

# The Dynamic Determinants of Food Insufficiency

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## Introduction

Households with incomes far below the poverty line face serious constraints on their income and must make choices that may result in food insufficiency. What is surprising, perhaps, is that in 1992 only 10.2 percent of households with monthly incomes below 50 percent of the poverty line sometimes or often did not get enough to eat, i.e., were food insufficient. Households above the poverty line, however, are expected in principle to have enough income, before expenses, to afford enough food to eat.<sup>1</sup> Despite this, 3.6 percent of households with monthly incomes between 100 and 200 percent of the poverty line were food insufficient. Previous work using static analyses has examined why a significant minority of households are food insufficient, while households with nearly identical incomes are food sufficient. These include analyses of the effect of non-income differences between households (Rose, Gundersen, and Oliveira, 1998) and the effect of food stamps on food insufficiency (Gundersen and Oliveira, 2000).

What has not been considered, however, is how the recent economic histories of food-sufficient and food-insufficient households may differ in ways not portrayed by current income. The importance of past actions and expectations of

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<sup>1</sup>The poverty line in the United States was originally defined as three times the cost of the Thrifty Food Plan, a minimally adequate, food-sufficient diet constructed by the U.S. Department of Agriculture. Since then it has been updated annually by the Consumer Price Index. Food prices have risen more slowly than other goods so today the purchase price of the Thrifty Food Plan constitutes less than one-third of the poverty line. Therefore, households with incomes above the poverty line should be able to purchase a food-sufficient diet.

the future are incorporated into many other economic analyses, such as the effect of savings decisions on current consumption (e.g., Friedman, 1957), the influence of human capital investments on current pay (e.g., Mincer, 1958), and the effect of monetary authorities' expected actions on actors' decisions (e.g., Kydland and Prescott, 1977). In the poverty literature, the measurement of poverty has incorporated past consumption and savings decisions of households (e.g., Slesnick, 1993; and Wolff, 1990) and the welfare participation decision has been expressed in terms of past, present, and future actions (e.g., Blank and Ruggles, 1996; and Fitzgerald, 1995).

In this paper, we move beyond looking at just current economic status as an explanation for food insufficiency. Households make consumption decisions over multiple periods based on their expectations of future income, their current income, their stock of savings, and their ability to borrow. Unexpected changes to a household's budget and losses of income can adversely affect these consumption decisions and render any household susceptible to food insufficiency. This is especially true for low-income households; while middle- and high-income households have the resources to mitigate the repercussions of job loss or other unexpected shocks to a family's budget, low-income households have more limited resources to weather these shocks. By looking at current income alone, we do not accurately portray the dynamic nature of households' consumption decisions.

We begin this paper by establishing a theoretical framework that allows us to examine the influence of current, past, and future incomes on food insufficiency. Two possible hypotheses emerge out of this framework. First, households with average incomes that are sufficiently low and no savings are more likely to be food insufficient. Second, households facing liquidity constraints are more likely to be food insufficient. These theoretical explanations are then pursued empirically with the 1991 and 1992 panels of the Survey of Income and Program Participation (SIPP). Our empirical investigation does not formally test the implications from the theoretical model, rather it proceeds by comparing food-

insufficient and food-sufficient households over a 9-month period. We find that, consistent with the theoretical model, food-insufficient households have relatively low average incomes, face more income shocks, and are less able to weather these shocks with saving or through borrowing than food-sufficient households.

## Economic Theoretical Explanations For Food Insecurity

Because we are analyzing the dynamic determinants of food insufficiency, our theoretical model has a household maximizing its utility subject to a budget constraint over multiple periods.<sup>2</sup> At time  $t=0$ , a household solves the following problem:

$$\max E_0 \left( \sum_{t=0}^T U(F_t, OG_t) \right),$$

subject to:

$$A_{t+1} = A_t + Y_t - p_F F_t - p_{OG} OG_t,$$

where  $E$  is the expectations operator,  $T$  is the end of the planning horizon,  $U$  is the one-period utility,  $F$  is food consumption,  $OG$  is other goods consumption (i.e., non-food items),  $A$  is assets,  $Y$  is income,  $p_F$  is the price of food, and  $p_{OG}$  is the price of other goods. Except for income, all of the variables are known with certainty. Households know the mean of their income and the variance. They do not, however, know when income shocks (deviations from mean income) will occur. Another key assumption in this model is that households presume they can borrow against future income. For simplicity, we do not incorporate discounting or interest earned on assets into our model; this is the same as setting the interest rate and the discount rate equal to zero.

Solving this maximization problem leads to the following first-order conditions:

<sup>2</sup>In this section, we provide two theoretical explanations for how food insufficiency can occur in a dynamic context. In the appendix is a third theoretical explanation.

$$\frac{\delta U / \delta F_t}{\delta U / \delta OG_t} = \frac{p_F}{p_{OG}}, \quad \frac{\delta U}{\delta F_t} = \frac{\delta U}{\delta F_{t+1}}, \quad \frac{\delta U}{\delta OG_t} = \frac{\delta U}{\delta OG_{t+1}}.$$

Under the assumption of a quadratic utility function, this implies that there will be constant levels of consumption of food and other goods.

Expressed in total consumption,  $C$ , at any  $t$ ,

$$C_t = \frac{1}{T} E_0 \left( \sum_{t=0}^T Y_t \right) + \frac{1}{T} A_0.$$

Under the assumption that households know the mean income over their planning horizon, this is expressed as:

$$C_t = \bar{Y} + \frac{A_0}{T}.$$

Expressed in terms of food and other goods,

$$p_F F_t + p_{OG} OG_t = \bar{Y} + \frac{A_0}{T}.$$

For any household, let  $\underline{F}$  be the minimum amount of food needed to ensure a food-sufficient diet and let  $\underline{OG}$  be the minimum bundle of other goods needed to ensure nondeprivation defined over those other goods.<sup>3</sup> A household is food insufficient in any period  $t$  if  $F_t < \underline{F}$  and is other good deprived in any period  $t$  if  $OG_t < \underline{OG}$ . Let  $\underline{Z} = p_F \underline{F} + p_{OG} \underline{OG}$  be the minimum expenditure needed to maintain food sufficiency and other goods sufficiency. A graphical depiction of  $\underline{Z}$  is in figure 1.<sup>4</sup> Within this general framework, we analyze two possible reasons for why households may be food insufficient.

### Average Income and Initial Assets are Too Low

The possibility of food insufficiency and other-goods insufficiency exists if:

$$\bar{Y} + \frac{1}{T} A_0 < \underline{Z}.$$

For this household, a choice must be made between food insufficiency and deprivation over

<sup>3</sup>For example, a household should be adequately sheltered. For more on conceptions of deprivation over other dimensions of well-being, see, e.g., Gundersen, 1996.

