Income Volatility and its Implications for School Lunch

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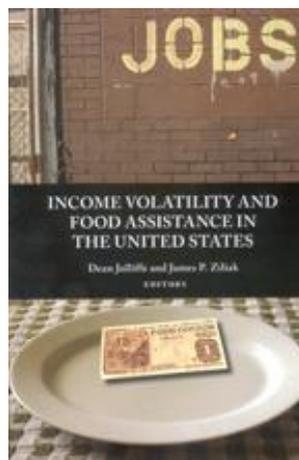
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Income volatility—month-to-month changes in a household's income—creates policy challenges for the administration of federal food assistance programs and potential hardship for families. As families shift in and out of eligibility, program designers must define eligibility rules that effectively target this changing population. And if volatility occurs involuntarily, a family might think of it as a short-term problem and forgo benefits for which they are eligible.

In this chapter, I examine the dynamic effects of monthly income volatility to better understand how it affects low-income populations. I also examine the implications of income volatility for household eligibility in the National School Lunch Program (NSLP). The analysis contributes to our understanding of the potential impacts of volatility on other USDA food assistance programs and on the changing economic conditions of low-income households.

First, I focus on the characteristics of income volatility for households with children. I compare the distributions of income volatility across six income groups using the coefficient of variation, a scale-independent measure of volatility. Then I examine the frequency of income changes occurring around the income-to-poverty ratio threshold of 185 percent, the figure used in the NSLP and other food assistance programs. Following that, I examine descriptive statistics and estimates from hazard models to understand which trigger events are most likely to explain eligibility changes.

Second, I examine the implications of income volatility for targeting efficiency in the NSLP. As this paper shows, an understanding of the interaction between income volatility and eligibility policy sheds light on recent concerns about NSLP integrity. A series of studies done in the

late 1990s raised concerns about the accuracy of the NSLP application and eligibility certification procedures. Estimates of overcertification rates—the share of students receiving benefits for which they were not entitled—ranged from 12 to 33 percent.

The U.S. Congress recently amended the National School Lunch Act (signed into law in 1946) through the Child Nutrition and Women, Infants, and Children (WIC) Reauthorization Act of 2004. One of the most important changes to eligibility was to extend the eligibility period from one month to the entire school year. A student is eligible for the whole school year if eligible by monthly household income at the time of application. Before that, the rules stipulated that households report any changes in income and household composition to school authorities. Households seldom reported such changes, and the administrative burden would have been significant if they had. Under the old rules, schools had to verify the eligibility of a sample of students before December 15. This was moved up to November 15 in the new rules.

This chapter estimates how income volatility contributed to overcertification as defined under the pre–2004 act regulations. The extent to which income volatility contributed to total overcertification is unknown, but it was always suspected as a source of error. In this chapter, I trace how changes in income by month affect eligibility changes of initially eligible households. This process allows me to estimate the likely effects of income volatility on verification results in December. I also estimate how the use of one month of income to determine eligibility (in August) compares with the use of one year of income, which better matches the eligibility period under the new law. This allows us to understand the importance of another eligibility policy, the ability of households to apply throughout the year.

The analysis suggests that households experience substantial income fluctuations, especially those households that are eligible for free or reduced-price NSLP meals. The fluctuations come largely from changes in household labor market participation, and they may explain a large amount of overcertification error. The chapter does not estimate the size of other types of errors that could also be important, such as errors made by households or administrators. But the evidence on income volatility contributes an important piece to the puzzle of what caused overcertification error rates in the past. And the analysis of how income

volatility affects NSLP eligibility can be extended to other USDA food assistance programs.

DATA AND ELIGIBILITY CRITERIA

SIPP: Description and Issue of Seam Bias

I use the 1996 panel of the Survey of Income and Program Participation (SIPP). Besides the benefits of its longitudinal design, SIPP has the advantage of supplying monthly rather than annual income. This provides the opportunity to analyze income dynamics over a shorter time frame than has been common. And for the problem of overcertification in the NSLP, annual data lack the needed detail for identifying eligibility changes within a year. The 1996 panel is a four-year panel that started in December 1995 and ended in February 2000.

SIPP has two important disadvantages: 1) attrition and 2) seam bias. I use the Census Bureau household weights for each month in order to match the initial sample design and control for attrition. The other problem, seam bias, occurs in surveys that ask for information from differentiated periods in the past. Earnings and total income data are susceptible to seam bias error (U.S. Census Bureau 1998).[1] However, I know of no research that examines the extent of seam bias for earnings or income data.[2] A common technique to avoid seam bias is to aggregate the monthly data by quarters. This technique is unavailable for this paper because I want to understand the differences that occur in very short time intervals in order to understand NSLP eligibility changes between September and December.

In the 1996 SIPP panel, I find seam bias in the income data. Table 6.1 shows the median percentage change in income in absolute terms by reference month, where the first month of the reference period is the month following the seam (Month 1). The magnitude of the percentage income change in Month 1 is much greater than the income changes in the other months: in Month 1, for each of the three school years examined, the percentage income change is 17–19 percent; for the other three reference months, the percentage income change is 2–6 percent.

**Table 6.1 Medians of the Absolute Percentage Income Change by
Reference Month: Unadjusted Data, Adjusted Data 1, and
Adjusted Data 2 (%)**

	Panel A: Unadjusted data			
	Reference month			
School year	Month 1	Month 2	Month 3	Month 4
1996–97	19	3	4	6
1997–98	18	3	4	5
1998–99	17	2	3	4

	Panel B: Adjusted data			
	Reference month			
School year	Month 1	Month 2	Month 3	Month 4
	Adjustment 1 (even distribution)			
1996–97	13	3	4	12
1997–98	12	3	4	11
1998–99	11	2	3	10
	Adjustment 2 (decreasing distribution)			
1996–97	7	9	9	9
1997–98	7	9	8	8
1998–99	7	9	8	8

SOURCE: SIPP 1996 Panel.

Seam bias creates a type of artificial volatility. Reported income
may jump from one month to the next, either because of some combina-
tion of an actual income change—which I would want to identify to as
great a degree as possible—or from misreporting at the seam. Using the
raw, unadjusted data on reported income would result in overestimat-
ing the true extent of volatility. In order to differentiate between true
income volatility and volatility from misreporting, I need to smooth the
data in some way. I perform two kinds of adjustments to the data, each
of which depends on different assumptions about the cognitive causes
of the seam problem.[3]

Based on two fundamental explanations for seam bias error, mem-
ory failure, and inference strategy, I tested two ways of adjusting the
data to smooth the differences across the seams.[4] In the first adjustment,
I assumed that the income change that was misreported at the seam
would have been evenly distributed over the first three months in the

interview period if accurately reported and that the most recent month was accurately recalled. This inference strategy is one commonly used by interviewees and is referred to as a "constant wave response" (Rips, Conrad, and Fricker 2003). In the second adjustment, I assumed a decreasing distribution around the seam with a small amount spilling back into the last month of the previous period and the rest being distributed in decreasing order from the first month of the current reference period through the next two months. The cognitive basis for this adjustment is simply that respondents cannot pinpoint the exact date of the change. It assumes that the respondent knows about when the change occurred and that the change probably occurred close to the date reported but actually occurred slightly before or sometime afterward.

