volatility has increased substantially between 1992 and 2003. Moreover, the greatest increases occurred in households with incomes below the poverty line. The increases in volatility were even larger for households in deep poverty (those with incomes below 50 percent of the poverty line) and for a population 'at risk' for welfare use (households headed by a single adult without a high school degree).

Among these households, the increase in income volatility over this time period appears to have its roots in the shift of household income away from relatively stable public assistance (AFDC/TANF) benefits and towards earnings. Volatility is smoothed considerably by the receipt of food assistance

[1]Newman (2006) and Farrell et al. (2003) follow similar strategies in examining monthly income variation.

benefits (food stamps and/or WIC) and the receipt of these benefits narrows the income volatility gap between lower- and relatively higher-income households. Nevertheless, the consideration of food assistance benefits does not eliminate the large *increases* in income volatility observed over the time period.

In a logistic regression model, we find that both the level of income and income volatility affect the predicted probability of food insufficiency. The results are consistent with theoretical models in which households face either liquidity constraints or binding constraints in spending associated with contractual nonfood expenditures. Finally, we find some evidence to suggest that the probability that higher income households suffer food insufficiency is not related to income volatility, which is consistent with these households not facing liquidity constraints.

II. BACKGROUND

There has been considerable investigation into the determinants of food insufficiency (e.g., Gundersen and Oliviera, 2001; Jensen, 2002; Huffman and Jensen, 2003; Rose, Gundersen and Oliveira, 1998; and Bernell, Edwards and Weber, 2005; among others), however, with the exception of Gundersen and Gruber (2001), other authors have not considered income variability as a contributing factor. Many simple correlations have been noted between food insufficiency and a range of factors, including the level of household income, Food Stamp receipt, demographics, household composition, education, physical and mental health status, and geography.

Gundersen and Gruber (2001) produce descriptive analysis from the 1991 and 1992 panels of the SIPP showing that food-insufficient households have higher income variability, are more likely to have suffered income shocks (such as loss of earnings or food stamps) and were less likely to have savings. In a study controlling for family characteristics and household fixed effects, Blundell and Pistaferri (2003) find a negative relationship between income volatility and food expenditures in the PSID for the years 1978–1992. Finally, in a sample of six hundred women from the Michigan Women's Employment Survey covering the years 1997–1999, Corcoran et al. (2004) find that a significant minority of former and

current welfare recipients experience job loss, hours and income reductions, and that job loss, in particular, is associated with increased food insufficiency, after controlling for other personal characteristics. Less directly related is a study by Ribar and Hamrick (2003). With data spanning 1994–1997 from the SIPP and the Survey of Program Dynamics, they find that assets, presumed to be indicative of a household's ability to borrow and save, are important to weathering bouts of poverty without experiencing food insufficiency. This implies that income (or expenditure) volatility may be important underlying determinants, but they do not test that hypothesis directly.

Understanding the role of income volatility in determining food insufficiency is especially important in light of policy changes in the last decade which might have contributed to changes in either income volatility or food insufficiency or the relationship between them for low-income, welfare- or Food Stamp-eligible populations. Welfare reform limited cash assistance as an entitlement, imposed increased work requirements on recipients of cash assistance, eliminated Food Stamp eligibility for some populations, and limited Food Stamp benefit levels for others (among other things). Food Stamp receipt declined precipitously through the 1990s, rebounding only somewhat in the last few years of that decade and into the early 2000s.[2]

Research to date has yielded somewhat conflicting reports on trends in food insufficiency and related measures during this time period. In reporting on data from the CPS Food Security Supplement, Nord (2001) notes that food insecurity among low-income non-Food Stamp users rose between 1995 and 1999 across a broad spectrum of household types. On the other hand, in more recent studies, Corcoran et al. (2004) report that food insufficiency declined only a little in the sample they studied during the period 1997–1999, and Nord, Andrews and Carlson (2004) report that food insecurity with and without hunger both declined during the second half of the 1990s. In any case, none of these studies cover the full time

[2]Ziliak, Gundersen, and Figlio (2000), Currie and Grogger (2001), and Kornfeld (2002) document that these changes in the Food Stamp Program caseload where driven by both policy changes and by macroeconomic conditions.

period that we are studying here and all three are more representative of the transition to the new welfare policy regime than of its full implementation.

Welfare reform is likely to have increased the volatility of income in the low-income population: For many households, relatively stable income from AFDC/TANF payments (and in-kind Food Stamp benefits) was replaced by potentially less stable earnings from employment. If hours of work per week or employment-spell lengths vary, then income will have become more variable for these families following the implementation of welfare reform. Because mean income levels and material well-being of welfare leavers and recipients have risen little since welfare reform (e.g., Bavier, 2000; Primus et al. 1999; Haskins, 2001; Loprest and Zedlewski, 1999; Moffitt and Winder, 2003; Bloom et al., 2002), there is little reason to expect that this population has either accumulated savings or has sufficiently high incomes to be able to weather this variability without consequence. However, to our knowledge, in the extensive literature that examines post-reform outcomes for welfare recipients and leavers, to date only Corcoran et al. (2004) look at the potential role of income variability.

Our study extends the previous literature by directly testing whether income volatility plays a role in determining food insufficiency using data which roughly bracket a time period of substantial policy change. We document a considerable rise in income volatility over this time period and find that income volatility is largest for lower income households. Our theoretical framework predicts that the impact of income volatility will be greatest for liquidity constrained households and our empirical analysis provides evidence that low-income households—which may be the most likely to face liquidity constraints—are indeed most affected by income volatility.

III. MODEL

Our empirical specification is motivated by a theoretical model that illustrates the relationship between income, income volatility, and food sufficiency.[3] In the model, we focus on the view that income volatility is a combination of both positive and negative income shocks rather than just the loss of income due to unemployment, work hour reductions, or the loss of benefits.[4] We follow the model developed by Gundersen and Gruber (2001). In this model, households are assumed to maximize expected utility over multiple discrete time periods.[5] The model has two goods—food (F) and all other goods (G).

$$(1) \qquad \text{Max } E \{ \sum U(F_t, G_t) \}$$

Households are allowed to both save and borrow against future income. Total borrowing is limited by the expected future stream of income. Therefore each household is subject to a budget constraint

$$(2) \qquad A_{t+1} = A_t + Y_t - p_F F_t - p_G G_t.$$

Where A is assets, p_F is the price of food, p_G is the price of other goods, and Y_t is income in time period t. At any time t, income can be expressed as the sum of an average component and a transitory deviation:

$$(3) \qquad Y_t = Y_P + Y_{Dt.}$$

Each household has certain knowledge of their average income component. The transitory component of income is assumed to have a mean of zero and known variance and follows a random walk

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[3]Aside from income, other factors may affect food sufficiency. Gundersen and Gruber mention three possibilities: (1) some households may face higher prices for food and non-food goods due to geographic isolation, (2) some may have higher requirements for sufficiency in non-food goods (e.g., medical expenses); and (3) some households may voluntarily choose food insufficiency in order to temporarily increase consumption of non-food goods. In addition to average and transitory income, our empirical specification will include a wide range of control variables.

[4]This approach stands in contrast to the work of Corcoran et al. (2004), who use measures such as job loss and loss of benefits in a logistic model predicting food insufficiency.

[5]Households are the unit of analysis because food stamp eligibility is based on a group of people who share common cooking facilities. Households may consist of unrelated individuals living in the same housing unit.

process.[6] However, households are assumed to know nothing about the timing of transitory income shocks. The variance of Y_{Dt} represents the degree of income volatility experienced by each household.

