U.S. Food Expenditures Away From Home by Type of Meal

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Working Paper 95-WP 143
December 1995

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The authors thank three anonymous reviewers for helpful comments and suggestions. This paper was Journal Paper No. J-16194 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 2851.

ABSTRACT

A nonnormal and heteroskedastic double-hurdle model is used to study household expenditures on breakfast, lunch, and dinner away from home in the United States. In the 1992-93 period, nearly 40 percent of households purchased breakfast, and about 75 percent of households purchased lunch or dinner in a two-week period. Wife's employment has a positive effect on the probability and level of lunch and dinner expenditures but not on breakfast expenditures. Income effects are all statistically significant and positive. The role of household composition, other demographics, and region are also important.

U.S. FOOD EXPENDITURES AWAY FROM HOME BY TYPE OF MEAL

Expenditures for food away from home (FAFH) constitute a relatively large share of the household food budget in the United States. Since the late 1970s, expenditures on FAFH have represented about 4.5 percent of disposable personal income and maintained that share until 1990, in the face of a continuing decrease in the share of the overall budget going to food (Putnam and Allshouse 1993). Since 1990 the FAFH share of disposable personal income has fallen to 4.2 percent, or $184 billion in 1992. This represented 36.5 percent of total food expenditures in 1992. In Canada, the FAFH share of household food budget has increased steadily to a level of more than 32 percent of total food expenditures in 1992 (Agriculture and Agri-Food Canada 1995).

Several recent studies have considered the reasons behind the growing importance of food prepared away from home (Kinsey 1983; Kolodinsky 1987; Reynolds and Goddard 1993; Yen 1993). Among the factors often identified are rising income, increased female labor-force participation, changes in household demographics, changes in lifestyle, and the expanded availability and variety of foods in fast-food establishments (Manchester 1992). A better understanding of the factors associated with FAFH has become increasingly important to explain changes in the food market, anticipate implications of changes in eating patterns on dietary quality, design effective nutrition intervention programs, and understand factors that motivate consumer behavior related to food choices.

Several researchers have investigated household expenditures of FAFH in total (Soberon-Ferrer and Dardis 1991; Yen 1993) and by types of facility (McCracken and Brandt 1987) in the United States. One aspect of the FAFH market not addressed in these studies is that FAFH purchases may differ by type of meal. Differences might be expected because some food items are consumed at certain meals and times of day but not traditionally at others. In addition, households also face varying constraints on time-use by time of day and by location of activities (e.g., work and school location). Recently, Reynolds and Goddard (1993) examined the determinants of FAFH for Canada both by types of facilities and by types of meal; their results indicate that household choices on FAFH differ by type of meal.

This paper investigates household expenditures on FAFH by type of meal in the United States. We use a relatively straightforward economic behavioral model, based on a household production framework that accounts for constraints on the availability of time as well as income as determinants of consumer choice.

One common feature of almost all of the recent FAFH studies is the use of limited dependent variable models to accommodate the observed zero expenditures in the sample. Except for Yen (1993), these studies are all based on the Tobit model (Tobin 1958). As is well known, however, the Tobit model has relatively restrictive parametric and distributional assumptions that limit its potential application for empirical analysis. Within the Tobit model structure, Reynolds and Goddard (1994) correct for heteroskedasticity of errors. A more general approach used by Yen (1993) employs the Box-Cox double-hurdle model, which features more flexible parameterization and distributional assumptions than the Tobit. However, as in traditional regression models, the Box-Cox transformation has drawbacks, as discussed below. In this paper, we consider an alternative transformation for the double-hurdle model that is free from the drawbacks of the Box-Cox double-hurdle model. The current study differs from Yen (1993) in several ways: (a) alternative distributional assumptions are considered in the double-hurdle model; (b) FAFH expenditures are investigated by type of meal; and (c) the sample is more carefully selected. Data for the period 1992-93 are used in the analysis.

Empirical Specification

The demand for FAFH and its components can be derived from household production theory (Michael and Becker 1973). In household production theory, broadly defined commodities enter the household utility function, which are maximized subject to the household production function, full-income constraint, and time constraint. Here, we consider the commodities (meals) produced by market purchased FAFH and time. Solving the constrained utility maximization problem, the demand for FAFH is a function of market prices, wage rates, non-wage income, and other sociodemographic variables. However, as is common in other cross-sectional surveys, information on market prices was not available in the data used (the U.S. Bureau of Labor Statistics Consumer Expenditure Diary Surveys). However, regional and seasonal variables are likely to account for much of the price variation. In addition, demographics such as education are expected to account for the variations in wage rates, which are not directly available from the survey (Bryant 1988). Therefore, the expenditure equation for FAFH is specified as

$$E_i = E_i(h, v, d\ ), \qquad (1)$$

where E_i is expenditure on meal i, h is wife's labor hours, v is nonwage income, and $\boldsymbol{d}$ is a vector of demographic and other variables. The specification of expenditure equation (1) is very common in studies of household consumption of FAFH and other service goods (Bryant 1988; Yen 1993). Household expenditures on breakfast (including brunch), lunch, and dinner away from home during a two-week period are used as the dependent variables.[1]