<sup>4</sup>Figures follow tables at the end of this paper.

other goods; its choice set based on its current income and average initial assets does not include food sufficiency and nondeprivation over other goods. In what follows, we only discuss the food insufficiency outcome—it is presumed that a household can always avoid food insufficiency when income plus average initial assets are less than  $\underline{Z}$ , but only if it accepts deprivation over other goods. There is nothing in the general utility function that we have specified, of course, that would imply such a choice. While households can presumably borrow against future income, even with borrowing they cannot avoid food insufficiency in every period because their average income is too low. For such households, food insufficiency is an inevitable outcome in at least some periods.

There are two related explanations for food insufficiency. First, households may face higher prices on food and/or other goods than the prices used to establish  $\underline{Z}$ . For example, households living in central cities may face higher housing prices than someone in a rural area. Second, some households may have a higher other-goods deprivation level than other households. For example, a household with a disabled child faces higher medical expenditures than one without a disabled child. If either of these explanations holds, the value of  $\underline{Z}$  will be higher.

Another explanation for food insufficiency is choice. Some households, even when food sufficiency and other-goods sufficiency is an option, may choose food insufficiency. For example, parents may forgo food for themselves to buy a small present for their child's birthday. These three explanations are in figure 2.

### Negative Income Shock, Lack of Savings, and Liquidity Constraints

We now consider households for which average income is at a level that the choice of food sufficiency is seemingly possible in every period, i.e.,

where  $\bar{Y} + \frac{1}{T} A_0 \geq \underline{Z}$ . In the absence of

negative income shocks, these households need not become food insufficient. However, the existence of income shocks, their timing, their mag-

nitude, and liquidity constraints may place households in danger of food insufficiency.

Consistent with the maximization of utility discussed earlier (which implies that  $A_T = 0$ ), a household has the following asset accumulation equation:

$$A_j = A_0 + \sum_{t=0}^j Y_t - \sum_{t=0}^j C_t = A_0 + \sum_{t=0}^j Y_t - j\bar{Y} - \frac{j}{T} A_0.$$

The change in assets from one period to the next is then:

$$A_j - A_{j-1} = Y_j - \frac{A_0}{T} - \bar{Y}.$$

If there is a negative income shock (i.e.,  $Y_j < \bar{Y}$ ) such that:

$$A_{j-1} < -Y_j + \frac{A_0}{T} + \bar{Y},$$

then  $A_j < 0$ . In other words, a household does not have sufficient savings to maintain its desired consumption level. This is not a problem insofar as we assume households can borrow to sustain their desired consumption level. Suppose instead that these households suffer both an income shock and a credit rejection shock (i.e., they find that they are liquidity constrained).<sup>5</sup> Liquidity-constrained households have  $A_j \geq 0$  for all  $j$ . This implies that the following must hold:

$$A_{j-1} \geq -Y_j + \frac{A_0}{T} + \bar{Y} = \bar{C} - Y_j,$$

where  $\bar{C}$  is the household's desired consumption level. If a household is liquidity constrained, and the income draw is such that:

$$A_{j-1} < \bar{C} - Y_j,$$

then the household must deviate from the desired consumption to a level such that:

$$C_j \leq A_{j-1} + Y_j.$$

If this new level of consumption is less than the minimum income level needed to maintain food sufficiency and other-goods sufficiency, food

<sup>5</sup>For more on liquidity constraints, see, e.g., Deaton, 1991; and Deaton, 1992, pp. 194-213.

insufficiency is one consequence of this income shock. In other words, if:

$$C_j < Z = p_F \underline{F} + p_{OG} \underline{OG}.$$

In the empirical section, we analyze these two explanations for food insufficiency by comparing food-sufficient and food-insufficient households. The data set we use for these comparisons is first described.

## Data and Descriptive Results

This paper uses the 1991 and 1992 panels of the SIPP, a multipanel longitudinal survey of the noninstitutional population of the United States administered by the U.S. Department of Commerce, Bureau of the Census. The panel is constructed from a group of addresses selected for interviews at the start of the year. All individuals living at these addresses over the age of 15 are then interviewed every 4 months (each 4-month segment constitutes a wave) for 2½ years. These individuals are followed even if they change addresses, move into an existing household, or form a new household. Monthly information is collected on earnings, hours of work, health insurance coverage, school enrollment, asset income, participation in government programs (e.g., Medicaid, AFDC, and food stamps), and numerous other demographic variables. In each wave, a Core Module and Topical Module are administered; the Core Module is the same in every wave, but the Topical Module changes.

The Well-Being Topical Module, administered in Wave 6 of the 1991 panel and Wave 3 of the 1992 panel, has a series of questions on food insufficiency. Respondents are asked to describe their households' recent food intake in terms of the U.S. Department of Agriculture (USDA) food sufficiency question: "Which of these statements best describes the food eaten in your household in the last four months?" They have four choices: "enough of the kinds of food we want to eat; enough but not always the kinds of food we want to eat; sometimes not enough to eat; or often not enough to eat." Those households

reporting that they sometimes or often do not get enough to eat are considered food insufficient and are asked a further question: "In what month(s) did your household not have enough to eat?"

Several studies have confirmed the validity of this USDA food sufficiency question as a measure of decreased food intake. Basiotis (1992) used national-level data to show that classification of respondents using this question was consistent with consumer theory regarding the demand for calories and food. Using data from the 1985-86 Continuing Survey of Food Intake by Individuals (CSFII), Cristofar and Basiotis (1992) found that usual food expenditures were lower in households reporting food insufficiency. The same study found that the mean food intake of women from food-insufficient households was lower than for food-sufficient women for 13 food groups, while the mean food intake of children from food-insufficient households was lower than for food-sufficient children for five food groups. Rose and Oliveira (1997) used the 1989-91 CSFII to show that after controlling for other factors that affect diet, food insufficiency was significantly related to decreases in nutrient intake at the household level. Calorie intake was 13 percent lower for food-insufficient households and the decrease in intake of 13 other nutrients ranged from 8 to 18 percent of consumption levels in food-sufficient households.

We examine households in the 8 months leading up to the first month of food insufficiency and their first (and perhaps only) month of food insufficiency. Figure 3 shows the structure of the breakdown. Waves 4, 5, and 6 of the 1991 panel and Waves 1, 2, and 3 of the 1992 panel are used in this analysis and these cover the identical time period. More precisely, Waves 6 and 3 cover the identical time period, and so forth. Households reporting that they were food insufficient for the first time in the first month of Wave 6 of the 1991 panel (Wave 3 of the 1992 panel) are examined in months one through nine; households reporting that they were food insufficient in the second month of Wave 6 (Wave 3) are in the sec-

ond category, etc.<sup>6</sup> The breakdown is as follows: 63 percent in the first 9 months, 9 percent in the second, 14 percent in the third, and 14 percent in the fourth. We assign food-sufficient households such that the percentage of food-sufficient households is 63 percent in the first 9 months, 9 percent in the second, etc. Through this assignment, rather than just, say, placing all food-sufficient households in months 1 through 9, we correct for any time-structured bias that may be present in the data. Unfortunately, the food insufficiency question is only asked in Wave 3 (Wave 6). The months for which we have information about food insufficiency are displayed in the banded portion of figure 3.