The effect of the two data adjustments on the measurement of data changes at the seams is shown in Table 6.2. The first adjustment does not fully remove the apparent seam bias as measured by absolute percentage income differences at the seams. The second adjustment, which has a decreasing function around the seam, appears to remove the seam bias: the absolute percentage income change across periods is fairly equal at the seam and within the reference period. In the following analysis I use the second adjustment for the analysis, and in some parts of the analysis I contrast the results using adjusted data with those using unadjusted data to show the adjustment effect.

Eligibility and Sampling Criteria

All children in participating schools can purchase an NSLP lunch at full price, and some qualify for reduced-price or free lunches. A student is eligible for a free meal if his or her household income is at or below 130 percent of the federal poverty guideline, and a student is eligible for a reduced-price meal if household income is between 130 and 185 percent of the guideline. If a student's household receives assistance from the Food Stamp Program, from Temporary Assistance for Needy Families, or from the Food Distribution Program on Indian Reservations (or if the student is homeless, a migrant, or a runaway), the student is categorically eligible for free lunch benefits.

In this study, eligibility is determined strictly by NSLP income limits, ignoring categorical eligibility. I use a pure income definition of eligibility in order to directly relate eligibility to income volatility. The

Table 6.2 Coefficient of Variation of Income Data: Distribution by Average Monthly Income-to-Poverty Status

Panel A: Unadjusted data

	≤ 0.75	0.75–1.30	1.30–1.85	1.85–2.40	2.40–3.00	> 3.00
No. of observations	792	1290	1402	1452	1387	4807
75%	0.77	0.57	0.47	0.41	0.37	0.37
50% (median)	0.52	0.39	0.32	0.28	0.25	0.24
25%	0.32	0.26	0.22	0.20	0.18	0.17
Mean	0.61	0.44	0.38	0.33	0.31	0.31
Std. dev.	0.45	0.28	0.26	0.19	0.24	0.23
Interquartile range	0.45	0.31	0.25	0.21	0.19	0.20

Panel B: Adjusted data

	≤ 0.75	0.75–1.30	1.30–1.85	1.85–2.40	2.40–3.00	> 3.00
No. of observations	792	1290	1402	1452	1387	4807
75%	0.68	0.51	0.42	0.36	0.33	0.33
50% (median)	0.45	0.34	0.28	0.25	0.23	0.21
25%	0.27	0.22	0.19	0.17	0.16	0.15
Mean	0.53	0.39	0.34	0.29	0.28	0.27
Std. dev.	0.40	0.25	0.23	0.17	0.22	0.20
Interquartile range	0.41	0.29	0.23	0.19	0.17	0.18

NOTE: CV over one year of monthly income data by average income-to-poverty status. The average CV in each income-to-poverty status group is significantly different from the average CV of all the other groups combined, and each average CV is significantly different from the average CV in the following and preceding income-to-poverty groups. The differences are all significant at the 0.01 level.
SOURCE: SIPP 1996 Panel.

restriction has little effect: in the SIPP data, less than 1 percent of the households that were categorically eligible were ineligible by income.

In the analysis, I often combine eligibility for either a free lunch or a reduced-price lunch into one eligible category. One reason for combining is that it simplifies the discussion. Another is that the savings to the USDA of catching errors related to differences in free and reduced-price status are much smaller than the savings from finding errors related to eligibility for either benefit. In 2004–2005, the amount reimbursed to schools by the USDA was $1.84 for a reduced-price lunch and $2.24 for a free lunch; both are much larger than the $0.21 reimbursed for a paid lunch.

INCOME VOLATILITY ANALYSIS

A 2003 study of poverty dynamics highlights the importance of income volatility. In a census report using the 1996 SIPP panel, John Iceland (2003) finds that the average monthly poverty rates for each year in the panel were higher than the corresponding annual poverty rates (1996–1999). Other, older studies find that annual poverty rates are lower than monthly poverty rates (Coder et al. 1987; Doyle and Trippe 1991; Ruggles and Williams 1987a). Stevens (1999) finds that half of all individuals exiting poverty reenter poverty within four years. Using annual data from the Panel Study of Income Dynamics for the years 1967–1988, she concludes that the amount of time spent in poverty has been underestimated by previous work that counted only single spells of poverty. She writes, "More than half of all blacks and around one-third of whites falling into poverty will spend five or more of the next ten years in poverty."

Analyses of the dynamics of participation in the USDA's Food Stamp Program (FSP) have highlighted the importance of multiple spells of participation. To be eligible for food stamps, an individual must have a gross monthly income of 130 percent of the poverty level or below (and meet other income and asset tests). Burstein (1993), using SIPP data from the late 1980s, finds that 38 percent of people who exit the program reenter within a year. Gleason, Schochet, and Moffitt (1998), also using SIPP, similarly find high FSP reentry levels in the early 1990s. They write, "More than half of those who stop receiving food stamps reenter the program within two years. . . . Among all individuals who exit food stamps, one-fourth start receiving food stamps again within four months and 42 percent within one year."

Income Volatility by Income Group

To compare volatility across income groups, I use the coefficient of variation (CV), since it measures relative volatility. Each household is assigned to one of the six income groups according to the household's average monthly income relative to the monthly poverty line, averaged over the number of months the household was in the survey.[5] Using the 55-percentage-point difference between the NSLP eligibility cutoffs at

130 and 185 percent of poverty as the yardstick for the three central groupings, the groups are broken down as follows: 0–75 percent, 76–130 percent, 131–185 percent, 186–240 percent, 241–300 percent, and 301 percent and over.

Figure 6.1 shows the CVs in monthly income across six income groups (adjusted for seam bias).[6] The graph shows a continuous decline, from the poorest group to the richest, in the medians of the groups' CV distributions. Table 6.2 shows that the CVs at the twenty-fifth and seventy-fifth percentiles of the distributions decrease for each higher income group. Mean CVs range from 0.27 to 0.53 across income groups, and the differences across groups are statistically significant. Whether adjusted or unadjusted data is examined, the mean CV of the lowest income group is double the mean CV of the highest income group.