For any household, the minimum amount of food necessary to provide a food-sufficient diet is designated by F^*. Similarly, a household can suffer from insufficiency of non-food goods such as housing, clothing, or medical care. The level of consumption necessary to avoid deprivation of non-food goods is G^*. It follows that for a given level of prices, the minimum level of expenditures to avoid both food insufficiency and non-food insufficiency is given by Z^*:

$$(4) \qquad Z^* = p_F F^* + p_G G^*.$$

Clearly, households can avoid both food insufficiency and non-food insufficiency as long as Y_p exceeds Z^*. Thus, even if a household suffers a large negative income shock in month t, they can avoid suffering food insufficiency by drawing down their assets or by borrowing against future income.[7]

Households with income below Y_P may still be able to avoid insufficiency if their initial assets are sufficient to cover the gap between Y_P and Z^*. For households with both low income ($Y_P < Z^*$) and inadequate initial assets, insufficiency in either food or non-food goods is inescapable. Indeed, if both income (Y_P) and initial assets are low enough, the household will be both food insufficient and non-food insufficient.

A key implication of this model is that food insufficiency at time t will be negatively related to the average component of income (Y_P) and unrelated to the transitory income component (Y_{Dt}). However, this implication depends on the ability of households to save and borrow against future income. If households are assumed to be liquidity constrained, it is possible to show that food insufficiency at time t will be negatively related to the sum of average and transitory income components ($Y_P + Y_{Dt}$) at time t.

Another possibility is partially constrained liquidity. This can happen two ways. First, some households may be completely liquidity constrained while others may not be liquidity constrained.

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[6]This implies that the first order serial correlation for transitory income is zero.

[7]Here we think of borrowing in the broadest sense. For example, households may seek loans or even gifts from friends or family when faced with income shortfalls.

Second, it may be that all households face partial liquidity constraints. For example, households are able to borrow against future income, but the amount of borrowing is small relative to the non-liquidity constraint world. Thus, households would be able to use borrowing to offset small negative income shocks but larger income shocks would still affect food sufficiency. In either of these two cases, we would expect that food insufficiency would be negatively related to both average and transitory income but that the effect of transitory income would be smaller in absolute value.

When average household income is close to Z^*, another way to think about the relationship between income volatility and food insufficiency is to model non-food consumption as being less flexible than food consumption.[8] In this view, non-food consumption at time t is determined by liquidity constrained households before they observe their actual income for time t. Thus, households plan their non-food consumption based on their knowledge of their expected future income. Food consumption is a residual expenditure and households may choose the level of non-food consumption to insure that their typical residual expenditures on food are adequate to achieve food sufficiency. In other words, given any level of average income, households will adjust the level of their non-food consumption in order to ensure food sufficiency.[9] This model would predict that non-food consumption would be related to average income but not transitory income. Conversely, food consumption and food sufficiency would be related to transitory income but not average income.

In our empirical specification, we model the probability that a household suffers food insufficiency at time t using a logistic function:

$$(5) \qquad \text{Prob}(F_t<F^*) = \exp(X\beta) / (1+\exp(X\beta))$$

where:

$$(6) \qquad X\beta = \beta_0 + \beta_1 Y_P + \beta_2 Y_{Dt}.$$

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[8]In the model developed by Gundersen and Gruber non-food consumption is referred to as to contractual consumption.

[9]It is probably most appropriate to think of the contractual expenditures model as applying to a fairly narrow range of average income around Z*. For low levels of average income, food insufficiency will be unavoidable. Similarly for higher levels of average income, food insufficiency will be unlikely.

If households face no liquidity constraints, the model predicts $\beta_1 < 0$ and $\beta_2 = 0$. If households are liquidity constrained, then the model predicts $\beta_1 = \beta_2 < 0$. If households are partially liquidity constrained, then the model predicts expect $\beta_1 < \beta_2 < 0$. Finally, if liquidity constrained households have to plan non-food consumption before they know their actual income, the contractual expenditures model would predict $\beta_1 = 0$ and $\beta_2 < 0$.

What is the role of income volatility in these models? Clearly, in the absence of income volatility, Y_{Dt} would always be zero and drop out of the equation. In the model without liquidity constraints, income volatility (as measured by the variance of Y_{Dt}) does not matter. Households are able to save and borrow to overcome the transitory effects of income volatility and so changes in the level of income volatility will not affect the level of food insufficiency.[10]

The story is different in the liquidity constrained world. In this case, income volatility will result in more highly variable probabilities of food insufficiency than would a constant income stream. In time periods with positive income shocks, households experience a lower probability of food insufficiency. Conversely, in time periods with negative income shocks, households will experience a higher probability of food insufficiency. Because the relationship between the probability of food insufficiency and income is nonlinear, however, the variation in the probability of food insufficiency caused by the positive and negative income shocks implied by income volatility will not exactly offset one another. In this formulation nonlinearity is imposed by the logistic function but any other standard method for estimating binary discrete models would do the same. Nonlinearity is also intuitively appropriate for a process that involves thresholds such as this. One would certainly expect that (assuming liquidity constraints) the rise in probability of food insufficiency is greater for a household whose monthly income drops from $1,000 to $0 than for a household whose monthly income drops from $6,000 to $5,000. Similarly, one would expect that as income rises, the probability of food insufficiency asymptotically approaches zero. Thus,

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[10]It is possible that the costs of engaging activities to smooth income (e.g., loan application fees or the time and trouble of borrowing) could be incorporated into the model and that these costs would leave fewer resources that could be used to purchase food and non-food goods.

the net effect of income volatility will be to necessarily increase the level of food insufficiency relative to a world with constant income, although the offsetting factors suggest that size of the effect is likely to be small. We estimate the magnitude of these effects in Section V.

IV. DATA

We use data from the 1991, 1992, and 2001 panels of the Survey of Income and Program Participation (SIPP). Each SIPP panel is a nationally representative stratified sample with waves of interviews administered at four-month intervals.[11] Each wave includes a core questionnaire covering income, labor force participation, and program participation, including Food Stamp, WIC, and AFDC/TANF participation. In addition, each wave includes a topical questionnaire covering additional subjects; topical modules in Wave 6 of the 1991 panel, Wave 3 of the 1992 panel, and Wave 8 of the 2001 panel contain questions relating to household food insufficiency. As such, we draw on these three waves and the two waves immediately preceding them in each panel to construct a 12-month data set for each household in each panel. In the 1991 and 1992 panels, this 12-month period is spread over the calendar months October 1991 through December 1992.[12] In the 2001 panel, they cover the span from October 2001 through December 2003. We combine data from the 1991 and 1992 panels. Following Huffman and Jensen (2003), we limit our sample to nonelderly (age 18 to 59) low-income household heads who head households of two or more people. We focus our analysis on households with income levels up to 300 percent of the poverty line. Household income on the SIPP is defined as all sources of money income before taxes. The survey is quite comprehensive and includes earned income (wage and salary income from employment), cash transfer payments (AFDC/TANF, SSI, Social Security, unemployment benefits, veterans payments), lump-sum and one-time payments (inheritances, insurance settlements, retirement distributions, etc.), regular salary or other income from a self-owned business,

[11]The 1991 panel had 8 waves, the 1992 panel had 10 waves, and the 2001 panel had 9 waves.

[12]The 12 months of interviews are spread over a total of 15 months because each SIPP panel is divided into four rotation groups and one-quarter of the interviews are conducted in each calendar month.

property income, and interest received on most types of assets. Interest accrued on Individual Retirement Accounts, 401(k)s, savings bonds, and similar instruments is excluded from the calculation of household income.[13] After restrictions related to sample definition, we have a sample of 8,383 household heads in 1991/92 and 6,477 household heads from 2001 for analysis.

Our central focus here is measuring food insufficiency, monthly and annual household income, income volatility, and a range of household head and household characteristics. Key contemporaneous variables, such as food insufficiency and current monthly income, and most household characteristics are defined for the twelfth interview month in the time span discussed above.[14] We will refer to this as 'Month 12'. Longitudinal measures, such as annual household income and income volatility, are defined for the 12 months up to and including Month 12.