Our sample is confined to households with average incomes in Wave 3 (Wave 6) below 200 percent of the poverty line. Eighty percent of food-insufficient households are in this category, and only 0.06 percent of households above 200 percent of the poverty line are food insufficient.

Food-insufficiency rates for selected variables are presented in table 1.<sup>7</sup> These are broken into three categories: all households with monthly incomes below 200 percent of the poverty line; households below the poverty line; and households between 100 and 200 percent of the poverty line. The variables are all from the final month of the 9-month categories discussed above. Current income clearly mattered in predicting who was food insufficient; 10.2 percent of households with incomes less than 50 percent of the poverty line were food insufficient, while 2.6 percent of households with incomes more than 150 percent of the poverty line were food insufficient. In the ensuing discussion, the results for all households are discussed—the ordering of categories is roughly similar for households below and above the poverty line, though the food-insufficiency

<sup>6</sup>Because each wave has four rotation groups, each with different interview months, the calendar months will differ between households even for households reporting that they were food sufficient in the first month. The months in Wave 6 (Wave 3) range from September to December 1992.

<sup>7</sup>Tables are at the end of this paper.

rates are always higher for those below the poverty line. Homeowners are much less likely to be food insufficient than renters: 8.3 versus 3.1 percent. Transfer recipients (Aid to Families with Dependent Children, Supplemental Security Income, and/or food stamps) are more likely to be food insufficient than nonrecipients.<sup>8</sup> Food insufficiency was lower in households headed by a senior citizen than those headed by others, 1.9 percent versus 7.8 percent. Food-insufficiency rates generally increased with household size, ranging from 4.0 percent in one-person households to 8.0 percent in six-person households. Household composition is broken into four categories: wife and husband with children, wife and husband without children, single person with children, and single person without children. Wife and husband with no children had the lowest food insufficiency rates (2.8 percent), while single-parent households had the highest (10.4 percent). Households are classified into four race-ethnicity categories: non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other. Non-Hispanic white, non-Hispanic black, and non-Hispanic other households had similar food insufficiency rates (5.0, 5.7, and 6.3 percent), while Hispanics had higher rates (9.3 percent).<sup>9</sup>

<sup>8</sup>This does not imply, of course, that households receiving transfers are worse off than if they did not receive the transfers. For more on the relation between food stamps and food insufficiency, see Gundersen and Oliveira, 2001.

<sup>9</sup>These bivariate results give us a useful description of the relation between various variables and the extent of food insufficiency. While illustrative, these do not give us information about the relative influence of the variables. Previous work using a sample of all households in the SIPP found that, after controlling for other factors in the preferred model, low-income households, larger households (with economies of scale), single-person households without children, single-parent households with children, non-high school graduates, and renters were all more likely to be food insufficient (Rose, Gundersen, and Oliveira, 1998, table 3, column 6). Previous work using a sample of households eligible for the Food Stamp Program found that after controlling for the simultaneity of the food stamp participation decision and food insufficiency status, households without a senior or a disabled person and households losing a job were more likely to be food insufficient (Gundersen and Oliveira, 2001, table 4, column 2).

## Empirical Results

We now empirically examine the theoretical explanations discussed above for why households may be food insufficient through a comparison of food-insufficient and food-sufficient households in the 9 months leading up to their first spell (possible spell) of food insufficiency.<sup>10</sup> We begin by considering the importance of low average income and high minimum income levels to the food insufficiency outcomes. We then look at the influence of income shocks, lack of savings, and liquidity constraints on the food insufficiency outcomes.

### Average Income and Initial Savings are Too Low

Food-insufficient households have lower average monthly incomes than food-sufficient households. Average monthly income is calculated by summing over the 12 months of Waves 1, 2, and 3 (Waves 4, 5, and 6) and dividing by 12. Out of households with incomes below 50 percent of the poverty line, 9.8 percent were food insufficient; with incomes between 50 and 100 percent of the poverty line, 8.6 percent; with incomes between 100 and 150 percent, 5.3 percent; and with incomes more than 150 percent, 3.2 percent. With the exception of the first two categories, the higher food-insufficiency rates due to lower income is statistically significant.

There is also some evidence that average monthly income is a more important determinant of food insufficiency than current monthly income. The average monthly income for food-

sufficient households is \$1,365 and for food-insufficient households is \$1,130, a difference of 17.2 percent. The average income in the first month of food insufficiency (or the first month assigned to food-sufficient households) is \$1,141 for food-sufficient households and \$996 for food-insufficient households, a smaller difference of 12.7 percent.<sup>11</sup> A low average income will have its largest effect on households without savings. We consider the evidence on lack of savings in the “Lack of Savings” section below.

We find some evidence to support differences in prices, in minimum expenditures needed for other goods sufficiency, and in preferences as explanations for food insufficiency. As seen in table 2, 8 percent of food-sufficient households have a non-senior, disabled person, while 13 percent of food-insufficient households have a non-senior, disabled person.<sup>12</sup> Expenditures needed for disabled persons (e.g., in-home care if the disability is serious enough) but not for nondisabled persons leads to a higher other-goods sufficiency line. A similar explanation holds for household composition. Single-parent households with children are more likely to be among food-insufficient households (35 versus 18 percent), while single-person households without children are less likely to be among food-insufficient households (33 versus 43 percent). Households with children face certain expenditures (e.g., school costs and additional clothing) that households without children do not face leading to higher other-goods sufficiency lines. The slightly higher percentage of food-insuffi-

<sup>10</sup>Three limitations with the SIPP prevent a more formal treatment of our theoretical model. First, there is information on food-insufficiency status only in Wave 3 (Wave 6). Thus, we do not know if, say, an income shock in month 2 has an immediate effect or only an effect in month 9. Second, the timeframe of the SIPP is relatively short: 12 months in the 1992 panel and 18 months in the 1991 panel. Because savings and consumption decisions often occur over many years, we cannot adequately incorporate these into a model using the SIPP. Third, the SIPP only has limited information about consumption. Thus, we do not precisely know the trade-offs households are making between food consumption and other consumption.