Eligibility Status Changes

In this section, I calculate the number of changes in monthly eligibility status within one year and within three years. The frequency of changes in eligibility provides a measure of the implications of income volatility for administrative burden when schools have to reexamine a

Figure 6.1 Monthly Income Variation among Groups with Lower Income-to-Poverty Ratios
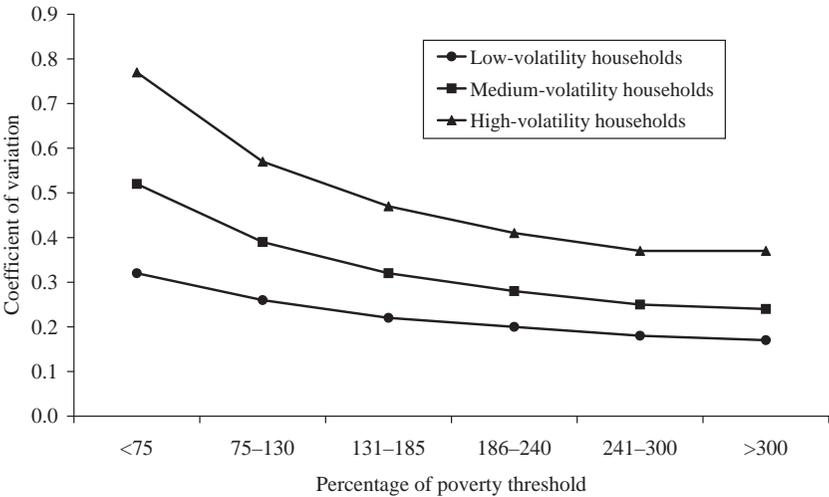
household's eligibility status for any change in income or household composition. Even though the rule was not generally enforced, it is an indicator of how the year-long eligibility rule reduces the schools' statutory responsibility and the amount of work that would have been required to fully enforce the previous law.

For the analysis in this section, I examine the frequency of income changes around the 185 percent poverty threshold. A change in status is defined as either exiting or entering eligibility; in order to get a simple, directionless measure, I do not distinguish between the directions of change. The reasons for change in one direction or the other may be different—and they have been shown to be[7]—but the frequency of eligibility change itself gives a distilled picture of the effects of volatility. I start the year in July because the monthly income for July is the first that may be used to determine eligibility if the household applies in August.

Figure 6.2 depicts the distribution of eligibility status changes across households with children during the 12-month period from July 1998 to June 1999. Of those, more than two-thirds (72 percent) never changed status. Of the households that changed status, it was just as common for them to change one time (9 percent of households) as it was for them to change two (9 percent) or three times or more (9 percent). Panel B of Figure 6.2 shows the status changes of the households that had at least one month of eligibility. This condition effectively narrows the sample to a low-income population. Among them, 37 percent had no change in status. Somewhat more (43 percent) had one or two status changes, while one-fifth (20 percent) had three or more status changes.

I also examine the number of eligibility changes within each of the income groups. As expected, most changes in eligibility status occur in the income groups closest to the eligibility limit. In the first income group, where average income was less than 75 percent of the poverty line, the average number of changes in status was 0.2. For the next income group, between 76 and 130 percent of poverty, the average number of status changes was 1.2. The two groups closest to the eligibility cutoff of 185 percent of poverty had the most changes. For the 131–185 percent group, the average number of status changes was 4.9, and for the 186–240 percent group, it was 5.0. The next two higher categories (241–300 percent and 301 percent and up) had an average number of changes of 2.2 and 0.6. The average number of 5.0 changes per year for

Figure 6.2 Eligibility Changes in 1998–1999, a Representative School Year

Panel A: All households
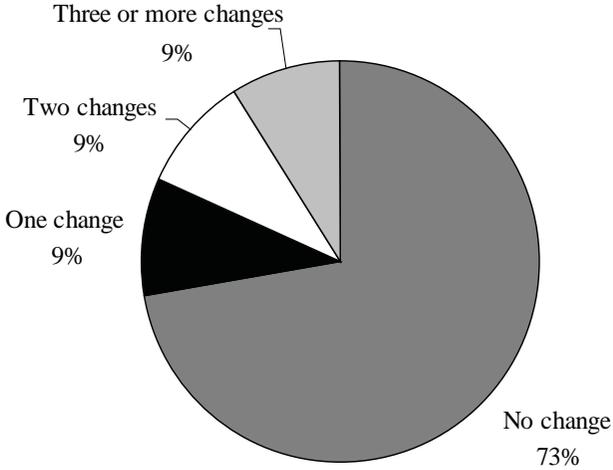
Panel B: Households eligible at least once, 1998–1999
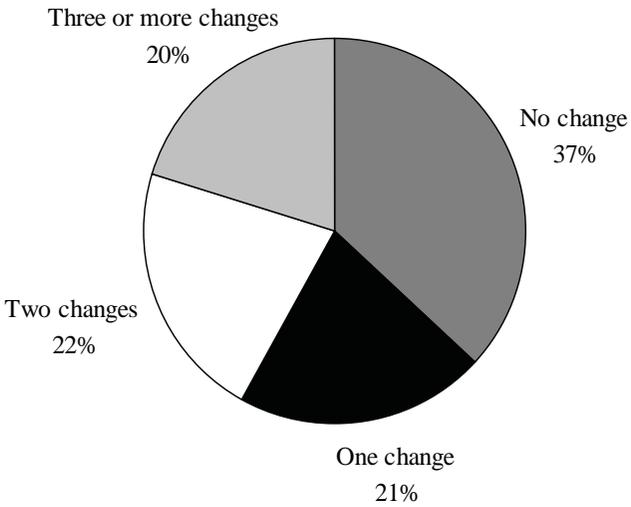
the income group immediately above and the one immediately below the 185 percent line reveals how important income volatility can be.

These results are consistent with the previously discussed findings of high rates of reentry into the FSP after exiting (Burstein 1993; Gleason, Schochet, and Moffitt 1998) and high rates of reentry into poverty after exiting (Stevens 1999). My results, like those cited, point to the importance of income volatility in understanding low-income population issues.

INCOME VOLATILITY TRIGGER EVENTS

While the previous section examined the magnitude of income volatility, this section investigates the sources of monthly income change that cause eligibility change. I use a hazard model to analyze the factors associated with entry into, and exit from, NSLP eligibility. This model is commonly used in studies of poverty dynamics (Bane and Ellwood 1986; McKernan and Ratcliffe 2002; Ruggles and Williams 1987b).