One primary explanatory variable of interest is wife's labor hours. Female household heads (wives in the case of married couples) have traditionally been the primary food preparers and, in recent U.S. food surveys, represented more than 75 percent of self-identified "main meal preparers," hence the inclusion of wife's market labor hours. However, wife's labor hours have been found to be endogenous in FAFH consumption. The use of observed labor hours, when not recognizing such endogeneity, causes simultaneous equation bias (Bryant 1988). In order to avoid potential problems with such bias, wife's labor supply equation is estimated with ML Tobit and the predicted labor hours are used as an explanatory variable.[2]

Besides the employment variable, the other explanatory variables used include income, household composition, and binary variables indicating wife's education, home ownership, race, season, and region. Income includes nonwage income and husband's wage earnings. Income and household composition have been important determinants of FAFH expenditures in previous studies (Soberon-Ferrer and Dardis 1991; Yen 1993). The education variables are included to accommodate differences in preferences and household market efficiency (Michael and Becker 1973); they are also used as proxies for wage rates (Bryant 1988). Other socio-demographic variables for household preferences include home ownership, race, season, and region. Homeowners may consume more FAFH because of higher income (and assets) and greater financial stability. However, despite the high income, homeowners may have lower cash flow for a given income or better facilities (i.e., fixed inputs) for home preparation of meals. Previous results on the effects of home ownership have been mixed (Soberon-Ferrer and Dardis 1991; Yen 1993).[3] Race is included to control for tastes and preferences. Seasonal and regional dummies often reflect price and other variations in a single cross-section. The set of explanatory variables selected are similar to those commonly found important in previous studies of FAFH.

Statistical Model

As is typical in many cross-section surveys, the data used in this study contain zero values in the dependent variables. For cross-sectional demand analysis with zero observations, the double-hurdle model has become increasingly popular (Gould 1992; Haines, Guilkey, and Popkin 1988). The double-hurdle model, specified by Blundell and Meghir (1987), is characterized by a probit mechanism which determines participation in the market, and a Tobit mechanism which generates zeros for true non-consumers (i.e., corner solutions in consumer choice). For positive consumption to occur, two hurdles have to be overcome: to participate in the market, and to actually consume. Thus, the double-hurdle model can be expressed by a participation equation, $\boldsymbol{z}_t\boldsymbol{\alpha} + v_t$, and a consumption equation, $\boldsymbol{x}_t\boldsymbol{\beta} + u_t$, such that

$$
\begin{aligned}
y_t &= x_t\beta + u_t \quad \text{if} \quad z_t\alpha + v_t > 0 \quad \text{and} \quad x_t\beta + u_t > 0 \\
&= 0 \qquad \text{otherwise} ,
\end{aligned}
\tag{2}
$$

where y_t is the observed dependent variable, $\boldsymbol{z}_t$ and $\boldsymbol{x}_t$ are vectors of explanatory variables accounting for participation and consumption respectively, and the error terms u_t and v_t are independent and are distributed as $u_t \sim N(0,\sigma_t)$ and $v_t \sim N(0,1)$. By allowing separate stochastic processes to determine participation and consumption, the double-hurdle model relaxes one of the most restrictive features of the Tobit model.

In empirical applications, the double hurdle model (2) is often estimated based on assumptions of homoscedasticity and normality of the error terms u_t and v_t. However, maximum-likelihood (ML) estimation produces inconsistent parameter estimates when either assumption is violated (Arabmazar and Schmidt 1981, 1982). To allow for nonnormal errors, one approach is to transform the dependent variable to accommodate the nonnormal error structure. For instance, Yen (1993) incorporates the Box-Cox transformation of the dependent variable in the double-hurdle model. However, a number of drawbacks are associated with the Box-Cox transformation. First, the transformed random variable cannot strictly be normal unless the Box-Cox parameter equals zero; such inherent nonnormality is known to cause inconsistency in traditional regression models (Amemiya and Powell, 1981) and may be of equal concern in limited dependent variable models. In addition, the transformation cannot be used on random variables that can take on negative values. Finally, the transformation is not scale-invariant and therefore empirical results may vary with the unit of measurement. To overcome these drawbacks, we consider the inverse hyperbolic sine (IHS) transformation (Burbidge, Magee, and Robb 1988)

$$
\begin{aligned}
y_t(\theta) &= \log[\theta y_t + (\theta^2 y_t^2 + 1)^{1/2}] / \theta \\
&= \sinh^{-1}(\theta y_t) / \theta ,
\end{aligned}
\tag{3}
$$

where θ is an unknown parameter. The transformation is linear when θ approaches zero and behaves logarithmically for large values of y_t. It is also known to be well suited for handling extreme values (Burbidge, Magee, and Robb 1988). More importantly, the transformation is scale-invariant (MacKinnon and Magee 1990). By applying the IHS transformation to the dependent variable y_t in (2), the IHS double-hurdle model can be expressed as

$$y_t(\theta) = x_t\beta + u_t \quad \text{if} \quad z_t\alpha + v_t > 0 \quad \text{and} \quad x_t\beta + u_t > 0$$
$$= 0 \qquad \text{otherwise} . \tag{4}$$

