The Monthly Food Stamp Cycle: Shopping Frequency and Food Intake Decisions in an Endogenous Switching Regression Framework[1]

Mean food spending by food stamp households peaks sharply in the first three days after benefits are received. For those who conduct major grocery shopping trips only once per month (42 percent of all food stamp households), mean food energy intake drops significantly by the fourth week of the month. For the remaining households, intake remains steady over the month. Therefore, an empirical model simultaneously accounts for shopping frequency and food intake decisions over time.

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This paper makes two contributions to the study of food demand by U.S. food stamp recipients. First, it employs nationally representative data to describe and measure monthly cycles in food expenditure and food intake. Second, because the food intake cycle is found to depend on the frequency of major grocery trips, the paper develops and estimates an econometric model of consumers' simultaneous shopping frequency and food intake decisions in two halves of the food stamp month. The econometric results suggest implications for policies that affect the frequency of grocery shopping.

Understanding the monthly food stamp cycle is important for policy-makers, who are concerned about periodic or episodic hunger among low-income Americans (Food and Consumer Service, 1994). It is also important for applied economists, because ignoring this type of cycle can induce inefficiency in food demand estimates using survey data where food expenditure or food intake information is collected for short periods (Fraker, 1990). For econometric models with limited dependent variables, which account for the "kink" in the budget constraints of food stamp recipients (Moffitt, 1989; Wilde & Ranney, 1996), ignoring the food stamp cycle may produce biased estimates as well.

The need for further research on the food stamp cycle has been identified previously. In his 1990 review of the literature on the Food Stamp Program, Fraker observed, "Despite the fact that it may enhance our understanding of why econometric studies show that food stamps have a much larger effect on food use than does cash income, research on the existence and nature of this cycle has been scarce."

Data Sources

The analysis here uses expenditure data from the Consumer Expenditure Diary Survey (CEX) for 1988-1992 and intake data from the Continuing Survey of Food Intakes by Individuals (CSFII) for 1989-1991. The CEX reports each household's daily expenditures over one or two weeks. The CSFII reports each individual's daily food intake over three days. The descriptive results below employ these individual food intake data from the CSFII. However, these data are aggregated to the household level for the econometric analysis, because all income variables and many demographic variables are only known at the household level. The main dependent variable in the econometric analysis is household food energy intake as a proportion of the Recommended Dietary Allowance (RDA) for food energy. This dependent variable is calculated as the sum of all members' food energy intake divided by the sum of all members' reference food energy intake levels in the RDA, where each member's reference level is based on that member's age, sex, and pregnancy/lactating status.

Both surveys report the date on which food stamps were most recently received and the dates to which food expenditure or intake data refer, so the number of days since food stamps were received can be calculated by subtraction. Therefore, although the data are cross-sectional, we can measure patterns in mean expenditure and intake over the food stamp month.

The number of observations from the CEX is large (2,875 food stamp consumer unit observations on 12,308 days with complete information). These expenditure data allow adequately precise comparisons of mean food expenditure on each day of the food stamp month. The number of food intake observations from the CSFII is smaller (the descriptive results use observations for 1,516 individuals and the econometric estimation uses

observations for 617 food stamp households with complete information). The food intake sample sizes place limits on how finely we may subdivide the sample. The descriptive results below report food intake for each of the four weeks of the month, and the econometric work divides the month into two halves

Monthly Patterns in Mean Food Expenditure and Food Intake

The monthly pattern in mean food expenditure is striking (figure 1). Mean daily expenditure per person on food at home peaks sharply in the first three days of the food stamp month and flattens out at a much lower level for the remainder. Foods that are purchased proportionately most heavily at the start of the month include some that are easily stored for consumption throughout the month, such as grains or canned vegetables, and some foods that are relatively perishable and probably represent some degree of splurging, such as seafood and miscellaneous dairy.

The monthly pattern in food intake is more moderate, and it depends on how frequently the household conducts major grocery shopping trips (figure 2). Households that conduct a major grocery shopping trip more frequently than once per month are defined as "frequent" shoppers. Households that conduct such trips once per month or less frequently are defined as "infrequent" shoppers. For frequent shoppers, mean food energy intake remains steady during the four weeks of the food stamp month. For infrequent shoppers, mean food energy intake falls from 83.0 percent of the RDA in first week to 73.4 percent of the RDA in the fourth week. A t-test finds that the difference between food energy intake in the first and fourth weeks is statistically significant at the .05 level.