<sup>11</sup>The average monthly income will by definition be substantially higher than the average income in the first spell of food insufficiency due to the sample selection method. Households with average monthly incomes less than 200 percent of the poverty line in Wave 3 (Wave 6) were selected into the sample. Households whose incomes were lower in previous waves but rose to above 200 percent of the poverty line in Wave 3 (Wave 6) were not included, but households whose incomes were higher in previous waves but fell to below 200 percent of the poverty line were included.

<sup>12</sup>Persons are defined as disabled in the SIPP if they have “...a physical, mental or other health condition that limits the kind or amount of work...” that they can do. Disability status is assigned to all members of the household between the ages of 15 and 69.

cient households paying for child care (3.2 versus 2.0 percent) is consistent with this explanation.

Food-insufficient households pay nearly one-third more for housing than food-sufficient households (\$302 versus \$232 in rent or mortgage payments), although this difference is not statistically significant at usual confidence levels. The rent statistics are for only the 1991 panel and, therefore, draw upon a smaller sample size than other statistics. This higher expenditure on housing could be due to higher housing prices in an area and/or a choice by food-insufficient households to live in better quality housing.

### **Negative Income Shocks, Lack of Savings, and Liquidity Constraints**

Low average income is one explanation for food insufficiency, but the large number of households with even average incomes above the poverty line (and hence, supposedly able to choose food sufficiency) means other explanations are needed. We now turn to these other explanations.

#### ***Negative Income Shocks***

Within our dynamic framework, a negative income shock is one explanation for why households face the possibility of food insufficiency. For our purposes, a “negative income shock” is defined as any event that causes a decline in the resources available to a household to purchase food. The effect of this negative income shock may have negative consequences beyond the first month it is experienced; in fact, the full effect may be felt only once households drain their available savings.<sup>13</sup> Previous studies have noted the importance of recent economic changes on the probability of food insufficiency. For example, Campbell and Desjardins (1989, footnote 53) found that 85 percent of food-insecure households experienced a major event in their house-

<sup>13</sup>Due to the data limitations discussed above, we do not necessarily know households’ food-insufficiency status in every month following the income shock and thus do not know when the full effect is felt.

hold in the past 12 months, the most common being a loss of employment. Other major factors influencing the resources available to a household include spouse leaving, birth of a baby, and moving. We say a household has experienced a negative income shock if one has occurred in any of the 9 months. The effects of two income shocks—loss of earnings and loss of food stamps—were influential on food insufficiency and were significant at the 95-percent confidence level. The results discussed in this section are in table 3.

**Loss of earnings.** For each month for every household member, SIPP has information on earnings from wage and salary work and self-employment. This information is summed across household members to arrive at a household earnings measure. We say a loss of earnings was determined to have occurred when a month in which income was earned is immediately followed by one in which there is no earned income. This definition of earnings loss would include a scenario in which a steady stream of earned income is interrupted by a single zero-income month. Thus, the loss of earnings need not be permanent to be recorded, using the rationale that even a temporary loss of income constitutes a negative shock. However, a period without work that straddles 2 calendar months could slip through this definition of earnings loss without detection. For example, a household that has no earnings one week into the calendar month and then has earnings in the last week of the next calendar month would appear to have had continuous earned income when in actuality the household experienced a 6-week period without earned income. A household without earnings does not necessarily mean that everyone is unemployed; a self-employed person without any sales, in the past month, for example, could still be employed but not earning any money.

Food-insufficient households are more likely to have lost earnings than food-sufficient households. Out of all households, 15.3 percent went from some earnings to zero earnings in the previous 9 weeks. Food-insufficient households had an earnings-loss rate of 23.6 percent, while food-

sufficient households had an earnings-loss rate of 14.8 percent.

**Loss of food stamps.** Following the method outlined earlier for determining loss of employment, a loss of food stamp benefits is said to occur when a month of positive benefits is followed by a month in which no benefits are collected. Thus, as with loss of earnings, a single month of zero food stamp income within an otherwise positive stream of benefits would constitute a loss.

To be eligible for food stamps, a household must have a gross income less than 130 percent of the poverty line; a net income (after various deductions) less than 100 percent of the poverty line; and assets less than \$2,000 (\$3,000 for elderly households). Because the gross income cutoff in our paper is 200 percent of the poverty line, not everyone in our sample had the possibility of receiving food stamps. As seen in table 2, 20 percent of food-sufficient households received food stamps, while 39 percent of food-insufficient households received food stamps.

A loss of food stamps may have an even larger effect on food insufficiency than a loss in earnings. Numerous studies based on experiments where food stamp recipients received cash instead of food stamps have shown that a dollar of food stamps has a larger influence on the marginal propensity to consume out of food stamps than out of cash (for recent articles, see Breunig et al., 2001; and Levedahl, 1995). The effect of losing food stamps may thus produce a larger increase in the probability of food insufficiency, in comparison with the same dollar loss in earnings.

Food-insufficient households are almost three times as likely to have lost food stamp benefits as food-sufficient households. Out of all households, 5.9 percent lost their food stamp benefits. Food-insufficient households had a food stamp-loss rate of 14.8 percent, while food-sufficient households had a food stamp-loss rate of 5.4 percent. In a study of hunger among adult patients receiving medical care, Nelson, Brown, and Lurie (1998) also found that loss of food stamps

was a significant determinant of food insufficiency.

One reason households lose their food stamps is because their gross income increased enough to render them ineligible. If this were the case, the negative effect of losing food stamps may be mitigated by their increased income. This situation does not appear to be the case for most households. Only 13.8 percent of food-insufficient and 12.3 percent of food-sufficient households lost food stamps because their gross monthly income rose to above 130 percent of the poverty line.<sup>14</sup> A large percentage of households losing their food stamps, however, do have incomes above 130 percent of the poverty line before and after they receive food stamps. Among food-insufficient households, 26.2 percent have incomes that are too high, while 21.0 percent of food-sufficient households have incomes that are too high. This percentage of seemingly ineligible households is roughly consistent with other analyses that have used more precise measures of eligibility (e.g., Cody and Trippe, 1997).

Variability of income may also be a determinant of food insufficiency. Households with higher variability of income experience more shocks and/or larger shocks than households with lower variability of income.

We constructed income variances as a proportion of deviation from the mean monthly income for all households. Strict numerical variance, however, obscures the magnitude of the difference in the severity of income shocks experienced by food-sufficient and food-insufficient populations. High mean income on the part of food-sufficient households (see table 2) allows the appearance of greater variance than low mean income food-insufficient counterparts. Adjusting for the difference in mean incomes between the two populations, however, reveals that as a proportion of income, food-insufficient households have a

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<sup>14</sup>There are other reasons why households could become ineligible. Two of the more common explanations would be a decrease in household size or an increase in a household's assets. We did not find either of these to be explanations in any case.



higher variance. For food-sufficient households, there was a variance of 18 percent around mean income, while for food-insufficient households, the variance was 31 percent.