Based on the assumption of independent errors (u_t and v_t), the sample likelihood function for an independent sample is

$$L = \prod_{y_t=0}\left\{1 - \Phi(z_t\alpha)\Phi\left(\frac{x_t\beta}{\sigma_t}\right)\right\}\prod_{y_t>0}\left\{\Phi(z_t\alpha)\frac{1}{\sigma_t}\phi\left[\frac{y_t(\theta) - x_t\beta}{\sigma_t}\right]\frac{1}{\left(1+\theta^2 y_t^2\right)^{1/2}}\right\}. \tag{5}$$

In (5), the term $(1 + \theta^2 y)^{-1/2}$ is the Jacobian of transformation from $y_t(\theta)$ to y_t. When $\theta = 0$, the IHS transformation (3) reduces to the linear form (Burbidge, Magee, and Robb 1988), the Jacobian of transformation vanishes, and the likelihood function (5) reduces to that of the standard double-hurdle model (Blundell and Meghir 1987). Analytic derivatives of the log-likelihood function, used in the numerical optimization, are available upon request from the authors.

To overcome the restrictions of homoscedasticity, the standard deviation σ_t is allowed to vary across observations and is specified as a function of exogenous variables $\boldsymbol{w}_t$

$$\sigma_t = \exp(w_t\gamma) , \tag{6}$$

where γ is a parameter vector. The parameters of the model ($\boldsymbol{\alpha}$, $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and θ) can be estimated by the ML method.

The nonlinear (IHS) transformation of the dependent variable, the heteroscedastic error specification, and the double-hurdle parameterization all complicate the interpretation of parameter estimates and, hence, the ability to easily evaluate the effects of explanatory variables on the dependent variable. This can be overcome by decomposing the unconditional mean of the dependent variable y_t into the probability of a non-zero outcome and the conditional mean of y_t. The decomposition of the unconditional mean is similar to that of McDonald and Moffitt (1980) for the standard Tobit model. The probability of a positive outcome is

$$P(y_t > 0) = \Phi(z_t\alpha)\ \Phi\left(\frac{x_t\beta}{\sigma_t}\right). \tag{7}$$

Due to the IHS transformation considered in this study, however, the conditional mean of the dependent variable does not have a closed form. The conditional mean of y_t is
and the unconditional mean of y_t is

$$E(y_t \mid y_t > 0) = \left[\Phi\left(\frac{x_t\beta}{\sigma_t}\right)\right]^{-1}\int_0^{\infty} y_t\frac{1}{\sigma_t}\phi\left[\frac{y_t(\theta) - x_t\beta}{\sigma_t}\right]\frac{1}{(1+\theta^2 y_t^2)^{1/2}}dy_t \tag{8)}$$

$$E(y_t) = E(y_t \mid y_t > 0)\, P(y_t > 0). \tag{8}$$

The elasticities can be derived by differentiating these components of the dependent variable. These elasticities can be evaluated using numerical integration and differentiation.

Data and Sample

The sample for the present study was drawn from the U.S. Bureau of Labor Statistics 1992 and 1993 Consumer Expenditure Diary Surveys (U.S. Department of Commerce 1992, 1993). Each year the Diary Survey is conducted on sampled consumer units during two consecutive one-week periods. For this study, the two-week information for each household was collapsed into one observation. Households with only one week of complete information are excluded.[4]

One focus of the current study is on the effect of wife's employment on household consumption of FAFH. Therefore, the sample is limited to husband-and-wife households. Single-person households and other households without a wife present are excluded because wife's employment is not defined in these households. Also excluded are households with missing information for the explanatory variables discussed above. The use of husband-and-wife households is common in studies of time-saving service goods (Bryant 1988; Soberon-Ferrer and Dardis 1991; Yen 1993). However, the sample used in the present study is less restrictive than that used in these previous studies and includes households with non-working husbands as well. By freeing the selection of sample from the potentially endogenous employment choices, one also avoids an important source of sample selection bias.[5]

The final sample contains 4113 observations, of which 2083 come from the 1992 Diary Survey and 2030 from the 1993 Diary Survey. Of the final sample, 1611 households (or 39.17 percent) reported expenditure on breakfast, 3149 (76.56 percent) on lunch, and 3025 (73.55 percent) on dinner away from home during the two-week period. The high proportion of non-consuming households for each meal suggests that standard statistical procedures such as ordinary least-squares are unlikely to produce reliable results. The sample statistics of FAFH expenditures by meal type are presented in Table 1, and the sample statistics of all explanatory variables are presented in Table 2.