To measure food insufficiency, we use the questions provided on the topical modules mentioned above and we define this in the same fashion as many other authors (e.g., Gundersen and Oliveira, 2001) as encompassing households who report that they 'sometimes or often did not get enough to eat' in a particular month. The SIPP topical module includes the food insufficiency question for all four months in a given wave; however, we limit our analysis to the food insufficiency data collected in the month closest to the interview (the last month in each wave). It is likely that the food insufficiency measure collected for the last month of each wave is most accurate because recall bias is minimized. Of course, since food insufficiency is the dependent variable in a logistic regression, the presence of measurement error will bias the estimated coefficients toward zero, introducing a conservative bias to our results. It is also worth noting that food insufficiency is a subjective measure that is not perfectly correlated with other measures such as hunger (Gundersen and Ribar, 2005). However, food insufficiency is the only measure that is readily available over this time period.

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[13]The value of non-cash benefits such as food stamps, WIC, or Medicaid are not included in the definition of income used here.

[14]Depending on the household's membership in particular rotation group, Month 12 will correspond to a calendar month in the period from September through December 1992 (for the 1991/92 panels) or September through December 2003 (for the 2001 panel).

With the exceptions of Farrell (2003) and Newman (2006), most authors to date have measured income variability using only discrete measures of job loss, loss of earned or unearned income, or loss of benefits such as food stamps (e.g., Corcoran et al., 2004; Gundersen and Gruber, 2001). We use two different continuous measures: Per our discussion of models above, we are interested in the contemporaneous deviation of current income from average income. We measure this as the gap between income in any given month and average monthly income over the 12 reference months. In order to develop a more generalized measure, we also measure income volatility over the full 12 months as the coefficient of variation of total monthly household income for those months.[15] An advantage of using the coefficient of variation is scale insensitivity. That is, an increase in the level of income alone will not lead to an increase in measured volatility. And the coefficient of variation reflects increases in variation in direct proportion. That is, a doubling of all the deviations around the mean in a data series will result in a doubling of the coefficient of variation. All income measures are deflated to 1992 dollars.[16]

Other controls and characteristics we develop include the following:

- a measure of family type (married couple with children, single parent with children, or no-child household);
- household head characteristics, including sex, age, education, employment status, marital status, and race/ethnicity;
- household location (urban vs. rural and census division); and
- household characteristics, including homeownership status, number of adults, number of children, and whether any member of the household was employed, disabled, or received benefits from any program such as AFDC/TANF, WIC or food stamps.

The analysis that follows includes both descriptive and explanatory components. In our descriptive analysis, we report on the levels of income volatility for nonelderly low-income households and for subgroups that include food stamp recipients, welfare recipients, and 'welfare at-risk' households

[15]The coefficient of variation of a data series (in this case, monthly income for 12 months) is the standard deviation of the data series divided by the mean.

[16]A small number of households with negative total income recorded in any month are eliminated from the analysis. Negative income derives from asset income. This is consistent with the approach of Rose et al. (1998) and Gundersen and Oliveira (2001).

(defined as single parents who did not complete high school living in households with no other adults). Because income volatility is the key independent variable, we compare the level of income volatility and subgroup decompositions across the two time periods.

In our explanatory analysis, we test the model developed in Section III. Along these lines, we test whether average or variable income is an important determinant of food insufficiency in a multivariate logistic regression, controlling for other explanatory variables. We also test whether these relationships have changed over time. All statistical calculations are made using procedures designed for survey data and applying appropriate household weights provided on the SIPP.

V. INCOME VOLATILITY

In Table 1 we present mean income volatility over the 12-month period for all low-income households in the sample, as well as for a variety of different subgroups. Results are shown for the both the 1991/92 panel and the 2001 panel. The volatility measure is, as discussed above, the coefficient of variation over 12 months of total household income.[17] While the results shown here are sample means, an analysis of sample medians yields comparable findings.

Volatility over Time. Table 1 shows that income volatility is generally higher for lower income households, for smaller households, and for households without children. However, few other characteristics seem to be directly related to income volatility. For instance, there is relatively little gap in volatility levels for those with and without high school diplomas, for those who do and do not own their own homes, or by race.

Comparing volatility measures across the two panels, however, we see that income volatility has increased considerably between the two time periods for all households in the sample, with the coefficient of variation rising from 28.7 to 34.1—an increase of 18 percent. One way to gauge the magnitude of this change is to compare it to the volatility measured for poverty and nonpoverty households within the

[17] In Tables 1 and 3, the statistic reported is the coefficient of variation multiplied by 100.

Table 1
Income Volatility
(Measured as 100 x coefficient of variation of total household income over 12 months)

	1991/92 Panel			2001 Panel		
	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line
All Households	28.7	36.8	26.4	34.1	49.8	29.3
HH income as percent of PL						
Below 50 percent	40.9			67.3		
Between 50 and 100 percent	34.7			39.7		
Between 100 and 150 percent	31.2			32.9		
Over 150 percent	25.0			28.1		
Welfare ‘At-Risk’ Population	29.8			52.8		
Not Welfare ‘At-Risk’	28.7			33.3		
Did Not Complete H.S.	30.4	35.4	27.5	36.8	48.4	30.3
H.S. Graduate	28.2	37.8	26.1	33.4	50.4	29.1
TANF/AFDC	29.7	27.3	36.9	41.5	43.5	36.8
No TANF/AFDC	28.6	43.2	25.9	33.8	50.6	29.2
Food Stamp Recipiency	33.5	31.6	38.1	45.6	49.2	38.7
No Food Stamp Recipiency	27.5	45.9	25.4	31.9	50.2	28.6
Disabled Person in HH	29.9	36.1	27.4	33.8	44.7	28.8
No Disabled Person in HH	28.2	37.2	26.0	34.1	51.6	29.4
Homeowners	27.1	41.4	25.2	30.8	48.7	27.9
Renters	30.4	35.1	28.0	37.9	50.3	31.4

(table continues)

Table 1, continued

	1991/92 Panel			2001 Panel		
	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line
Household Composition						
Wife and husband with child(ren)	27.0	40.3	24.7	30.6	46.4	27.5
Single persons with child(ren)	29.9	31.8	28.5	38.4	50.2	31.0
No children	31.7	50.1	28.8	35.4	55.9	31.4
Race/Ethnicity						
Non-Hispanic white	28.5	38.0	26.3	33.0	48.6	29.0
Non-Hispanic black	28.6	33.5	25.6	37.8	51.6	30.1
Hispanic	30.3	36.0	27.9	37.6	44.1	35.1
Non-Hispanic other	33.8	42.5	31.1	36.4	62.0	29.8
Household Size						
2 persons	31.7	39.8	29.4	37.2	55.2	31.7
3 persons	30.7	41.0	27.8	35.0	51.5	30.1
4 persons	27.0	35.8	24.9	33.1	51.6	28.3
5 persons	26.3	34.5	24.1	31.5	45.4	27.3
6 persons	26.4	31.2	24.5	31.0	39.6	27.4
7 or more persons	26.2	29.5	23.8	31.4	39.7	27.1
Unweighted sample size	8,268	1,847	6,421	6,432	1,570	4,862

Note: The welfare 'at-risk' population comprises single parents, persons without a high school diploma, and sole adults in household.
HH = household; PL = poverty line; H.S. = high school.

1991/92 panel. In the 1991/92 panel, volatility is 35 percent higher for poor households than for nonpoor households (36.8 versus 26.4). So the general increase in income volatility between the 1991/92 and the 2001 panels was about half as large as the difference in volatility between poor and nonpoor households in the 1991/92 panel.

The increase in income volatility over time occurred among different family types, across all races, in households with and without food stamps or AFDC/TANF, and so on. However, this increase is greatest among lower income households. For households in poverty, volatility increased from 36.8 to 49.8—an increase of 35 percent, while for nonpoor households the increase was less substantial (11 percent). The increase in volatility was greatest for the poorest households, those with income below 50 percent of the poverty line. In this group, volatility increased 64.4 percent.