I use a discrete-time hazard model, which can be accurately estimated with a traditional logit specification (Allison 1984; Jenkins 1995). A discrete formulation of the probability is used to account for my data, which are in discrete monthly periods. Most studies of poverty and program participation dynamics use the discrete-time logit hazard model (Stevens 1999; McKernan and Ratcliffe 2002), which is written as

$$P(t) = \frac{1}{1 + e^{-z(t)}} \ , \ \text{ where } \ z(t) = c(t) + X\beta \ .$$

The model of eligibility, $z(t)$, is a function of $c(t)$, the baseline hazard function. $X\beta$ represents the matrix of explanatory factors and their respective parameters. The model is estimated by maximum likelihood, and I report the odds ratios. I use household weights and correct for standard errors using variables provided with SIPP to represent primary sampling units ("ghlfsam") and strata ("gvarstr").

I report results using eligibility determinations from both seam-adjusted income and unadjusted income. It is quite likely that seam bias exists in many of the independent variables, and rather than trying to correct for it where appropriate, I use unadjusted income, since that

will show us what factors are at least contemporaneously associated (and jointly affected by survey respondents' memories of when events occurred). I also report results using the adjusted income to determine eligibility for the case of no seam bias on the right-hand side.

I look at the role of changes in circumstances—trigger events—as well as static characteristics such as household composition, labor force participation, state unemployment rates, and others. The full list is shown in Table 6.3, along with the variables' summary statistics. The trigger events are depicted by dummy variables, which equal one when a characteristic has changed. Among the trigger variables included are increases in total household hours worked and changes in the number of jobs held by different members of the household: the reference person, that person's spouse or partner, and other adults (as a composite). The number of jobs held is a coarser measure of employment than hours worked, and it is used here to identify job changes by household member type. The change-in-hours trigger provides an aggregate view of household work changes, and the change in the number of jobs held by a household member provides a more detailed view of the relative importance of jobs held by different members. Because employment changes can occur in so many ways in a household, I wanted to include as many aspects as possible. The results should not be interpreted as causal effects, because some of the independent variables may be endogenous.

I use changes in five different household wages as trigger dummy variables: wages for primary and secondary jobs of the household reference person, wages for primary and secondary jobs of the spouse, and a summed pay rate for all other adults in the house in all of their jobs. Wages are measured in one of two ways. The first is a wage reported as the regular hourly pay rate, which is separately provided for the primary and secondary jobs. The second, which is used only if the first is not available, is the sum of monthly gross earnings from the job divided by the product of the usual hours worked per week at this job and the number of weeks with a job in the month.

For most trigger variables, I allow the effects of a change in a given characteristic to be captured by the trigger dummy variables over one month. It is common in the literature to allow for delayed effects, but I wanted to test the effects of short-term events as much as possible. I made an exception for changes in marital status, public assistance re-

ceipt, disability status, presence or not of a subfamily in the household, and changes in the number of children. I thought that the effects of these variables, especially those that occur very infrequently, would be too hard to capture in one month. For marital status changes, the dummy variable for a change is equal to 1 if the change occurred one or two months prior to the current observation or if it occurred one month after the current observation. For the other types of changes, the dummy variable is equal to 1 if the event occurred in the last one or two months.

The data used for the analysis are from all years and months in the 1996 panel. Before any data are excluded, the sample has 436,479 household-month observations and 20,016 unique households. I exclude left-censored spells, the spells cut off at the beginning, but I keep right-censored spells, spells cut off at the end. The exclusion of left-censored spells reduces the sample size considerably and means I examine only households that underwent at least one change in eligibility.

The sample is divided into two parts: households that are in spells of ineligibility (the entry sample) and households that are in spells of eligibility (the exit sample). The exit sample is smaller because fewer households have incomes below 131 percent of the poverty line than have incomes of 131 percent or above. And the samples differ in size depending on the income measure used to define eligibility. Excluding left-censored spells of eligibility from the exit sample leaves 65,084 household-month observations in the adjusted income sample and 71,066 household-month observations in the unadjusted income sample. And excluding left-censored spells of ineligibility from the entry sample leaves 82,419 household-month observations in the adjusted income sample and 87,445 household-month observations in the unadjusted income sample. Results from the models of NSLP eligibility exit and NSLP entry are shown in Tables 6.4 and 6.5.

Exit Results

In the unadjusted income sample (last two columns, Table 6.4), the change most associated with exit from eligibility was that of a household changing from female-headed to married. This variable was not significant in the adjusted income sample. In a previous version of this analysis (Newman 2006) in which unadjusted income was not used, the result that getting married did not lead to exit raised many ques-

Table 6.3 Summary Statistics for Exit and Entry Model Variables

	Exit		Entry	
	Mean	Std. dev.	Mean	Std. dev.
Characteristics (weighted and SE-corrected)				
Dependent variable: end/beginning of eligibility spell	0.18	0.00	0.12	0.00
Log of time	1.38	0.02	1.70	0.01
State unemployment rate	4.85	0.03	4.71	0.03
No. of working adults per household member	0.28	0.00	0.42	0.00
No. of school-aged children	1.78	0.02	1.75	0.02
No. of jobs held by household reference person	0.73	0.01	0.88	0.01
No. of jobs held by spouse of reference person	0.38	0.01	0.60	0.01
No. of jobs held by other adults	0.29	0.01	0.54	0.01
Tenure of household reference	0.24	0.07	0.19	0.07
Tenure of spouse or partner	0.68	0.06	0.67	0.04
Tenure of other adults	0.19	0.02	0.13	0.01
Education of reference person	2.71	0.02	3.02	0.02
Education of spouse	1.70	0.03	2.28	0.03
Black/non-Hispanic reference person	0.19	0.01	0.12	0.01
Hispanic reference person	0.18	0.01	0.12	0.01
Native American reference person	0.02	0.01	0.01	0.00
Asian reference person	0.03	0.00	0.03	0.00
Disabled reference person	0.11	0.00	0.07	0.00
Disabled spouse or partner	0.06	0.00	0.05	0.00
Disabled other adults	0.05	0.00	0.05	0.00
Subfamily shares household[a]	0.08	0.00	0.07	0.00

Household receives public assistance	0.16	0.01	0.05	0.00
Single female–headed household	0.32	0.01	0.20	0.01
Single male–headed household	0.08	0.01	0.07	0.00
Group home household	0.00	0.00	0.00	0.00
Triggers				
Public assistance gained/lost	0.02	0.00	0.01	0.00
Reference person left disability rolls/became disabled	0.03	0.00	0.02	0.00
Female head of household to married change/married to female head of household change	0.00	0.00	0.00	0.00
Child left/entered household	0.01	0.00	0.02	0.00
Subfamily added to household[a]	0.00	0.00	0.00	0.00
Household total hours worked increased/reduced	0.27	0.00	0.33	0.00
Reference person gained one job or more	0.02	0.00	0.01	0.00
Spouse/partner gained one job or more	0.01	0.00	0.01	0.00
Other adults gained one job or more	0.02	0.00	0.02	0.00
Reference person's wage from primary job increased/decreased	0.10	0.00	0.15	0.00
Reference person's wage secondary job increased/decreased	0.02	0.00	0.03	0.00
Spouse/partner's wage primary job increased/decreased	0.08	0.00	0.10	0.00
Spouse/partner's wage secondary job increased/decreased	0.01	0.00	0.02	0.00
Other adults' wages increased/decreased	0.06	0.00	0.07	0.00
Increased/decreased % of working adults in household	0.04	0.00	0.03	0.00
N	71,066		87,445	

NOTE: SE = standard error of the odds ratio. The sample used here is the one in which unadjusted income was used to determine eligibility entry and exit.