Other possible shocks to the resources used to avoid food insufficiency include a change in household composition (e.g., a divorce or birth of child), moving, and loss of transfer payments (AFDC and SSI). There were no statistically significant differences between food-sufficient and food-insufficient households in these factors.

### **Lack of Savings**

Households experiencing a negative income shock and/or unexpected new expenses can avoid the problem of decreased consumption if they have alternative sources of funds available. In this section, we consider three statistically significant differences (at a 95-percent confidence level) between food-insufficient and food-sufficient households in terms of savings stocks. Evidence about lack of savings is relevant for households with income shocks, but it is also relevant for households with low average income. As discussed in the theoretical section of this paper, households with low average incomes can avoid food insufficiency if they have high enough initial savings level.

**Liquid assets.** For each wave, SIPP collects information on whether a household receives interest (reinvested or distributed) from a wide variety of liquid assets. Assets include passbook savings accounts, money market deposit accounts, certificates of deposit, interest-earning checking accounts, money market funds, U.S. Government securities, municipal or corporate bonds, stocks, and mutual funds. A household is said to have positive savings if they receive interest from one or more of these assets. Uninterrupted positive returns throughout the entire sample period were required for a household to be marked as having access to liquid assets.

There is a sharp disparity in the amount of savings available to food-sufficient and food-insufficient households. Only 3.6 percent of food-

insufficient households have savings, while 26.7 percent of food-sufficient households have savings. These figures, though, should be considered a lower-bound estimate on the number of households with access to liquid assets, because money in the form of cash or noninterest-bearing checking accounts are not included in this measure.

**Homeownership.** Owning a home provides households with three main ways to prevent food insufficiency from occurring in face of an income shock. First, households without mortgages and households with mortgage payments less than the rental value of their homes have more money available for food than if they were renting. Second, homeowners can avoid making needed repairs to their houses whereas renters needing the same repairs may find their rent increased. This is akin to liquidating an asset. Third, homeowners can borrow against the equity present in a house. Instead of drawing down a liquid stock of savings, homeowners can draw down the equity in their homes. Households, primarily seniors, receiving a monthly payment in exchange for the equity in their house (reverse mortgages) collect a similar flow from their housing asset.

As with savings, to be considered a homeowner, a household was required to maintain home ownership throughout the sample period. Almost twice as many food-sufficient households own their home in comparison with food-insufficient households: 46.8 to 24.0 percent, respectively.

**Health insurance.** A household does not draw upon insurance as they draw upon a liquid asset or a home, but the effect can be similar. Insurance enables a household to afford unexpected expenditures for other goods, avoiding the possibility of food insufficiency. Because health care costs can be especially extreme for some households, we look at whether households have health insurance.

Households covered by health insurance for the entire sample period were counted as having health insurance. Health insurance includes private health insurance, employer-provided health insurance, Medicaid, and Medicare. Food-

insufficient households are significantly less likely to be covered by health insurance than their food-sufficient peers (69.6 to 56.7 percent).

While we observe income shocks, we do not observe unexpected increases in expenses, e.g., a major appliance or an automobile needing repairs. These three forms of savings help to alleviate the consequences of both income shocks and unexpected increased expenses. In table 4, for the observed income shocks discussed earlier, we further examine the households losing food stamps and households losing earnings by types of savings available.

Not only are food-insufficient households more likely to experience observed income shocks, those suffering from income shocks are less likely to have the resources to ameliorate those shocks. Food-insufficient households losing earnings are especially ill-suited to weather these shocks, compared with food-sufficient households losing earnings. Only 2.3 percent of food-insufficient households losing earnings have liquid savings (compared with 20.2 percent for food-sufficient households); 23.0 percent are homeowners (compared with 42.1 percent); and 45.6 percent have health insurance (compared with 51.7 percent). Similar differences between food-sufficient and food-insufficient households, although less stark, exist for households losing food stamps.

### Liquidity Constraints

Households experiencing negative income shocks can avoid food insufficiency if they have enough savings and/or if they can borrow. While evidence of savings differences between food-insufficient and food-sufficient households exists (as discussed earlier), we are unable to ascertain directly from the SIPP whether households are liquidity constrained. The SIPP does not include questions about whether loans were applied for and rejected nor are there questions about borrowing levels. Moreover, the short time length of the SIPP and the lack of consumption questions prevents an analysis of liquidity constraints similar to that of, e.g., Zeldes (1989).

Previous research, however, has shown that liquidity-constrained households are more likely to have the characteristics of food-insufficient households. Zeldes (1989) showed that households with less than 2 months worth of average income in liquid savings were liquidity constrained.<sup>15</sup> As seen in table 3, food-insufficient households have lower savings rates. Jappelli (1990, table III) examined the factors that differentiated “unconstrained households” from “rejected applicants” and “discouraged borrowers” (i.e., households answering “yes” to the question: “Was there any time in the past few years that you (or your husband/wife) thought of applying for credit at a particular place but changed your mind because you thought you might be turned down?”). The probability of receiving credit was greater with high income and high wealth, and white households and homeowners were more likely to receive credit. Food-sufficient households are more likely than food-insufficient households to have these characteristics (tables 2 and 3).

## Conclusion

In studying the dynamic determinants of food insufficiency, we have sought to go beyond simple, and not completely satisfying, mean income level explanations of food insufficiency to consider how the actual time-path of income can affect a household’s food consumption decisions. Whereas low average income is an intuitively appealing explanation for food insufficiency, the data do not wholeheartedly support such a conclusion. The coexistence of food-sufficient households with incomes below 50 percent of the poverty line and food-insufficient households with incomes above 150 percent of the poverty line is evidence that mean income and food insufficiency are not perfectly correlated.

Further insight into the determinants of food insufficiency is provided by our study of income

<sup>15</sup>A household is liquidity constrained in Zeldes (1989) if, in comparison with the unconstrained case, the marginal utility of consumption in the current period is higher relative to the next period.

dynamics. We have shown that food-insufficient households are disproportionately likely to suffer from income shocks associated with the loss of earnings and food stamps. Additionally, food-insufficient households were calculated to experience a greater variance of income, measured as a proportion of mean income, than their food-sufficient peers, lending further credibility to the conjecture that the path of income and income shocks are important components for determining food insufficiency.

The amount of savings available to a household in the event of a negative income shock is an important determinant of food insufficiency. Only a small number of food-insufficient households possess any savings to fall back on in the event of a negative income shock. Low rates of food-insufficient homeownership and health insurance coverage also indicate vulnerability to negative income shocks, since these households do not have options to borrow against their homes or use health insurance to smooth consumption over health crises. A household with the ability to borrow can smooth consumption over any temporary drop in income through the assumption of debt. However, we have shown (indirectly) that food-insufficient households are often liquidity-constrained households. Liquidity constraints are an important aspect of constructing a hypothesis of income shock-initiated food insufficiency.