Because the receipt of cash assistance dropped dramatically through the 1990s (due to both welfare reform and economic factors), a direct comparison of AFDC/TANF recipients across the two panels is something of an 'apples and oranges' exercise. In this sample, receipt of cash assistance dropped from 12.2 percent to 3.8 percent from the first to the second time period (Table 5). Based on the extensive literature on the welfare population before and after reform, we suspect that the composition of households receiving cash assistance changed considerably. In order to generate a comparable group of individuals in both panels who are likely to have been influenced by the changes in welfare policy, we instead examine households who might be 'at-risk' for welfare participation. We define these to be families headed by single parents who have not graduated from high school and who are living with their children with no other adults present. The measured income volatility for this group jumps dramatically between the two time periods. In the 1991/92 panel, there is little difference in income volatility levels between the households deemed 'at risk' for welfare and those who are not (with income volatility measures of 29.8 and 28.7, respectively). In the second time period, that gap has grown considerably. The income volatility measure for the 'at-risk' households rose to 52.8 (a 77.5 percent increase), while for other families it rose to only 33.3 (a 16.7 percent increase). This increase in volatility was accompanied

by little in the way of higher income; mean annual household income for these households rose only from $9,811 to $9,905 (Table 6).

Newman (2006) notes that 'seam bias' or recall bias that differentially affects the reporting of income (or other variables) in the last month of wave T as compared with the first month of wave T+1, will introduce additional volatility in reports of monthly income that span more than one wave of the SIPP. If the bias is greater for lower income households or if it increased over time, then this could partly explain the findings here. It is not implausible that seam bias might vary with household characteristics and we will investigate this in future drafts. However, even after undertaking a correction to smooth the seam bias in the SIPP data, Newman (2006) finds results very similar to those here for differences in volatility by income levels. Furthermore, there is no clear reason to expect seam bias to increase across the two panels studied here. In fact, the SIPP introduced computer assisted personal interviewing (CAPI) in 1996, which is likely to have reduced the magnitude of seam bias somewhat in the later panel. This change in interviewing process should introduce a conservative bias to our comparison over time, since we find that later income was considerably more volatile than earlier income.

Decomposing Volatility. To further examine the potential sources of the increased volatility, we decompose total household income into three components: earnings, AFDC/TANF income, and all other income. Panel A of Table 2 reports the coefficient of variation for each of these components of income for the 1991/92 and 2001 SIPP panels. In the sample of households with income below 300 percent of poverty, we find that the volatility of both earnings and of all other sources of income is larger than the volatility of total income in both panels. In contrast, AFDC/TANF is much less volatile than total income in both panels. The same pattern holds for the various subgroups reported in Table 2.

The change in the volatility of the components cannot explain the increase in volatility in total household income. For example, among all households in the sample, we find that earnings volatility is virtually unchanged, while AFDC/TANF and all other income volatility actually declined between 1991/92 and 2001. Thus, the increase in volatility for total household income must be explained by a

Table 2
Decomposition of Income Volatility, by Income Level and Household Type, 1991/92 and 2001 Panels

	All Households < 300% of Poverty		Welfare 'At-Risk'		Not Welfare 'At-Risk'		Household Income Relative to Poverty Line							
							< 50%		50–100%		100–150%		150–300%	
	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001
Panel A: Coefficient of Variation (x100) over 12 Months														
Total Income	28.7	34.1	29.8	52.8	28.7	33.3	40.9	67.3	34.7	39.7	31.2	32.9	25.0	28.1
Earnings	40.1	40.7	51.4	63.9	39.6	39.8	61.2	72.5	61.5	55.7	44.8	41.0	30.8	32.2
AFDC/TANF	9.3	5.8	23.4	25.9	8.6	4.9	19.8	20.2	20.8	11.6	13.9	5.0	3.8	2.4
Other Income	67.6	49.9	60.1	54.9	67.9	49.7	70.8	41.4	42.7	46.3	73.5	49.0	71.7	52.4
Panel B: Percent of Total Annual Income from														
Earnings	76%	82%	36%	56%	78%	83%	31%	50%	55%	72%	77%	83%	87%	89%
AFDC/TANF	7	2	41	15	5	1	42	14	19	3	3	0.5	0.3	0.1
Other Income	17	16	23	29	17	15	27	36	27	26	20	16	12	10
Panel C: Share of Income Volatility from														
Earnings	85%	88%	54%	67%	87%	89%	45%	61%	72%	80%	87%	89%	93%	93%
AFDC/TANF	5	2	79	8	1	2	63	22	4	1	0.2	0.3	0.1	0.0
Other Income	10	10	-33	25	12	10	-8	17	24	19	13	11	7	7
N	8,268	6,432	357	248	7,911	6,184	607	573	1,240	997	1,410	1,214	5,011	3,648

compositional shift away from less volatile sources of income (AFDC/TANF) to more volatile sources (earnings and all other income). Indeed, the share of total income derived from earnings rose from 76 percent to 82 percent, while the share derived from welfare income fell from 7 percent to 2 percent (Panel B of Table 2). This change is much more pronounced for lower income and welfare at-risk households. For welfare at-risk households, earnings as a share of total income rose from 36 to 56 percent, while welfare payments dropped from 41 to 15 percent of income. Other income as a share of the total rose somewhat, from 23 to 29 percent. Results for households in poverty are similar.

The net effect of changes in both the volatility of components and of the shares of income components can be summarized with a variance decomposition proposed by Shorrocks (1982). Shorrocks shows that the share of the coefficient of variation squared (and similarly, the share of the variance) attributable to the *kth* element of income is equal to:

$$S^k = \text{Cov}\,(Y^k, Y)/\,\text{Var}\,(Y),$$

where Y is total income and Y^k is its *kth* element. In the application here, we compute S^k for each household based on the variance of their total income over the 12 months included and the covariance between income components and total income over those 12 months. Averages across households are reported in Panel C of Table 2.

The Shorrock decomposition suggests that earnings are the largest contributor to income volatility.[18] Furthermore, the share of volatility attributable to earnings rose over this period (from 85 to 88 percent), with a corresponding drop in the share attributable to welfare payments, volatility derived from all other sources of income was constant in the two panels. An examination of the different household types and income levels, however, indicates that these changes largely occurred among households below the poverty line and those at-risk for welfare. For example, among those at-risk for welfare, the share of volatility attributable to earnings rose from 54 to 67 percent, while the share from

[18]This finding is consistent with Newman (2006) who finds that monthly income volatility in low-income households with children is largely a result of changes in hours or weeks worked, changes in the wages, or employment exit or entry by adults in the household.

AFDC/TANF dropped from 79 to 8 percent.[19] In contrast, for households not at-risk for welfare or for those households above the poverty line, the share of volatility attributable to each component was relatively constant.

Food Assistance Programs. Under most definitions of household income, including the definition used on the SIPP, in-kind transfers such as food stamps and WIC are excluded from the calculation of income. However, the SIPP survey collects data on Food Stamp and WIC Program participation and food stamp benefits, as well as imputing the value of the WIC benefit amount. In order to gauge how these two program benefits affect the overall stability of income, we added the food stamp and WIC benefit amounts to total household income and recomputed the volatility measures using this augmented version of household income. These results are presented in Table 3. A comparison of Tables 1 and 3 indicates that the inclusion of the food assistance programs results in a reduction in overall volatility. This result holds for households above and below the poverty line as well as for the various demographic subgroups displayed in both tables. The inclusion of food assistance programs also reduces, but does not eliminate, the difference in volatility between poverty and nonpoverty households in both time periods. However, we still observe a comparable overall increase in volatility between the 1991/92 and 2001 panels, and that increase is still greatest for the most disadvantaged households. In sum, we conclude that the inclusion of food assistance in income reduces overall income volatility for all groups and in both time periods, and reduces the disparity between low-income and (relatively) high-income households. But measured increases in income volatility over time are similarly large regardless of which definition of income is used.