The food intake pattern for infrequent shoppers is notable, because food stamp recipients are more likely than low-income nonrecipients to be infrequent shoppers. Using the CSFII data, 42 percent of food stamp households were classified as infrequent shoppers. Only 16 percent of a comparison group of low-income nonrecipients were classified as infrequent shoppers. This comparison is imperfect, because even low-income nonrecipients may have higher average incomes than food stamp recipients, but the large difference in shopping patterns is suggestive. The main descriptive result, which motivates the analytic work to follow, is that frequent shoppers appear to avoid monthly cycles in food energy intake through successful food purchase and storage behaviors, but infrequent shoppers experience a significant drop in food energy intake at the end of the food stamp month.

Figure 1
Food Expenditure by Consumer Units, At-Home and Away-From-Home

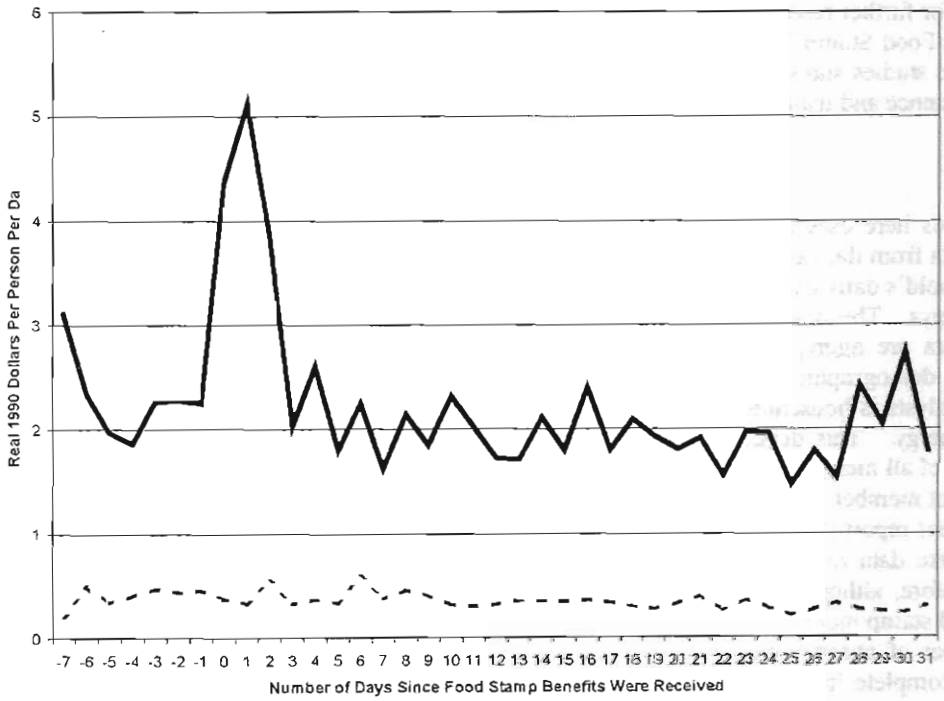
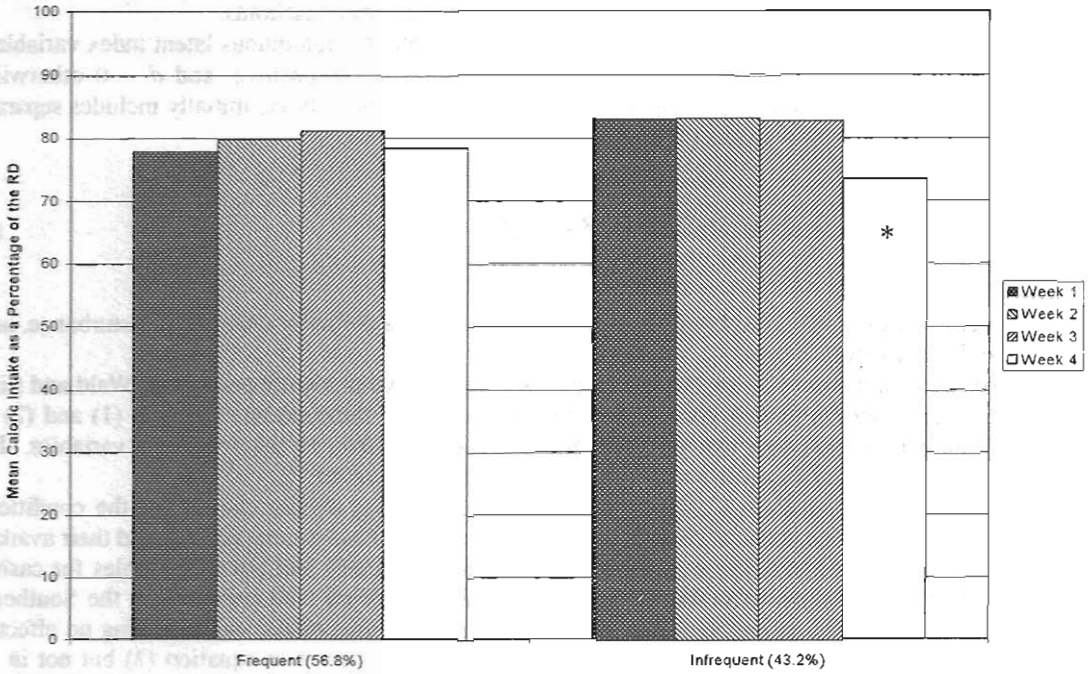