This paper informs policy in three primary ways. First, we emphasize the influence of savings and access to credit on the well-being of low-income households. At least in terms of food insufficiency, policymakers may wish to seek ways to improve the ability of low-income households to weather negative income shocks. Efforts to make credit more readily available for low-income households with low credit risks, improve their credit-worthiness, and encourage savings can help to improve low-income households' well-being in instances of negative income shocks. Second, we provide some support for using asset tests as part of the eligibility criteria for the Food Stamp Program. Currently, households with liquid assets above \$2,000 (\$3,000 for seniors) are ineligible for food stamps, even if

they are income eligible. Given the results here, insofar as having some assets is a very imperfect method of ascertaining food stamp eligibility, asset ineligible households appear to be at less risk of food insufficiency than asset eligible households. Third, we show how important maintaining receipt of food stamps is to the food-insufficiency status of eligible households. As analysis of the effects of welfare reform on low-income households continues, one aspect that might be considered is how loss of food stamps (or other programs) affects the well-being of households over more direct measures such as food insufficiency. In particular, these analyses may wish to consider the effects of limited food stamp eligibility on able-bodied adults without dependents (ABAWD's) and on the still-eligible former recipients of Temporary Assistance for Needy Families who no longer receive food stamps.

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**Table 1—Food-insufficiency rates by selected variables<sup>1</sup>**

Variable	All households below 200 percent of the poverty line	Households below the poverty line	Households between 100 and 200 percent of the poverty line
<i>Percent food insufficient, weighted</i>			
All households	5.7	9.2	3.6
<b>Income of household, percent of poverty line:</b>			
≤50 percent	10.2	10.2	—
> 50 and ≤ 100 percent	8.7	8.7	—
> 100 and ≤ 150 percent	4.6	—	4.6
> 150	2.6	—	2.6
<b>Education of household head:</b>			
Did not complete high school	6.0	9.8	3.0
High school graduate	5.5	8.7	3.9
<b>Homeownership status:</b>			
Owners	3.1	5.5	2.1
Renters	8.3	11.4	5.4
<b>Transfer reciprocity status:</b>			
Household receives AFDC or SSI <sup>2</sup>	9.7	12.0	4.8
Household does not receive AFDC or SSI <sup>2</sup>	4.6	7.5	3.4
<b>Food stamp reciprocity status:</b>			
Household receives food stamps	10.3	11.4	6.8
Household does not receive food stamps	4.4	7.5	3.3
<b>Senior citizen status:</b>			
< 65 years of age	7.8	11.1	5.4
> 65 years of age	1.9	4.4	.9
<b>Disabled nonsenior citizen in household:</b>			
Non-disabled	4.8	8.1	3.0
Disabled	8.5	12.2	5.7
<b>Household size:</b>			
1 person	4.0	6.0	2.6
2 persons	5.1	9.1	3.3
3 persons	7.6	12.1	4.9
4 persons	7.5	12.8	4.3
5 persons	7.1	12.4	4.1
6 persons	8.0	9.2	6.8
7 or more persons	7.1	9.9	4.0
<b>Household composition:</b>			
Wife and husband with child(ren)	6.0	9.3	4.5
Wife and husband without children	2.8	6.8	1.7
Single person with child(ren)	10.4	13.8	5.9
Single person without children	4.4	6.5	3.1
<b>Race-ethnicity of the household head:</b>			
Non-Hispanic white	5.0	8.5	3.4
Non-Hispanic black	5.7	8.5	2.6
Hispanic	9.3	12.9	5.9
Non-Hispanic other	6.3	8.2	5.0

<sup>1</sup>Data are from the 1991 and 1992 panels of the Survey of Income and Program Participation. These figures are for the month of a household's first spell of food insufficiency. For food-sufficient households, these figures are for the "first month" as described on pages 95-96.

<sup>2</sup>AFDC is the abbreviation for Aid to Families with Dependent Children, and SSI is the abbreviation for Supplemental Security Income.

**Table 2—Sample means for selected variables<sup>1</sup>**

Variable	All households below 200 percent of the poverty line	Food-sufficient households	Food-insufficient households
	<i>Mean, weighted (standard deviation)</i>		
Income	1,075.02 (709.21)	1,085.46 (713.06)	902.27 (616.67)
High school graduate	.61	.61	.58
Homeownership	.48	.50	.26
Household receives AFDC or SSI <sup>2</sup>	.21	.20	.36
Household receives food stamps	.22	.20	.39
Household head more than 65 years of age	.36	.37	.12
Disabled nonsenior citizen in household	.09	.08	.13
Household size	2.65 (1.75)	2.63 (1.75)	3.0 (1.79)
Wife and husband with child(ren)	.24	.24	.25
Wife and husband without children	.14	.14	.07
Single person with child(ren)	.19	.18	.35
Single person without children	.42	.43	.33
Non-Hispanic white	.68	.68	.59
Non-Hispanic black	.17	.17	.17
Hispanic	.13	.12	.20
Non-Hispanic other	.03	.03	.03

<sup>1</sup>Data are from the 1991 and 1992 panels of the Survey of Income and Program Participation. These figures are for the month of a household's first spell of food insufficiency. For food-sufficient households, these figures are for the "first month" as described on pages 95-96.

<sup>2</sup>AFDC is the abbreviation for Aid to Families with Dependent Children, and SSI is the abbreviation for Supplemental Security Income.

**Table 3—Income shocks and savings by food-insufficiency category<sup>1</sup>**

Variable	All households below 200 percent of the poverty line	Food-sufficient households	Food-insufficient households
	<i>Percent</i>		
<b>Income shocks:</b>			
Households losing earnings	15.3	14.8	23.6
Households losing food stamps	5.9	5.4	14.8
<b>Savings:</b>			
Households with liquid savings	25.4	26.7	3.6
Homeowners	45.5	46.8	24.0
Households with health insurance	68.8	69.6	56.7

<sup>1</sup>Data are from waves 1 to 3 of the 1992 panel of the Survey of Income and Program Participation (SIPP) and waves 4 to 6 of the 1991 panel of the SIPP.

**Table 4—Savings of food-sufficient and food-insufficient households experiencing income shocks<sup>1</sup>**

Variable	With liquid savings	Homeowners	With health insurance
	<i>Percent</i>		
<b>Food sufficient households:</b>			
Households losing earnings	20.2	42.1	51.7
Households losing food stamps	3.5	33.0	47.2
<b>Food insufficient households:</b>			
Households losing earnings	2.3	23.0	45.6
Households losing food stamps	0	19.6	39.9

<sup>1</sup>Data are from waves 1 to 3 of the 1992 panel of the Survey of Income and Program Participation (SIPP) and waves 4 to 6 of the 1991 panel of the SIPP.