We also examine volatility by decomposing our augmented definition of income into its five components: earnings, AFDC/TANF, all other income, food stamp benefits, and WIC benefits. As shown in Panel A of Table 4, earnings and all other income sources remain more volatile than total augmented

[19]Note that for both welfare at-risk households and those with incomes below 50 percent of poverty, the initial contribution of 'all other income' to total income volatility is negative. This suggests that in the first time period that 'all other income' was negatively correlated with total income, and thus, was a stabilizing influence.

Table 3
Income Volatility for Augmented Income (Total Income Plus Value of Food Stamp and WIC Benefits)
(Measured as 100 x coefficient of variation of total household income over 12 months)

	1991/92 Panel			2001 Panel		
	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line
All Households	27.1	30.9	26.0	32.0	42.4	29.0
HH Income as Percent of PL						
Below 50 percent	31.5			52.6		
Between 50 and 100 percent	30.6			36.9		
Between 100 and 150 percent	30.2			32.0		
Over 150 percent	24.8			28.0		
Welfare 'At-Risk' Population	24.5			39.5		
Not Welfare 'At-Risk'	27.3			31.7		
Did Not Complete H.S.	27.6	28.8	27.0	32.8	38.5	29.7
H.S. Graduate	27.0	32.5	25.8	31.8	44.1	28.8
TANF/AFDC	23.9	20.5	33.9	32.6	31.6	34.6
No TANF/AFDC	27.6	38.0	25.7	32.0	43.8	28.9
Food Stamp Recipiency	26.7	23.3	35.2	34.3	33.5	35.7
No Food Stamp Recipiency	27.2	44.5	25.3	31.6	49.6	28.4
Disabled Person in HH	28.0	30.3	27.1	30.8	36.0	28.4
No Disabled Person in HH	26.8	31.3	25.6	32.3	44.7	29.1
Homeowners	26.5	37.4	25.0	30.2	45.5	27.8
Renters	27.8	28.6	27.4	34.2	40.9	30.7

(table continues)

Table 3, continued

	1991/92 Panel			2001 Panel		
	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line	All Households below 300% of Poverty Line	Households below the Poverty Line	Households above the Poverty Line
Household Composition						
Wife and husband with child(ren)	26.0	35.2	24.4	29.8	43.1	27.2
Single persons with child(ren)	26.7	25.4	27.7	33.3	38.1	30.4
No children	30.9	44.9	28.7	35.2	56.2	31.3
Race/Ethnicity				31.6		
Non-Hispanic white	27.3	32.8	26.0	33.0	43.0	28.7
Non-Hispanic black	25.5	26.1	25.1	35.0	39.6	29.4
Hispanic	28.2	29.4	27.6	35.4	36.8	34.3
Non-Hispanic other	32.9	40.0	30.9	36.0	57.7	29.7
Household Size				32.7		
2 persons	30.3	34.4	29.1	30.9	51.4	31.5
3 persons	28.8	34.1	27.4	29.3	42.9	29.7
4 persons	25.6	29.8	24.6	28.8	42.5	28.0
5 persons	24.8	28.4	23.8	28.8	36.8	27.0
6 persons	24.8	26.6	24.1	6,397	32.9	27.0
7 or more persons	24.1	25.1	23.4		32.9	26.7
Unweighted sample size	8,258	1,837	6,421		1,535	4,862

Note: The welfare 'at-risk' population comprises single parents, persons without a high school diploma, and sole adults in household.
HH = household; PL = poverty line; H.S. = high school.

Table 4
Decomposition of Income Volatility, with Augmented Income (Total Income Plus Value of Food Stamp and WIC Benefits), by Income Level and Household Type, 1991/92 and 2001 Panels

	All Households < 300% of Poverty		Welfare 'At-Risk'		Not Welfare 'At-Risk'		Household Income Relative to Poverty Line: < 50%		50–100%		100–150%		150–300%	
	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001	1991/92	2001
Panel A: Coefficient of Variation (x100) over 12 Months														
Total Income plus FS and WIC	27.1	32.0	24.5	39.5	27.3	31.7	31.5	52.6	30.6	36.9	30.2	32.0	24.8	28.0
Earnings	40.2	41.0	51.5	66.3	39.6	40.0	62.3	77.7	61.5	55.7	44.8	41.0	30.8	32.2
AFDC/TANF	9.3	5.8	23.3	26.9	8.6	5.0	20.0	21.6	20.8	11.6	13.9	5.0	3.8	2.4
Other Income	67.6	50.2	59.9	57.0	68.0	49.9	71.7	44.4	42.7	46.3	73.5	49.0	71.7	52.4
FS	18.3	15.3	27.4	37.1	17.8	14.4	19.5	27.1	33.6	30.1	32.1	18.5	10.3	8.9
WIC	8.4	11.5	15.6	20.6	8.1	11.2	18.5	21.7	13.7	17.2	11.4	13.7	4.9	7.9
Panel B: Percent of Total (Augmented) Annual Income from														
Earnings	75%	81%	33%	49%	77%	82%	26%	41%	50%	68%	76%	82%	87%	89%
AFDC/TANF	5	1	27	8	4	1	25	7	15	2	2	0	0.3	0.1
Other Income	16	15	19	23	16	14	20	27	23	23	19	16	12	10
FS	5	3	21	18	4	3	28	23	12	6	2	2	0.3	0.3
WIC	0.3	0.4	1	2	0.3	0.3	1	2	1	1	0.3	0.4	0.1	0.1
Panel C: Share of (Augmented) Income Volatility from														
Earnings	84%	87%	49%	62%	86%	88%	39%	57%	67%	79%	87%	89%	93%	93%
AFDC/TANF	2	2	14	5	2	1	12	17	8	1	1	0.3	0	0
Other Income	11	10	21	23	11	9	26	17	19	17	12	11	7	7
FS	2	1	13	10	2	1	19	8	4	2	1	0	0	0
WIC	0.4	0.2	3	0.2	0	0	3	2	1	0	0	0	0	0
N	8,258	6,397	356	240	7,902	6,157	597	538	1,240	997	1,410	1,214	5,011	3,648

Note: FS = food stamps; WIC = Women, Infants, and Children Nutrition Program.

income, while AFDC/TANF, food stamps, and WIC are less volatile. This is generally true across the various subgroups displayed in Table 4, with the exception that volatility of food stamp benefits occasionally exceeds that for the total augmented income for certain subgroups in 1991/92.

Panel B of Table 4 shows that the food stamp benefit represents a large share (20 to 25 percent) of augmented income for the welfare at-risk households and for households with income below 50 percent of poverty. Among these households, the proportion of augmented income derived from food stamp benefits did not change much between 1991/92 and 2001. In contrast, the share of augmented income from AFDC/TANF dropped from 27 percent to 9 percent among the welfare at-risk group. The WIC share is small but doubled between 1991/92 and 2001 among the welfare at-risk households and those households below 50 percent of poverty.

Panel C of Table 4 illustrates the share of volatility that can be attributed to each of the sources of augmented income. Within each of the time periods, we find that earnings and all other income sources remain the largest contributors to overall volatility. As might be expected, transfer programs generally have a stabilizing influence. For lower income and welfare at-risk households, the share of volatility derived from earnings increases substantially over time. Once again, this is consistent with the findings reported in Table 2—increasing volatility in earnings is the source of increased income volatility for low-income households, regardless of which definition of income is used.