[a] A subfamily is a nuclear family that is either related or not to the household reference person but does not include that person.

SOURCE: SIPP 1996 Panel.

Table 6.4 Logit Estimates of the Determinants of NSLP Eligibility Exit

	Adjusted income		Unadjusted income	
	Odds ratio	SE	Odds ratio	SE
Characteristics (weighted and SE-corrected)				
Log of time	0.66***	0.01	0.67***	0.01
State unemployment rate	0.99	0.01	0.99	0.01
No. of working adults per household member	2.20***	0.22	1.77 ***	0.18
No. of school-aged children	0.92***	0.02	0.91***	0.01
No. of jobs held by household reference person	1.20***	0.03	1.28***	0.03
No. of jobs held by spouse of reference person	1.23***	0.04	1.33***	0.03
No. of jobs held by other adults	1.27***	0.03	1.32***	0.03
Tenure of household reference	1.00***	0.00	1.00***	0.00
Tenure of spouse or partner	1.00	0.00	1.00***	0.00
Tenure of other adults	1.00	0.00	1.00	0.00
Education of reference person	1.09***	0.01	1.09***	0.02
Education of spouse	1.06***	0.01	1.05**	0.02
Black/non-Hispanic reference person	0.82***	0.03	0.80***	0.03
Hispanic reference person	0.81***	0.04	0.82***	0.04
Native American reference person	0.86	0.07	0.86	0.08
Asian reference person	0.73***	0.07	0.69***	0.06
Disabled reference person	0.92	0.04	0.91	0.04
Disabled spouse or partner	0.91	0.06	0.93	0.05
Disabled other adults	1.00	0.04	1.03	0.04
Subfamily shares household[a]	1.07	0.06	1.09	0.06

Household receives public assistance	0.61***	0.03	0.59***	0.03
Single female–headed household	1.00	0.05	0.96	0.05
Single male–headed household	1.13	0.07	1.10	0.06
Group home household	1.18	0.40	1.19	0.33
Triggers				
Public assistance gained	0.98	0.11	0.93	0.09
Reference person left disability	1.00	0.06	0.72***	0.05
Female head of household to married change	1.44	0.34	2.06***	0.41
Child left household	0.82	0.09	0.82	0.08
Subfamily added to household[a]	0.93	0.16	0.83	0.13
Household total hours worked increased	1.37***	0.04	1.37***	0.04
Reference person gained one job or more	1.12	0.11	0.84	0.08
Spouse/partner gained one job or more	1.03	0.10	0.83	0.08
Other adults gained one job or more	1.00	0.08	0.82**	0.06
Reference person's wage from primary job increased	1.04	0.04	0.88***	0.03
Reference person's wage from second job increased	0.91	0.08	0.75***	0.06
Spouse's wage from primary job increased	1.14*	0.06	0.88*	0.04
Spouse's wage from secondary job increased	0.92	0.10	0.78	0.08
Other adults' wages increased	1.12	0.06	0.84***	0.04
Increased % of working adults in household	1.23***	0.07	1.04	0.06
N	65,084		71,066	

NOTE: SE = standard error of the odds ratio. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level.

[a]A subfamily is a nuclear family that is either related or not to the household reference person but does not include that person.

SOURCE: SIPP 1996 Panel.

Table 6.5 Logit Estimates of the Determinants of NSLP Eligibility Entry

	Adjusted income		Unadjusted income	
	Odds ratio	SE	Odds ratio	SE
Characteristics (weighted and SE-corrected)				
Log of time	0.45***	0.01	0.40***	0.01
State unemployment rate	0.98	0.01	0.99	0.01
No. of working adults per household member	0.27***	0.03	0.42***	0.04
No. of school-aged children	1.01	0.02	1.04	0.02
No. of jobs held by household reference person	0.91***	0.02	0.95	0.02
No. of jobs held by spouse of reference person	0.94	0.03	0.93	0.03
No. of jobs held by other adults	0.79***	0.02	0.80***	0.01
Tenure of household reference	1.00	0.00	1.00***	0.00
Tenure of spouse or partner	1.00	0.00	1.00*	0.00
Tenure of other adults	1.00	0.00	1.00	0.00
Education of reference person	0.87***	0.01	0.88***	0.01
Education of spouse	0.89***	0.01	0.90***	0.01
Black/non-Hispanic reference person	1.18***	0.06	1.17***	0.05
Hispanic reference person	1.18***	0.05	1.17***	0.05
Native American reference person	1.33	0.22	1.41	0.22
Asian reference person	0.95	0.09	0.96	0.08
Disabled reference person	1.00	0.05	1.09	0.05
Disabled spouse or partner	0.94	0.06	1.01	0.06
Disabled other adults	0.89	0.05	0.96	0.05
Subfamily shares household[a]	0.98	0.06	1.00	0.05

Household receives public assistance	1.12	0.06	1.13	0.05
Single female–headed household	0.95	0.05	0.92	0.04
Single male–headed household	0.85	0.05	0.85*	0.05
Group home household	0.79	0.26	0.86	0.26
Triggers				
Public assistance lost	1.05	0.12	0.94	0.09
Reference person became disabled	1.03	0.11	0.64***	0.06
Married to female head of household change	3.09***	0.55	5.50***	1.03
Child added to household	1.09	0.09	1.05	0.08
Subfamily left household[a]	0.55*	0.12	0.66	0.13
Household total hours worked reduced	1.54***	0.03	1.56***	0.03
Reference person lost one job or more	0.92	0.09	0.51***	0.06
Spouse/partner lost one job or more	0.78	0.11	0.49***	0.08
Other adults lost one job or more	0.74**	0.08	0.78	0.08
Reference person's wage from primary job decreased	1.21***	0.05	0.87***	0.03
Reference person's wage from second job decreased	1.11	0.08	0.86	0.06
Spouse's wage from primary job decreased	1.11	0.05	0.86***	0.04
Spouse's wage from secondary job decreased	1.45***	0.13	1.16	0.11
Other adults' wages decreased	1.27***	0.07	0.84***	0.05
Decreased % of working adults in household	1.48***	0.11	1.12	0.09
N	82,419		87,445	