Figure 1  
**Minimum expenditures needed for food sufficiency and other goods sufficiency**

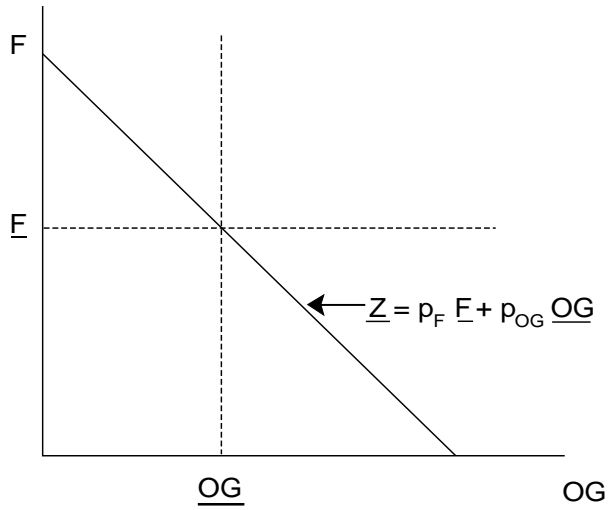


Figure 2  
**Examples of how food insufficiency can occur with seemingly sufficient income levels**

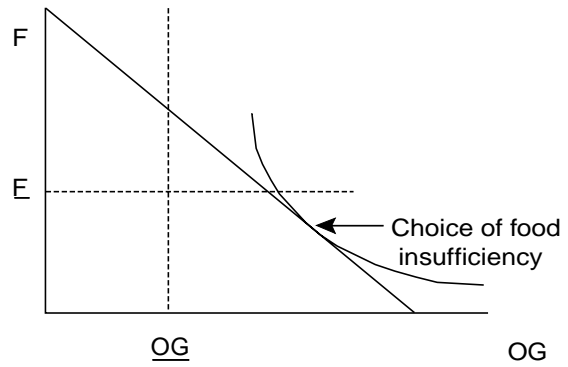


Figure 2(a)

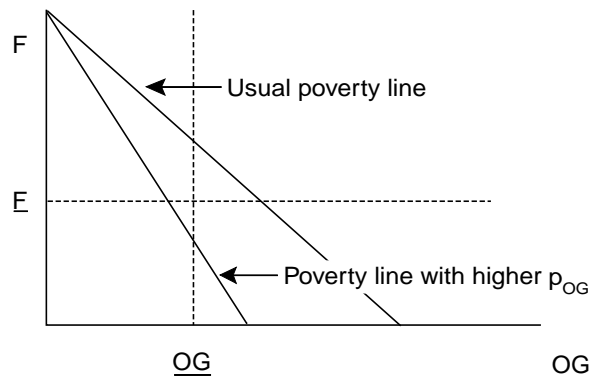


Figure 2(b)

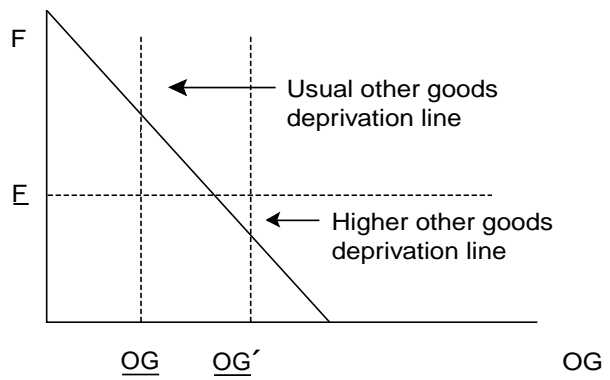
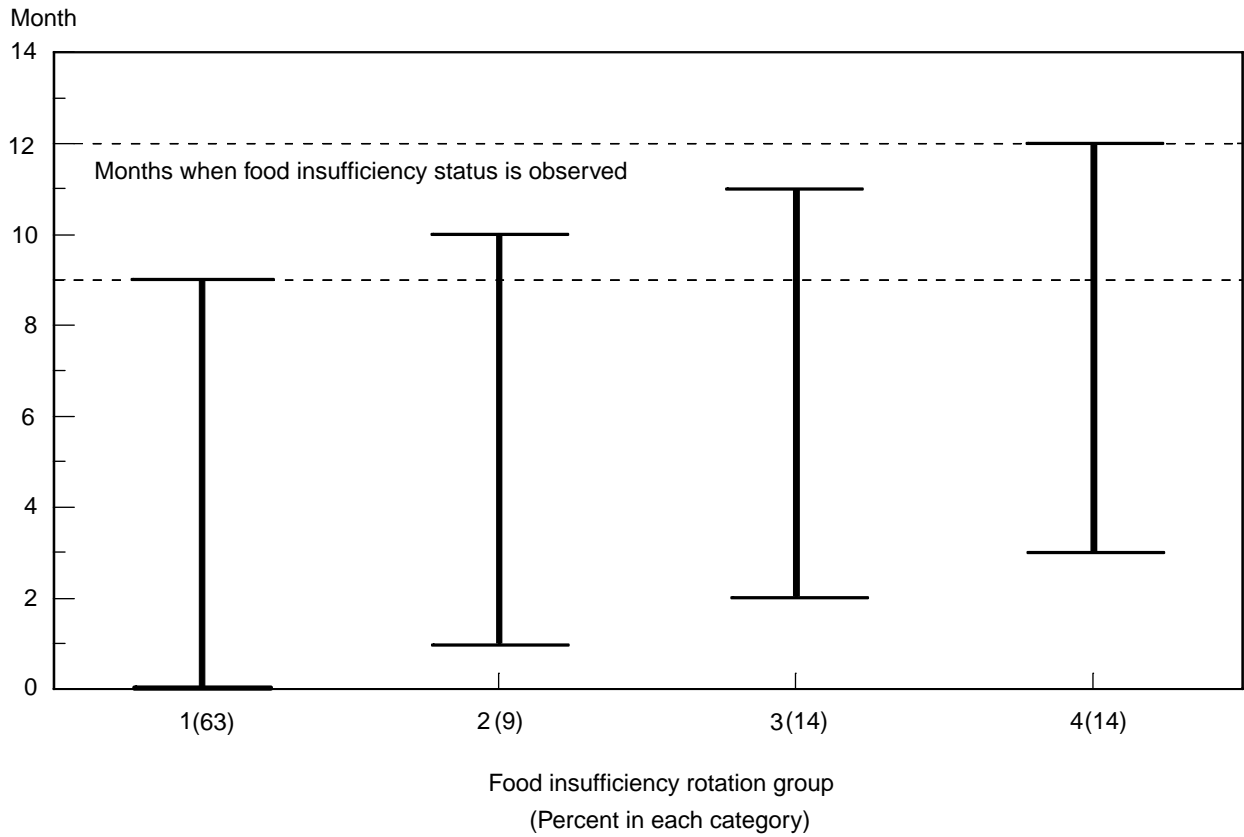