Figure 2
Food Energy Intake by Individuals, According to Shopping Frequency



Theoretical and Econometric Approach

The direction of causation for this relationship between food shopping and food intake is not obvious. It has been suggested that some households may experience low food intake at the end of the month because they were not "frugal" enough to save their food stamp resources for a longer period. Alternatively, we suggest that households facing transportation difficulties, time constraints, or stigma may choose to conduct a major grocery trip with food stamps only once monthly, and they may have trouble storing food for consumption four weeks later as a consequence. The theory employed here supposes that consumers weigh the disadvantages of frequent major grocery trips (loss of leisure time, stigma, etc.) against the advantages (less food spoilage, less need for smaller trips to closer, higher-priced stores toward the end of the month). This theory supports a tractable econometric model: an endogenous switching regression model where the consumer simultaneously chooses a shopping frequency regime and food intake levels in each half of the month. Details of the linkage between the theoretical and empirical specifications are available in Wilde and Ranney (1999), but the structure of the main econometric model may be explained briefly here.

We consider two time periods (t=1,2), representing the two halves of the food stamp month, and two shopping regimes (d=0,1), respectively denoting "infrequent" and "frequent" shopping patterns. We estimate regression equations for household food energy intake (defined in the data section above) under the two shopping regimes and, simultaneously, an equation reflecting the household's choice of one shopping regime or the other. Some unobserved household characteristics that affect the shopping regime decision may also affect food intake, so in principle the error terms in these regression equations may be correlated. Thus, the equations are estimated jointly by maximum likelihood.

We begin with a specification for the food intake functions that permits nonlinear (quadratic) Engel curves and distinct marginal effects for food stamp benefits (S) and cash income (C):

$$F_t^d = \beta_t^{0d} + \beta_t^{1d} S + \beta_t^{2d} S^2 + \beta_t^{3d} C + \beta_t^{4d} C^2 + \beta_t^{5d} Z^f + \varepsilon^d \qquad (1)$$

where Z^f is a vector of the observed household characteristics that affect food intake, ε^f is a normally distributed disturbance, and the βs are parameters to be estimated. For notational convenience, we suppress a subscript i indicating that each independent variable and disturbance may differ across households.

The regression equation for the shopping regime choice employs a continuous latent index variable (V^*), as in a probit model. The dichotomous regime choice is $d = 1$ when V^* is positive, and $d = 0$ otherwise. The functional form for the regime choice equation, like the food intake equation above, initially includes separate linear and quadratic terms for food stamp benefits and cash income:

$$V^* = \gamma^0 + \gamma^1 S + \gamma^2 S^2 + \gamma^3 C + \gamma^4 C^2 + \gamma^5 Z^f + \gamma^6 Z^r + \varepsilon^r \qquad (2)$$

where Z^r is a second vector of observed household characteristics. ε^r is a normally distributed disturbance, and the γs are parameters to be estimated.

We also consider a more parsimonious special case. Using asymptotically equivalent Wald and Likelihood Ratio statistics, we consider the joint hypothesis that the parameters on the quadratic terms in (1) and (2) are zero and that food stamp benefits and cash income have the same marginal effect on the dependent variables. Based on these hypothesis tests, this special case is chosen as our preferred specification.