NOTE: SE = standard error of the odds ratio. * significant at the 0.10 level; ** significant at the 0.05 level; *** significant at the 0.01 level.
[a]A subfamily is a nuclear family that is either related or not to the household reference person but does not include that person.
SOURCE: SIPP 1996 Panel.

tions. A change in the opposite direction (i.e., a household becoming female-headed) was a significant determinant of entry into eligibility, so it seemed somewhat odd that the results were asymmetric. Possible explanations were suggested, but this new result makes more sense, and the fact that getting married is a significant correlate with exiting eligibility when using the unadjusted income probably means that the timing of events is more in sync. Getting the joint timing right is especially important for events such as changing household marital status since such events are quite infrequent in the data.

In both the adjusted and unadjusted samples, the share of working adults in the household had a positive and significant effect on the odds of exit. Another significant static variable was the logarithm of time, indicating that the likelihood of exit decreased over time. Also, more school-aged children per household led to lower odds of exit. More jobs for the reference person, spouse or partner, or other adults led to higher odds of exit. The working tenure of the reference person and the spouse had significant but almost negligible effects on exit. A higher education level of the reference person and the spouse led to greater odds of exit. Households with a minority reference person had lower odds of exit than those with a white reference person. And anyone in the household receiving public assistance had lower odds of exit.

Three trigger events were significant determinants of exit in the adjusted income sample: 1) increases in total household hours worked, 2) increases in the share of working adults in the household, and (less significantly) 3) increases in the spouse's primary wage. In the unadjusted income sample, the only difference in those three adjusted sample results from the adjusted sample was that an increase in the share of working adults was not significant. More variables were significant in the unadjusted sample than in the adjusted sample, such as the change in marital status being significant, as mentioned above. And if a household reference person left disability, or was no longer disabled, he or she was significantly less likely to leave eligibility. One would expect the opposite result, but it is possible that the effects of a disability on income status are fairly persistent over time. Perhaps, for example, it is hard for a newly able person to enter the workforce after some time out. Other significant triggers were found in the unadjusted sample, and these too had the opposite effect of the one expected, including an increase in the reference person's wages, from either primary or secondary jobs; an

increase in the number of jobs held by other adults in the household; an increase in other adults' wages; and an increase in the spouse's primary wages. That these factors made the odds of exit lower than 1 suggests that changes in wages and the number of jobs held by other adults are unimportant compared to other factors such as the total amount of time household members spent working.

Entry Results

The results from the hazard models of entry into NSLP eligibility are consistent with the results from the exit models (Table 6.5). As in the exit models, a change in marital status was the variable most strongly associated with entry in both the adjusted and unadjusted samples: in this case, the marital-status change is a household change from married to female-headed. In both the adjusted and unadjusted samples, the one significant household characteristic that was positively associated with entry was the race of the reference person being black or Hispanic. The significant factors that were negatively associated with entry were the log of time, the share of working adults in the household, the number of jobs held by the reference person and other adults, the education level of the reference person and spouse, and the household being single male–headed. All of these effects were significant in the expected directions.

Other trigger events that significantly and positively affected the odds of entry into eligibility were a reduction in total household hours worked; a reduction in the wages of the reference person, the spouse, and other adults; and, in the adjusted sample, a reduction in the share of working adults in the household. Two negative, significant triggers in the adjusted sample were the departure of a subfamily and an increase in the number of jobs held by other adults in the household. Negative, significant triggers in the unadjusted sample included the loss of a job by either the reference person or the spouse and the reference person becoming disabled. For all of these negative triggers, it must be remembered that they are less likely to lead to entry, meaning that these variables are less important than the positive ones. The most positive triggers in both samples were the change in household marital status to female-headed and the reduction in total household hours worked. A decrease in the share of working adults in the household was strongly

associated with entry in the adjusted sample, as it was for the result in the exit model.

Overall, it would stand to reason that the unadjusted income sample is more likely to capture the important correlates, given that many of the independent variables are also likely to be affected by seam bias. According to results from the unadjusted income exit and entry models, the factors most associated with eligibility changes are changes in marital status and in total household hours worked. While changes in marital status occur infrequently in the data, when they do occur they appear to make a large difference in household income levels in both directions. Changes in hours worked occur much more frequently and are shown to be the most important change among the labor force participation variables in influencing volatility. The other trigger event significant in the adjusted sample is a change in the share of working household members, but the static share of working household members is significant in both samples. Wage changes and changes in the number of jobs per member appear to be unrelated to entry or exit. The results for labor market variables point to the relative importance of changes in total labor market participation at the household level as opposed to changes in labor market participation by a particular household member.

NSLP ELIGIBILITY AND INCOME VOLATILITY

In this section, I examine the effects of income volatility on eligibility under the pre-2004 rules for eligibility in the NSLP. Since 1981, schools have been required to verify the eligibility status of NSLP beneficiaries. Before 2004, schools did so by asking for proof of current income from a sample of recipients by December 15 of each year (changed to November 15 in 2004). The percentage of students found in the verification process to have received benefits that they were not entitled to, based on their December incomes, was referred to as the rate of overcertification error.

Studies in the 1990s raised concerns that the rate of overcertification error was somewhere between 15 and 27 percent (St. Pierre et al. 1990; USDA 1997, 1999). One study found, however, that the overcer-

tification rate was only around 2 percent (Neuberger and Greenstein 2003). The USDA's Food and Nutrition Service launched more in-depth studies in the early 2000s to better understand the problem. In one of these, Gleason et al. (2003) found an estimated range of error of 12–33 percent: 12 percent under the assumption that nonresponding households were eligible, and 33 percent if nonresponding households were not eligible.

In several studies, income volatility was predicted to be an important determinant of NSLP eligibility dynamics. A 1992 study of household NSLP eligibility found that changes resulting from income and household composition changes were about 3 percent per month (St. Pierre and Puma 1992). A more recent study by Burghardt, Silva, and Hulsey (2004) assessed the verification results from a sample of 21 large metropolitan schools. They estimated that as much as 30–40 percent of the difference in household eligibility among respondents at the time of verification could be explained by changes in household income or household composition.