VI. DETERMINANTS OF FOOD INSUFFICIENCY

In Table 5 we provide an overview of other sample characteristics for all variables that are included in our estimated models. Unless otherwise stated, measures are for Month 12 of the interview period. Average income levels changed little between the 1991/92 and 2001 panels (measured in 1992 dollars), while the percentage reporting food insufficiency declined by one-third. This decline is not inconsistent with the downward trend in food security measures observed by Nord, Andrews, and Carlson (2004) during the second half of the 1990s. As discussed above, receipt of cash welfare assistance and food stamps declined considerably, but WIC enrollment did not. There was some shift in the racial

Table 5
Sample Means, Households Below 300 Percent of the Poverty Line

	1991/92 Panel		2001 Panel	
Variable	Mean	SD	Mean	SD
Annual HH Income (1992 $)	$22,865	$11,777	$22,517	$14,113
Month 12 HH Income (1992$)	$2,038	$1,329	$2,160	1,570
Percent Food Insufficient	4.0%	21.3%	2.9%	25.9%
Percent Food Stamp Recipiency	20.3	42.0	16.1	38.6
Percent AFDC/TANF	12.2	34.6	3.8	19.4
Percent WIC	8.7	29.5	12.8	35.9
Percent H.S. Graduate	74.8	45.3	79.6	43.2
Percent Own Home	50.8	51.6	53.8	54.2
Percent with Disabled Person in HH	30.1	47.2	19.5	41.8
Percent Wife and Husband with Kids	52.3	51.6	47.0	54.2
Percent Single Person with Kids	28.8	47.7	32.2	49.7
Percent without Kids	18.9	40.4	20.8	43.7
Percent non-Hispanic White	66.0	49.9	57.2	53.6
Percent non-Hispanic Black	15.8	39.9	17.3	40.4
Percent Hispanic	14.2	36.7	20.7	44.8
Percent non-Hispanic Other	3.9	20.0	4.7	22.1
Household Size	3.8	1.5	3.7	1.6
Number of Adults	2.1	0.8	2.1	0.9
Number of Children	1.7	1.3	1.7	1.4
Percent of Households with:				
2 persons	22.1	43.6	24.0	46.2
3 persons	23.1	43.9	22.6	47.2
4 persons	28.6	46.3	27.1	47.5
5 persons	15.8	37.2	15.6	38.6
6 persons	6.2	24.2	6.6	25.8
7 or more persons	4.2	20.2	4.2	20.4
Unweighted Sample Size	8,383		6,477	

composition of household heads (with a rising percentage of Hispanics) that is consistent with Census tabulations of the changing demographics of low-income households in the United States. There were more minor shifts in measures such as the percent of households comprised of married couples with children and the educational attainment of the household head. While we measure a more substantial decline in the number of households with a disabled person, we suspect this in part reflects different definitions of disability in the two panels.[20] In Table 6 we also provide sample means for various population subgroups of interest—the welfare 'at-risk' population, single parents, and those with incomes below 100 and 200 percent of the poverty line, respectively. Characteristics vary with income as might be expected.

Next we turn to a test of the relationship between average and transitory income components and food insufficiency as discussed above in Section III. We base our estimation on equations (5) and (6):

$$(5) \qquad \text{Prob}(F_t<F^*) = \exp(X\beta) / (1+\exp(X\beta))$$

$$(6) \qquad X\beta = \beta_0 + \beta_1 Y_P + \beta_2 Y_{Dt,}$$

which we operationalize as a logistic regression. As discussed above, food insufficiency (F_t) is measured in Month 12. The associated measure of average income (Y_P) is the average monthly household income for the preceding 12 months. Transitory income in Month 12 (Y_{Dt}) is measured as the gap between household income in Month 12 and average income. Both income measures are specified in hundreds of dollars.[21] In addition to both transitory and average income components, we include independent variables that we believe to be either underlying factors affecting, or proxies indicative of, determinants of a necessary food budget, of other necessary household expenditure needs, or of household liquidity. These include a variety of controls for household size and composition, dependence on social programs for in-

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[20]With the exception of annual household income and household size, changes in means across the two panels are statistically significant at the .05 level.

[21]If we use the augmented total income measure (including the value of WIC and food stamp benefits) in place of total household money income used here, we obtain results that are virtually identical to those reported here.

Table 6
Sample Means for Subpopulations Households below 300 Percent of the Poverty Line

	1991/92 Panel				2001 Panel			
	Welfare At-Risk	Single Parents	< 100% Poverty	< 200% Poverty	Welfare At-Risk	Single Parents	< 100% Poverty	< 200% Poverty
Annual HH Income (1992 $)	$9,811	$16,049	$8,408	$16,203	$9,905	$17,187	$8,186	$15,982
Month 12 HH Income (1992 $)	$741	$1,363	$934	$1,513	$788	$1,588	$935	$1,599
Percent Food Insufficient	10.1%	7.0%	9.0%	6.1%	4.3%	3.7%	5.2%	4.3%
Percent Food Stamp Recipiency	69.6%	44.3%	62.7%	31.9%	58.3%	30.8%	45.1%	24.1%
Percent AFDC/TANF	60.3	33.4	39.7	19.5	20.4	8.8	11.3	5.6
Percent WIC	16.8	13.2	18.5	13.1	29.8	18.5	23.0	17.1
Percent H.S. Graduate	0.0%	72.6%	59.7%	68.8%	0.0%	75.9	68.6%	74.3%
Percent Own Home	11.7	28.1	27.3	41.4	13.2	33.2	31.9	44.3
Percent with Disabled Person in HH	27.4	27.4	37.7	34.1	18.0	16.6	26.3	22.8
Percent Wife and Husband with Kids	0.0%	0.0%	34.3%	47.3%	0.0%	0.0%	32.4%	43.0%
Percent Single Person with Kids	100.0	100.0	53.7	37.5	100.0	100.0	52.7	39.2
Percent without Kids	0.0	0.0	12.0	15.2	0.0	0.0	14.8	17.8
Percent non-Hispanic White	41.0%	50.5%	49.1%	59.2%	30.0%	45.1%	43.5%	50.4%
Percent non-Hispanic Black	29.8	30.7	26.5	19.6	34.3	31.4	26.9	20.4
Percent Hispanic	25.5	15.5	20.2	17.3	33.3	19.7	25.0	24.4
Percent non-Hispanic Other	3.7	3.3	4.1	4.0	2.3	3.9	4.6	4.8
Household Size (mean)	3.3	3.4	4.0	3.9	3.1	3.5	3.9	3.8
Number of Adults	1.0	1.4	1.8	2.0	1.0	1.5	1.8	2.0
Number of Children	2.3	2.0	2.2	1.9	2.1	1.9	2.0	1.8
Percent with Two Persons	30.7	28.7	22.1	21.4	30.7	28.7	22.1	21.4
Percent with Three Persons	30.3	32.6	22.4	21.7	30.3	32.6	22.4	21.7
Percent with Four Persons	23.6	21.3	24.8	27.0	23.6	21.3	24.8	27.0
Percent with Five Persons	9.4	9.0	14.9	16.8	9.4	9.0	14.9	16.8
Percent with Six Persons	2.7	4.4	7.9	7.0	2.7	4.4	7.9	7.0
Percent with Seven or More Persons	3.3	4.0	7.9	6.0	3.3	4.0	7.9	6.0
Unweighted Sample Size	361	2,293	1,931	4,994	249	2,165	1,600	4,073

kind support (including food stamps), household location, homeownership, education level, employment status, and disability status of any household members.

Jensen (2002) and Gundersen and Oliveira (2001) have noted that while Food Stamp Program participation itself may be an important determinant of food insufficiency, such participation should be considered an endogenous variable in a food insufficiency equation. This is for two reasons: First, Food Stamp Program participation is a function of many of the same variables that would determine food insufficiency (e.g., income and assets). Thus, inclusion of Food Stamp Program participation in the equation introduces multicollinearity among the regressors. Second, Food Stamp Program participation is likely to be correlated with the error term in a food insufficiency equation, leading to biased coefficients on the Food Stamp Program participation variable. In this paper, we are not explicitly evaluating the role of food stamps in reducing food insufficiency, so we are not concerned with bias to the point estimate on food stamps as a result of the second item. The multicollinearity introduced due to the first item will potentially affect our coefficient estimates on the income variables in particular, by increasing the variance associated with the estimates, thus introducing a bias against finding a significant result.[22] The presence of this bias should be kept in mind when considering our results. As a check on the robustness of our results, we estimate our food insufficiency equations with and without controls for food stamp receipt and find only minor changes in point estimates and variances, all in the expected direction. We also estimate the food insufficiency equation for a variety of population subgroups that include food stamp recipients. By estimating our equations for this group alone, we eliminate potential multicollinearity and errors-in-variables.