The independent variables in Z^f, which affect both the shopping regime choice and the conditional food intake functions, were chosen on grounds of their usefulness in previous food stamp research and their availability in the data set. They include household size in adult male equivalents (AME) and binary variables for cash welfare receipt, female headship, participation in the WIC program, urban residence, and residence in the Southern states. The vector Z^r includes independent variables that affect the shopping regime choice, while having no effect on food intake conditional on the shopping regime choice. This vector, which appears in equation (2) but not in equation (1), is required to avoid nonlinear identification that relies entirely on the normality assumption in the specification of the stochastic terms. The only variable in the CSFII that could be assigned to Z^r *a priori* is the distance to the grocery store where major grocery shopping trips occur.

Econometric Results

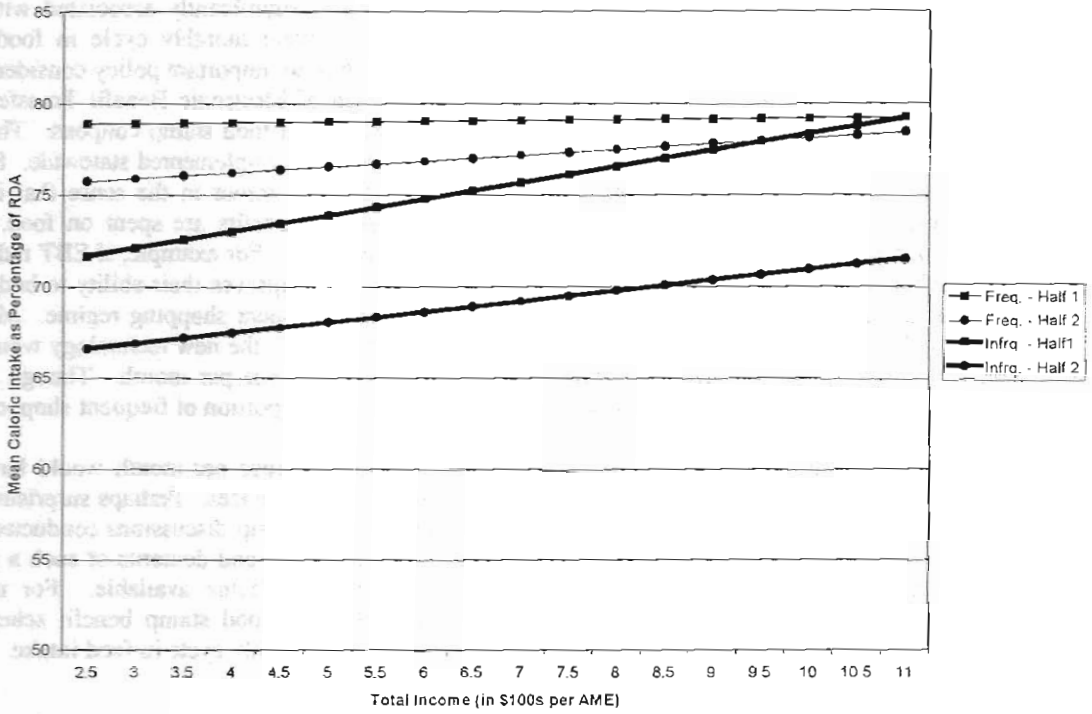
This section presents results for the final specification discussed above, which has identical food stamp and cash income effects and no quadratic terms. Parameter estimates for food energy intake under the two shopping regimes appear in table 1. There are four parameters for the effects of total monthly income (food stamp benefits plus cash income). Each parameter represents the marginal effect of total income on a latent food intake variable for a particular shopping regime in a particular half of the month. These parameters may in principle differ from the marginal effect of total income on expected food intake for participants who are actually observed in the two shopping regimes, because the latter marginal effect requires an adjustment for self-selection into shopping regimes. As we report below, however, the estimated covariances that would indicate such self-selection are not statistically significant.

Table 1
Regression Estimates for Food Energy Intake Under Two Grocery Shopping Regimes

	Regime 0 (R0)			Regime 1 (R1)		
	Estimates		Std. err.	Estimates		Std. err.
Dum: 1st Half Month	56.437		14.667	77.658		5.940
Dum: 2nd Half Month	52.144		14.867	73.830		6.072
Total Income * 1st Half	0.890		0.785	0.041		0.429
Total Income * 2nd Half	0.580		0.464	0.317		0.378
Household Size	4.797	**	1.488	0.364		1.229
Dum: Welfare	1.063		3.583	6.281	**	2.913
Dum: Female Head	2.591		3.781	-0.227		2.895
Dum: WIC	8.420	**	3.584	6.573	**	3.282
Dum: Urban	0.761		3.043	-5.474	**	2.550
Dum: South	1.207		3.375	-3.100		2.854

Data: Continuing Survey of Food Intake by Individuals, USDA.
Note: * Indicates significant at alpha=.10, one-tailed test. ** Significant at alpha=.05.