Income Changes Likely To Be Detected at Verification

Next, I examine the possible effects of volatility on verification findings. The purpose is to identify the extent to which income volatility may have accounted for verification error rates under the regulations in effect until 2004. Specifically, I count how many of the households eligible in August were still eligible for the same benefits in subsequent months. I look separately at three school years, 1996–1997, 1997–1998, and 1998–1999. In this section, I look at eligibility for free and reduced-price lunches, both together and separately. I combine them for reasons previously discussed, and I separate them in order to understand how much of the change in status was due to changes across these categories. I show the results from both the unadjusted data and the seam-bias-adjusted data, but I discuss only the adjusted results.

These results do not take into account possible household choices about whether to apply for the program or not, given the household's income situation, so the results represent solely the effect of income volatility if all income-eligible (at the time of application) households participate. Additionally, I assume that all eligible households were correctly certified at the start of the year. Thus, the analysis examines the

extent to which income volatility for eligible households alone may account for overcertification.

Households can become eligible again in this counting frame-work—that is, households that become ineligible in one month are not excluded from the sample. Given the number of changes in eligibility we saw earlier, some households are known to be cycling in and out of eligibility status over the course of a year.[8]

Table 6.6 shows estimates from each different school year of the share of initially eligible households that are ineligible in each subse-quent month of the school year. December is highlighted to show the share of initially eligible households that had become ineligible by the month of verification.

When I use adjusted income data, we see that, as expected, the share of households that became ineligible is lower month-by-month than in the unadjusted data.[9] The adjusted percentages for September for the three consecutive school years are 13.7, 11.8, and 7.2 percent. The data for December for the three school years are 19.5, 18.4, and 16.8 percent.

What about the error related to households eligible for free lunches becoming eligible for only reduced-price lunches by December? This change in eligibility is considered an overcertification error because it entails an unwarranted payment of benefits. Results from the adjusted income series show that, in the 1996–1997 school year, 9.4 percent of households that were eligible for free lunches in August were eligible for only reduced-price lunches by December (Table 6.7). For the next two years, the share was 8.2 and 7.9 percent.

Combining the two types of errors, which would lead to a benefit reduction or termination in December verifications under the old law, I estimate the overcertification error for the three school years at 28.9, 26.6, and 24.7 percent, or an average of 26.7 percent. These estimates are notable when compared with the estimates of errors found in the December verifications discussed above. My estimate of ineligibility stemming from an income volatility of 27 percent constitutes a large percentage of the high-end estimate of total error of 33 percent. Since I do not estimate the effects of participation that income volatility might also affect, this estimate may be upwardly biased.

I examine how changes in a household's month-to-month eligibility status differ from its original eligibility status—reduced-price or free

Table 6.6 Percentage Ineligible in Months Following August

Ineligible by the following month	August-eligible 1996–97		August-eligible 1997–98		August-eligible 1998–99	
	No adjustment	Seam-adjusted	No adjustment	Seam-adjusted	No adjustment	Seam-adjusted
September	15.6	13.7	13.9	11.8	8.7	7.2
October	14.4	12.9	14.3	13.1	13.1	11.1
November	19.0	17.6	22.2	21.1	18.6	17.0
December[a]	**21.1**	**19.5**	**19.2**	**18.4**	**17.9**	**16.8**
January	20.7	20.3	20.9	19.8	19.1	19.0
February	22.8	22.1	24.5	23.8	20.3	20.0
March	23.2	23.0	21.9	21.6	19.5	18.8
April	21.9	22.2	22.2	22.0	20.9	20.6
May	22.4	23.1	23.9	23.5	24.3	23.8
June	26.3	25.9	25.7	25.3	22.7	22.5
July	22.7	23.3	23.2	23.2	23.8	23.6

[a]December is set off in bold because this is the month when incomes were typically verified (before the 2004 change in the law).
SOURCE: SIPP 1996 Panel

Table 6.7 Changes in Free to Reduced-Price Eligibility by Month

	Seam-adjusted data		
	August-eligible 1996–97	August-eligible 1997–98	August-eligible 1998–99
Ineligible by the following month	% of free eligible that went to RP-eligible	% of free eligible that went to RP-eligible	% of free eligible that went to RP-eligible
September	7.2	6.9	4.5
October	6.8	6.0	7.1
November	8.9	9.1	8.2
December[a]	**9.4**	**8.2**	**7.9**
January	9.2	8.3	9.2
February	10.9	9.4	10.1
March	10.3	7.7	9.3
April	10.1	8.7	10.5
May	10.1	9.2	11.0
June	11.3	9.6	9.9
July	10.8	9.1	10.6

[a]December is set off in bold because this is the month when incomes were typically verified (before the 2004 change in the law).
SOURCE: SIPP 1996 Panel

lunch—using the adjusted data. Most of the households that became ineligible in the months immediately after August had been eligible for the reduced-price lunch. For example, in the 1996–1997 school year, 80.3 percent of households that were ineligible in September were households that had been in the reduced-price-meal category in August. In the other years, 79.3 and 70.0 percent of households that were ineligible in September had been eligible for the reduced-price lunch the month before. The preponderance of reduced-price households among the households that crossed the 185 percent income threshold is logical because these households were closest to the threshold.

Annual versus Monthly Eligibility Determination

Schools use monthly income most often to determine household eligibility at the time of application. This was the case under the old rules and still is under the new rules. Households apply for program benefits

based on one month of income under the tacit assumption that monthly income is a good predictor of annual income. One would imagine that its power as a predictor would decline the more variable it was over the year. To explore the power of one month of income as a predictor in the context of NSLP eligibility, I compare estimates of eligibility using August income alone against estimates of eligibility based on annual income reported in the following months of the school year (using adjusted data). I do not think that August has any particular seasonal properties; any single month's income would provide similar results.

Table 6.8 allows us to view the complete overlap of the two categories of eligibility, determined by month and by year. Looking at the first section of the table, which shows the cross-tabulations for August 1996 and the school year 1996–1997, I see that the share of households eligible from the annual calculation is 33.8 percent. In contrast, the share of households eligible from the August (monthly) calculation is 29.9 percent, about 4 percentage points lower. Similarly, for the other two years, the August calculation is lower by about 3 percentage points in 1997–1998 and by almost 5 percentage points in 1998–1999.

In 1996–1997, of the households that were annually eligible, the monthly determination of eligibility counted 68.9 percent of them as eligible, whereas for the households annually ineligible, the monthly determination was closer—it counted 90.1 percent of them as ineligible. There are many more households above the eligibility limit, and thus, for them, one month of income is more likely to be representative of annual earnings. Italicized numbers in Table 6.8 show the results of analyzing the monthly cross-tabulations. In 1996, 78 percent of households that were eligible in August were also annually eligible; in that same year, 85 percent of households that were ineligible in August were also annually ineligible. The single-month determination appears to be better at capturing annually ineligible than annually eligible households. The same pattern was repeated in the other two years.