The coefficient estimates for the full equation estimated for each time period are shown in Table 7. The coefficients for both average and transitory income are negative and statistically significant. In the 1991/92 panel, the coefficient estimates for the average and transitory components are -.069 and -.046,

[22]Alternatively, omitting the Food Stamp Program participation variable is likely to introduce omitted variable bias, biasing the estimated coefficients on income variables towards zero.

Table 7
Logistic Regressions of Food Insufficiency Households below 300 Percent of the Poverty Line

	1991/92 Panel		2001 Panel	
Variable[a]	Coefficient (Std Error in Parenthesis)	Estimated Odds Ratio	Coefficient (Std Error in Parenthesis)	Estimated Odds Ratio
Intercept	-2.089*** (0.40)		-3.501*** (0.44)	
Income Components				
Average monthly income (100s of $)	-0.069*** (0.01)	0.93	-0.064*** (0.01)	0.94
Income deviation, Month 12 (100s of $)	-0.046*** (0.01)	0.96	-0.045*** (0.02)	0.96
Householder Characteristics				
High school graduate	-0.24* (0.15)	0.78	-0.15 (0.19)	0.86
Male	-0.46** (0.19)	0.63	-0.73*** (0.27)	0.48
Black (non-Hispanic)	-0.52** (0.21)	0.60	-0.48 (0.30)	0.62
Hispanic	-0.05 (0.18)	0.95	-0.14 (0.30)	0.87
Other race (non-white, non-Hispanic)	-0.80 (0.42)	0.45	-0.55 (0.48)	0.57
Household Type				
Single parent	0.004 (0.26)	1.004	-0.21 (0.31)	0.81
Married couple with children	0.05 (0.23)	1.05	0.00 (0.51)	0.996

(table continues)

Table 7, continued

Variable[a]	1991/92 Panel		2001 Panel	
	Coefficient (Std Error in Parenthesis)	Estimated Odds Ratio	Coefficient (Std Error in Parenthesis)	Estimated Odds Ratio
Household Characteristics				
Number of adults	0.10 (0.10)	1.11	0.42*** (0.11)	1.52
Number of children	0.17*** (0.05)	1.18	0.18 (0.10)	1.19
Disabled person in household	0.65*** (0.14)	1.92	0.78*** (0.20)	2.17
Employed person in household	-0.04 (0.18)	0.97	0.34 (0.24)	1.40
Elderly person in household	-1.70 (1.00)	0.18	0.02 (0.43)	1.02
Home owned by household member	-0.48*** (0.16)	0.62	-1.25*** (0.31)	0.29
Household member receives AFDC/TANF	0.34 (0.23)	1.41	0.26 (0.31)	1.30
Household member receives food stamps	-0.05 (0.25)	0.95	0.02 (0.24)	1.02
Household member receives WIC	-0.22 (0.19)	0.81	-0.25 (0.25)	0.78
Unweighted sample size	7,867		6,358	
C	0.786		0.769	

***Significant at the .01 level.
**Significant at the .05 level.
[a]Controls for urban and regional location included in each equation.

respectively. The corresponding estimates from the 2001 panel are virtually the same: -.064 and -.045. The odd ratios for these variables imply that a unit increase in income ($100) will result in a decline in the predicted probability of food insufficiency of approximately 6.5 percent for average income and approximately 4.5 percent for transitory income. In both time periods, tests for equality of coefficients indicate no significant differences between the coefficients on the average and transitory components of income. Thus, the estimated coefficients are consistent with the predictions of Gundersen and Gruber's (2001) model with liquidity constraints.[23] This suggests that income volatility indeed has an impact on food insufficiency rates for low-income households, even after accounting for the average level of household income over time. Of course, we have observed an increase in income volatility between these two periods, a factor that would, all other things equal, contribute to an increase in food insufficiency.

One concern is the possibility that our measure of transitory income represents measurement error and not real shocks to household income. This would bias the estimated coefficient for transitory income toward zero. For the lower income households, this adds a conservative bias to our findings. For higher income households, the finding of a nonsignificant coefficient for the income deviation variable could simply be a result of measurement error. However, it seems implausible that measurement error would be more significant for higher income households. In addition, there is no reason to believe that rising household income volatility over time can be explained by measurement error.

A second question of interest is whether the relationship between income volatility and food insufficiency changed between the two time periods studied. It appears that it has not. We find remarkable consistency over time in the estimated coefficients on both average and transitory income components in numerous variations of the model that we estimated. Furthermore, the estimated coefficients on average and transitory income are highly robust and change little whether entered in an equation by themselves or with the inclusion of a variety of control variables. A number of the control variables have coefficients

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[23]Though the point estimates for β2 are slightly closer to zero than the point estimates for β1—consistent with the notion of partial liquidity constraints.

that are significantly different from zero as well. We consistently find that (after controlling for household income) smaller households, those headed by blacks, males, and those living in housing units owned by a household member are all less likely to experience food insufficiency. In contrast, households including one or more disabled persons are more likely to be food insufficient. The impact of these variables is large and fairly stable in both panels. For instance, households headed by either blacks or males have about half the rate of food insufficiency as other households; those containing a disabled member are almost twice as food insufficient. Homeownership may serve as a proxy for a higher level of liquidity that a household can draw on when needed to avoid food insufficiency. The presence of a disabled household member may imply additional necessary expenditures that compete with food purchases when budget constraints are binding.

Subgroup Analysis. We also examine the relationship between food insufficiency and income volatility for a number of subgroups. In Table 8, we show the coefficients estimated on both the average and transitory income measures for food stamp recipients, single parents, those living below 200 percent of the poverty line, and for those living above and below 150 percent of the poverty line. In particular, as noted above, we examine the relationship separately for households that receive food stamps to explore the impact of the endogeneity of Food Stamp Program participation. We find the estimated size and sign of the income effects to be similar for food stamp recipients and other comparable subsamples.

Turning to the equations on the various other subsamples, several general patterns we have seen continue to hold: The coefficients estimated on both income measures are always negative and, with only a few exceptions, are statistically significant. A test for equality of coefficients suggests that in most equations (indicated on Table 8), the difference between the coefficients on the two income components is not statistically significant. As with the whole sample, the coefficient estimates show little change across time periods. Of greatest interest perhaps, is the following pattern: The absolute value of the coefficient on average income is smaller for lower income households (e.g., those below 200 percent of poverty, or food stamp recipients) and larger for higher income households (e.g., those above 150 of

Table 8
Logistic Regressions of Food Insufficiency, Households below 300 Percent of the Poverty Line

		1991/92 Panel			2001 Panel		
Sample	Variable	Coeff	Odds Ratio		Coeff	Odds Ratio	
Below 300% of Poverty Line	Average monthly income (100s of $)	-0.069***	0.933	a	-0.064***	0.938	a
	Income deviation, Month 12 (100s of $)	-0.046***	0.955		-0.045***	0.956	
Food Stamp Recipients	Average monthly income (100s of $)	-0.050***	0.951	a	-0.054***	0.947	a
	Income deviation, Month 12 (100s of $)	-0.065**	0.937		-0.037	0.964	
Single Parents	Average monthly income (100s of $)	-0.065***	0.937	a	-0.074***	0.928	a
	Income deviation, Month 12 (100s of $)	-0.050**	0.951		-0.036	0.965	
Below 200% of Poverty Line	Average monthly income (100s of $)	-0.030**	0.970	a	-0.032**	0.969	a
	Income deviation, Month 12 (100s of $)	-0.045**	0.956		-0.041**	0.960	
Below 150% of Poverty Line	Average monthly income (100s of $)	-0.025	0.975	a	-0.024	0.977	a
	Income deviation, Month 12 (100s of $)	-0.048***	0.953		-0.044**	0.957	
Above 150% of Poverty Line	Average monthly income (100s of $)	-0.137***	0.872		-0.156**	0.856	a
	Income deviation, Month 12 (100s of $)	-0.030	0.970		-0.046**	0.955	

***Significant at the .01 level.
**Significant at the 0.5 level.
[a]Coefficients on average monthly income and income deviation not significantly different from one another (.05 level).

poverty). For households below 150 percent of poverty, the coefficient on average income is not only smaller (in absolute value), but also loses statistical significance. In contrast, the size of the coefficient on transitory income generally remains roughly constant across the different subsamples. The one exception is among higher income households in the first panel; the coefficient on transitory income drops in size and loses statistical significance.