Figure 3
Engel Curves for Food Energy Intake in Each Time Period and Shopping Regime



For the frequent shopping regime (Regime 1). the marginal effects of total income on latent food intake in the two periods are positive but very near zero and not statistically significant. The p-values for one-tailed z-tests of the null hypotheses that the true parameters are zero are 0.46 for the first half of the month and 0.20 for the second half. Thus, food energy intake does not appear to increase with additional total income under the frequent shopping regime. For the infrequent shopping regime (Regime 0). the estimated marginal effects of total income on latent food energy intake in the two periods are positive and larger than the comparable parameters under Regime 1. although they still fail to register as statistically significant at conventional levels. The p-values for one-tailed z-tests of the null hypotheses that the true parameters are zero are 0.13 for the first half of the month and 0.11 for the second half. Thus, we cannot rule out sampling variation as an explanation for this observed effect.

The four Engel curves corresponding to these results are illustrated in figure 3, where total income varies from approximately the 10^{th} percentile to the 90^{th} percentile of the low-income sample and other variables are held constant at their mean values. The frequent shopping regime has the highest levels of predicted latent food energy intake at all levels of total income. The infrequent shopping regime has lower predicted latent food energy intake in both halves of the month. The fall in food intake from the first half of the month to the second is greater under the infrequent shopping regime than under the frequent shopping regime.

The parameter estimates for the regime choice equation (2) are not displayed here. but the main results are as follows. Cash welfare participation. female headship. urban residence. residence in the U.S. South, and increased distance to "major" grocery store each significantly reduces the probability of shopping frequently. By contrast, although parameter estimates for total income and household size are positive. as one might expect. they are not significantly different from zero. The final category of econometric results concerns the cross-equation covariances between the error terms in the regime choice and food intake equations. These covariances are small and not significantly different from zero. Thus. although one could not have known so ahead of time. endogenous self-selection into the two shopping regimes did not prove an important consideration in the empirical estimation.

Policy Implications

This research focuses attention on how policies that affect shopping frequency could in turn affect the monthly cycle in food intake for food stamp recipients. For example, municipalities often express concern about

attracting or retaining supermarkets in low-income urban areas. In terms of our econometric model, such policies affect the distance households must travel to the store where they conduct their major grocery shopping. The econometric results suggest that increased distance to the grocery store is significantly associated with lower probability of choosing the frequent shopping regime, which has a less severe monthly cycle in food intake. However, the magnitude of this effect in our estimates is not large enough to be an important policy consideration.

A policy with potentially greater impact is the recent introduction of Electronic Benefit Transfer (EBT) systems, using plastic cards akin to automatic teller cards, in place of traditional food stamp coupons. Thirty-five states and the District of Columbia use EBT systems, and 27 of these systems are implemented statewide. From the point of view of traditional consumer demand theory, this change might seem minor in the sense that it affects neither total household resources nor the legal requirement that food stamp benefits are spent on food. In the framework of this paper, however, certain features of EBT seem more important. For example, if EBT reduces the stigma associated with using food stamps, reduces recipients' fear of theft, or improves their ability to budget over the month, one might anticipate an increase in the propensity to choose the frequent shopping regime. Moreover, because the routine updating of benefits is implemented electronically under EBT, the new technology would make it less expensive to deliver benefits in smaller portions more frequently than once per month. Though research would be required to demonstrate so, we would foresee a sharp increase in the proportion of frequent shoppers under such a policy.

The potential advantages of updating food stamp benefits more than once per month would have to be weighed against the restrictions it might place on household budgeting and preferences. Perhaps surprisingly, this change was recommended by some food stamp recipients themselves in focus group discussions conducted as part of a food stamp cash-out experiment in San Diego (Ohls et al., 1992). The merits and demerits of such a proposal would be a worthwhile topic of future research as post-EBT data sources become available. For now, the contribution of this paper is to suggest that policy instruments other than the food stamp benefit schedule are available to influence shopping frequency and, as a consequence, to affect the monthly cycle in food intake.

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Endnotes

[1] This paper is excerpted with permission from a forthcoming article in the American Journal of Agricultural Economics (Wilde & Ranney, 1999). The reader is referred to the full article for further details that have been omitted for reasons of space. This research is based originally on several sections from Wilde's 1998 dissertation in the Department of Agricultural, Resource, and Managerial Economics (ARME) at Cornell University.

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