Figure 2(c)



Figure 3  
**Assignment of households to 9-month time periods**



## Appendix

### An Alternative Dynamic Model of Food Insufficiency

In this appendix, we formally demonstrate, using a different model than in the text, how a household can be both food insufficient and above the poverty line. In this model, a household maximizes the sum of future expected utility defined over the consumption of two categories of goods,  $C_t$  and  $D_t$ . Food consumption is subsumed under  $C_t$ , and other-goods consumption is subsumed under both  $C_t$  and  $D_t$ . (In order to more fully concentrate on food insufficiency, below we assume that  $C_t$  consists only of food consumption.) Goods are distinguished by the timing of their purchase decisions:  $C_t$  goods are chosen and consumed within the period, while  $D_t$  requires a purchasing decision one period prior to consumption. We impose two conditions on the model that distinguish it from earlier models. First, we do not allow savings and we impose complete liquidity constraints. As discussed in the empirical section, these assumptions are consistent with the experiences of the vast majority of food-insufficient households. Second, decisions regarding the consumption of good  $D_t$  must be made in the period prior to the purchase and consumption of the good.  $D_t$  can be thought of as any consumption that might involve a degree of planning or preparation, such as rent, commuting costs, and cable TV.  $D_t$  consumption is not quite durable goods, but rather contractual consumption. Income is not known at the time contractual consumption is chosen. Whereas standard intertemporal consumption models introduce their temporal element through the budget constraint and the ability to borrow and lend consumption, our model is intertemporal as a result of the consumption decisionmaking process. There is not temporal dependence in the budget constraint or the utility function, so that on the surface the model seems to be a collection of stand-alone static optimization problems. The model is made dynamic through the existence of contractual consumption. Expected utility is maximized subject to a series of period-specific

budget constraints equating current income to current  $C_t$  and  $D_t$  expenditures:

$$\begin{aligned} \text{Max}_{C_{t+1}, D_{t+1}} U &= E_t (C_{t+1}, D_{t+1}) \\ \text{s.t. } Y_t &= C_t + D_t \\ E_t (Y_{t+1}) &= E_t (C_{t+1}) + D_{t+1}, \end{aligned}$$

where  $u(\bullet)$  is a generic utility function and  $Y_t$  is income. Without loss of generality, we set the prices of  $C_t$  and  $D_t$  to 1. Note that at time  $t$ , the consumption of  $D_t$  was chosen in  $t-1$  based on expectations of income and consumption at time  $t$ , and the resulting consumption of  $C_t$  is the residual after the realization of income in time  $t$ . At time  $t$ , the agent also makes a decision about the consumption of  $D_{t+1}$  based on expectations in time  $t$  of income and consumption in time  $t+1$ .

### The First-Order Conditions

Substituting  $C_t$  out of the utility function using each period's budget constraint then solving results in the following first-order condition :

$$E_t \left( \frac{\delta u}{\delta C_{t+1}} \right) = \left( \frac{\delta u}{\delta D_{t+1}} \right).$$

There is no first-order condition for period  $t$  because when we substitute out  $C_t$ , there is no choice variable to maximize over. The predetermination of  $D_t$  implies a value for  $C_t$  and period  $t$  utility before that period actually arrives. The first-order conditions relate the marginal utility of  $C_t$  and  $D_t$  consumption within each period. There is no relation between marginal utilities across time as a result of our assumptions regarding the budget constraint.

### The Utility Function

To proceed any further in analyzing consumer behavior in our model, a functional form must be imposed on utility:

$$u = C_t - \frac{1}{2} C_t^2 + D_t - \frac{1}{2} D_t^2.$$

Thus, utility is quadratic in both its arguments, which are then simply summed. The first-order equations can now be rewritten:

$$E_t (C_{t+1}) = D_{t+1}.$$

The consumer chooses  $D_{t+1}$  to equal  $C_{t+1}$  in expectation. Solving for  $D_{t+1}$  through the budget constraint reveals:

$$D_{t+1} = \frac{E_t(Y_{t+1})}{2}.$$

### The Income Process

To reveal the dynamics of the specified model, it is necessary to make some assumptions regarding the nature of the income process. A convenient assumption is that income follows a random walk so that next period's income is current income plus a normally distributed mean-zero error and current income is the best predictor of future income:

$$Y_{t+1} = Y_t + \varepsilon_{t+1}.$$

Thus,

$$E_t(Y_{t+1}) = Y_t,$$

$$D_{t+1} = \frac{Y_t}{2},$$

and

$$C_{t+1} = \frac{Y_t}{2} + \varepsilon_{t+1}.$$

Consumption of good  $D$  in period  $t+1$  is determined by the consumer's best guess of next period's income. The variation from this expectation,  $\varepsilon_{t+1}$ , must be fully borne by  $C_{t+1}$  due to the pre-committed contractual nature of  $D_{t+1}$ . Income innovations only affect  $C_t$  in the period that they occur.

### Poverty Line Defined Over Food Insufficiency

Hereafter, to concentrate on food sufficiency outcomes, we restrict  $C_t$  to include food alone. Akin

to our earlier models, suppose now that there is a minimum sufficient level of  $C_t$  and  $D_t$  consumption that sum to the minimum sufficient income,

$$\underline{C} + \underline{D} = Z.$$

Allow  $\gamma$  to represent the proportion of this minimum budget that must be spent on food, so that:

$$\underline{C} = \gamma Z,$$

and then,

$$\underline{D} = (1 - \gamma)Z$$

### When Food Insufficiency and Above Poverty Line Income Occur Simultaneously

A household is food sufficient in period  $t+1$  if  $\underline{C}$  exceeds  $C_{t+1}$ , which implies:

$$\gamma Z - \frac{1}{2}Y_t > \varepsilon_{t+1}.$$

A household's income is above the poverty line if  $Y_{t+1}$  exceed  $Z$ , which implies:

$$\varepsilon_{t+1} > Z - Y_t.$$

Together the two inequalities imply a range of  $\varepsilon_{t+1}$  over which period  $t+1$  income exceeds the poverty level simultaneously with  $C_{t+1}$  being below its sufficient level  $\underline{C}$ :

$$\gamma Z - \frac{1}{2}Y_t > \varepsilon_{t+1} > Z - Y_t.$$