As noted above, the pattern of coefficient estimates we find for the overall sample is consistent with the model in which liquidity constrained households are meeting their food needs (and thus transitory income is as important as average income in determining food insufficiency). The shift in coefficients with household income, however, suggests that higher and lower income households face somewhat different constraints. For households above 150 percent of the poverty threshold, the coefficient on average income is larger in absolute value (more negative) and significant, while the coefficient on transitory income is smaller in absolute value (and in the second time period is not significant). This pattern (either $\beta_1 < 0$ and $\beta_2 = 0$, or $\beta_1 < \beta_2 < 0$) suggests either full or partial absence of liquidity constraints for higher income households. In contrast, for households below 150 percent poverty, the opposite pattern holds. In both time periods, average income seems to have little relevance to determining food insufficiency, while transitory income continues to be important ($\beta_1 = 0$ and $\beta_2 < 0$). This suggests that these households face constraints associated with liquidity and with what Gundersen and Gruber identify as "contractual consumption."

Simulations. To gauge the impact of an income shock on the predicted probability of food insufficiency, we compute two different simulations. First, we estimate the effect of a typical negative income shock by computing the increase in the predicted probability of food insufficiency when transitory income changes from zero to one (negative) standard deviation. Second, we repeat this calculation using the standard deviation from the 1991/92 panel.

We use the estimated coefficients from the 2001 panel to compute a predicted probability of food insufficiency for a hypothetical individual with the mean characteristics and transitory income equal to zero. Holding the values of the independent variables at the mean, we next compute the increase in the

predicated probability of food insufficiency with a negative income shock equal to one standard deviation (-$707). Using the model coefficients and means estimated from the 2001 panel along with 2001 income volatility levels, we find that this negative income shock results in an increase in the predicted probability of food insufficiency from 1.6 percent to 2.2 percent.

Repeating the exercise with 2001 model coefficients and means but with 1991/92 volatility levels, we find that a negative income shock of one standard deviation would be equal to -$596 and the corresponding predicted probability of food insufficiency would be 2.1 percent. We conclude that the general rise in income volatility between 1991/92 and 2001 implies that a negative income shock of one standard deviation results in an 18 percent greater rise in the predicted probability of food insufficiency.

The simulation above was based on the entire sample of households below 300 percent of poverty. We know that low-income households experienced a much greater increase in income volatility during the 1990s. We repeat the simulation using model coefficients and means estimated on a subsample of households with incomes below 50 percent of poverty. We find that using 2001 volatility levels, a negative income shock equal to one standard deviation would result in rise in the predicted probability of food insufficiency from 4.2 percent to 4.6 percent. However, when using the standard deviation from the 1991/92 panel, the predicted probability of food insufficiency increases from 4.2 percent to 4.4 percent. Thus, for households below 50 percent of poverty, we conclude that the rise in income volatility results in a doubling of the effect of a negative income shock equal to one standard deviation.

VII. DISCUSSION

In a logistic regression model of food insufficiency estimated for lower income (nonelderly) households, we find that income volatility—not just the mean level of household income—is a statistically significant determinant of food insufficiency. These effects are robust across different model specifications, with more variable income being associated with higher rates of food insufficiency. Furthermore, the relative importance of income *volatility* versus income *level* in determining food insufficiency increases as household income falls. For lower income households (below 150 percent of

poverty), income variability is a statistically significant determinant of food insufficiency while average (mean) income is not. These findings are consistent with models in which such households face either greater liquidity constraints or more binding constraints in spending that are associated with contractual expenditures.

In this context, public or private safety nets (such as publicly provided cash or food assistance, or assistance from family or friends, soup kitchens, or food banks) could be considered to be a relaxation of liquidity constraints. Thus, one might expect that the relationship between income volatility and food insufficiency would in part be a function of the availability of such assistance, with stronger safety nets mitigating some of the impact of income volatility on food insufficiency. However, while the years studied (1992 and 2003) represent significantly changed welfare policy environments in the United States, the relationships estimated here are quite stable over time. This could indicate that the controls for public assistance that were included in the estimated equations (receipt of AFDC/TANF, food stamps, and WIC) adequately capture the changes in the policy environment that occurred during this time. Or there could have been unmeasured but counterbalancing influences in the policy environment—for example, a decrease in the availability of cash assistance, but subsequent increases in outreach for food stamps and WIC; or, a rise in privately provided support that matched any decline in the publicly available social safety net.

A second important set of findings relates to the degree and source of income volatility itself. We find that income volatility in this sample is considerably larger for lower than for higher income households and that it increased between 1992 and 2003. Furthermore, this increase in volatility was largest for households in deep poverty and those at risk for welfare usage (with 64 and 78 percent increases, respectively). In simulating the probability of food insufficiency for households in deep poverty, we show that the increase in income volatility between the two time periods would double the impact of a one standard deviation negative income shock on predicted food insufficiency.

In order to examine the sources of increased household income volatility, we decomposed income into three components: earned income, AFDC/TANF income, and all other income. Our analysis indicates

that the increase in volatility is largely attributable to the shift in the composition of income from welfare payments to earnings and other income sources among the poorest households and among welfare at-risk households. The inclusion of food assistance benefits (food stamps and WIC) is shown to mitigate household income volatility and to narrow the volatility gap between relatively higher and lower income households. The consideration of food stamps and WIC benefits, however, does not dampen the observed large rise in income volatility among lower income households. This rise (and the associated shift in income composition) could be a result of changes in underlying household characteristics or could have its roots in changes in federal and state social policy. A cursory consideration of the mean household characteristics tabulated here suggests that they have been relatively stable over time. Both hypotheses bear further investigation, however.

While income volatility rose over time, and is shown to contribute to food insufficiency, we did not observe the expected concomitant rise in food insufficiency in this sample over this time period. On the contrary, food insufficiency rates declined across the two samples studied, from 4.0 to 2.9 percent. This finding is consistent with other data reported on food security with and without hunger. We expect that this may be a result of a number of countervailing influences: For instance, home-owning households are less likely to be food insufficient than others (presumably homeownership proxies for access to more financial resources). The strength of this effect increased across the two time periods (the odds ratio dropped from .62 to .29) while homeownership rates also rose. There was a similar effect relating to black household heads. Controlling for other factors, black household heads report lower rates of food insufficiency and this effect strengthened over time, while the proportion of blacks in the sample rose somewhat. And while receipt of cash assistance (AFDC/TANF) dropped dramatically over this time period, food stamp and especially WIC receipt rose. Finally, however, there are unexplained factors at work. The intercept of the equation shifted considerably during the two time periods, suggesting lower food insufficiency rates that are unaccounted for by other factors in the model.

Large recent increases in income volatility, taken together with the importance of volatility in determining food insufficiency for low-income households, suggests that the nexus of income level,

income volatility, liquidity constraints, and access to a social safety net may be more generally important to the well-being of lower income households than previously recognized in this and related literatures. Various aspects of these relationships deserve continued attention.

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