A household's income from a single month can be very different from its annual average income because of volatility. To the extent that households are not aware of their ability to apply for NSLP benefits throughout the year, using monthly income to determine eligibility could lead to a lower certification rate than that which would come from using annual income, which more accurately matches the certification period of a year. This outcome suggests that it is important for schools

**Table 6.8 Monthly (August) vs. Annual Eligibility Determinations:
Two Categories of Eligibility over Three School Years**

		Annual 1996–97		
		Ineligible	Eligible	Totals
August 1996	Ineligible	*85.0*	*15.0*	*100.0*
		90.1	31.1	70.1
	Eligible	*22.0*	*78.0*	*100.0*
		9.9	68.9	29.9
	Totals	*66.2*	*33.8*	*100.0*
		100.0	*100.0*	*100.0*
		Annual 1997–98		
		Ineligible	Eligible	Totals
August 1997	Ineligible	*86.6*	*13.4*	*100.0*
		90.5	29.4	70.7
	Eligible	*21.9*	*78.1*	*100.0*
		9.5	70.6	29.3
	Totals	*67.6*	*32.4*	*100.0*
		100.0	*100.0*	*100.0*
		Annual 1998–99		
		Ineligible	Eligible	Totals
August 1998	Ineligible	*86.2*	*13.8*	*100.0*
		92.4	32.3	73.5
	Eligible	*19.6*	*80.4*	*100.0*
		7.6	67.7	26.5
	Totals	*68.6*	*31.4*	*100.0*
		100.0	*100.0*	*100.0*

NOTE: Annual income uses data from months July to June of each respective school
  year. Italicized numbers show the results of analyzing the monthly cross-tabulations.
SOURCE: SIPP 1996 Panel

to emphasize to families that they can apply for benefits at any time of the year.

CONCLUSION

In this chapter, I find that income volatility among households with children can cause frequent shifts in school lunch program eligibility. Using the coefficient of variation of monthly income, I find that lower-income households unequivocally have more volatile incomes than higher-income households do. I also find that, among households with children that were eligible for the school lunch program in at least one month of a year, almost two-thirds (63 percent) had one or more transitions into or out of eligibility, and that one-fifth (20 percent) had three or more transitions. Households with children whose average monthly income fell between 130 percent and 240 percent of poverty crossed the eligible line five times per year on average.

In hazard models of eligibility exit and entry, the most important factors were changes in household marital status (married or female-headed), changes in the total household hours worked in a month, and changes in the share of working adults in the household. I obtained the standard results with respect to static household-level determinants that one would expect in a model of poverty dynamics. For example, greater education levels led to higher chances of exit from eligibility, and households with black or Hispanic reference people were less likely to exit than those with white reference people. Corresponding results were obtained for the entry model.

In terms of the effects of income volatility on participation in the National School Lunch Program, I found that up to one-fifth of households that were eligible in August for either a reduced-price or a free lunch in the NSLP became ineligible in the following month of September. Moreover, the share of August eligibles that were ineligible increased through December to 27 percent on average. In the literature on certification errors, estimates of overcertification differ widely, with the extremes ranging from 12 to 33 percent. My estimate of overcertification of 27 percent in December from income volatility alone is higher than most estimated overcertification rates. However, an important qualifier

to these results is that I had to assume that all households participate if eligible and that all certifications are made correctly. I conclude that income volatility has the potential to explain a large portion of NSLP overcertification error but that the exact amount is unknown.

I found that a certification process that uses a single month's income produces systematically fewer eligible households than a certification process that uses annual income. A single month's determination is more likely to err in the direction of ineligibility because of volatility.

Since the Child Nutrition and WIC Reauthorization Act of 2004 extended NSLP eligibility through the school year, income volatility will no longer affect NSLP eligibility. However, it remains an important issue to other USDA food assistance programs. The evidence here shows that income volatility is relatively higher for low-income households and that it is strongly linked to monthly changes in the characteristics of a household's labor force participation and marital status. For USDA food assistance programs, the volatility associated with low-income working households will become an increasing challenge to program administration.

Notes

This chapter is a revised and shortened version of a report published by the U.S. Department of Agriculture's Economic Research Service (Newman 2006).

1. Seam bias occurs when the differences in reported values for a given variable are much greater between time periods in which there is a break in survey administration than between time periods reported within a survey administration. For example, in SIPP, each time a survey respondent is visited to report his or her information, the respondent is asked to report about the past four months, one month at a time. The differences in variable values within the four months tend to be much smaller than the difference between the last month reported and the next month reported when the survey respondent is visited for the second round of questioning. This is referred to as seam bias, since it is a bias that occurs at the "seams" of reported information.
2. Research on the extent of seam bias has focused on how it affects estimates of program participation transition data (Doyle, Martin, and Moore 2000; see U.S. Census Bureau [1998] for a review).
3. I also tested other ways of adjusting and organizing the data that are not discussed here, such as using only the most recent month of data (the fourth reference month) and using three-month intervals that skip the seam instead of four-month

intervals. Both methods provided similar evidence of income volatility, as I show later.

4. See Kalton and Miller (1991), Marquis and Moore (1989), and Rips, Conrad, and Fricker (2003) for analysis of the cognitive roots of seam bias.

5. I include all households that were in the survey for 12 months or more in order to maximize observations (11,135). The median number of months in the survey for those in the survey 12 months or more was 31 months, and 39 percent of the households were in for the maximum of 36 months. The results are similar, if not more pronounced, when using the smaller sample sizes of households in the survey for 24 months or more (7,195 households) or in the survey for 36 months (4,333 households).

6. The same diagram using unadjusted data shows qualitatively the same result of lower CVs at higher income-to-poverty levels. But the unadjusted data show higher CVs for all groups than do the adjusted data, as expected.

7. See the next section, "Income Volatility Trigger Events," and McKernan and Ratcliffe (2002).

8. In other words, these are not life tables of the percentage of households with children who become ineligible by a certain month and are treated as no longer at risk for reentry or reexit in following months. Instead, these tables are a tally of ineligibility in any month, inclusive of those who may have reexited and reentered. This analysis is designed to estimate what percentage of households with children can be expected to be ineligible if a verification sample of these households is conducted in various months.

9. The data reverses in the 1996–1997 school year for some months after April in that the share from the adjusted data exceeds the share from the unadjusted data. I am not entirely sure why these adjustments would yield higher estimates in some cases. The differences, however, are not large enough that the 95-percent confidence intervals of each estimate do not also contain the other estimates.

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