Empirical Results

The IHS double-hurdle model for each meal was estimated by maximizing the log-likelihood function. One major specification issue in estimation of the models was selection of the first-hurdle and second-hurdle regressors. Such selection is often difficult because the number of variables is typically limited and theory provides little guidance. For each meal, the complete list of regressors discussed above are included in the expenditure equation. Because exclusion conditions are often important for estimation of such models (Jones 1992), a subset of these regressors are included in the participation equation. In particular, regional dummies for urban areas of the Northeast, Midwest, South, and West are excluded from the participation equation; such exclusion was supported by a likelihood ratio test for each meal.[6]

Another specification issue relates to the choice of variables in the heteroscedastic equation (6). We consider all continuous variables as potential candidates, and the household composition variables are finally selected and included in the heteroscedastic equation. Because wife's predicted labor hours is used as a regressor in both the participation and the consumption equations, the variance-covariance matrix of parameter estimates is adjusted for heteroscedasticity caused by the predicted regressor (Yen 1993).

Table 3 presents the ML estimates for all three meals. Most of the variables are statistically significant. For all meal groups considered, the IHS parameter (θ) is significantly different from zero, which indicates the condition of nonnormality in the expenditure data and justifies the need for the transformation. In addition, for each meal, a number of household composition variables are statistically significant in the heteroscedasticity equation. Thus, both the normality and homoscedasticity assumptions are rejected.

A number of variables appear to affect participation and consumption differently. For instance, homeowner status and one of the household composition variables (age $\geq$ 65) have conflicting signs in the participation and consumption equations for breakfast. Opposite effects are also observed for age 19-44 on lunch and similar, though weaker (i.e., insignificant), patterns are also observed for a number of other variables. The opposing signs of variables highlight one of the advantages of the double-hurdle over the Tobit parameterization and the importance of examining the effects of variables by elasticities. As discussed below, opposite effects of variables are also reflected in the elasticities.

Table 4 presents the elasticities of probability, conditional level, and unconditional level with respect to continuous explanatory variables. Also presented are the standard errors for elasticities, derived by mathematical approximations (Yen 1993). Overall, these elasticities suggest that income and household demographics are important factors in FAFH consumption. The effects of some of these variables are consistent across all meal types, although the elasticities differ.

The number of pre-school children (age $\leq$ 6) decreases both the probability and level of expenditures on all types of meals away from home. The negative effects of pre-school children are consistent with findings by Reynolds and Goddard (1993) for Canada, and by Soberon-Ferrer and Dardis (1991) for total FAFH in the United States. The number of school-age children (age 7-18) has negative effects on breakfast but positive effects on lunch; these positive effects on lunch expenditure away from home are obviously related to school lunches. The numbers of family members age 19-44 and 45-64 have significant and positive effects on the conditional level of lunch expenditure, but a negative effect on the probability to consume dinner away from home. These two age categories include mainly household members in the work force and therefore positive effects of these variables are expected on lunch away from home. The number of family members of age over 65 has significant and negative effects on the probabilities to consume all types of meal away from home. Interestingly, the effect of this variable on the conditional level of lunch away from home is significant and positive, suggesting that once a decision is made to consume, the number of older members in the household increases the expenditures on lunch away from home.

The effects of income on probability and levels are significant and positive for all types of meal. The magnitude of the income elasticities differs slightly across meal types but, overall, these income elasticities are relatively small. For instance, a one-percent increase in income increases the probability of consuming dinner away from home by 0.10 percent, the conditional level by 0.17 percent, and the unconditional level by 0.26 percent. The positive effects of income on FAFH expenditures are in agreement with findings from previous studies in the United States (McCracken and Brandt 1987; Soberon-Ferrer and Dardis 1991; Yen 1993), and in Canada (Reynolds and Goddard 1993). In terms of magnitudes, the income elasticities differ from findings by McCracken and Brandt (1987), Reynolds and Goddard (1993), and Yen (1993) on total FAFH expenditure. In particular, our elasticities of probability of consuming each meal with respect to income are slightly higher, whereas the elasticities of conditional level are slightly lower, than the corresponding elasticities for total FAFH reported by Yen (1993). McCracken and Brandt (1987) reported a higher elasticity of probability, and lower elasticity of conditional level, with respect to income; these different elasticities may be related to the restrictive Tobit parameterization, however. In contrast, Reynolds and Goddard (1993) report much higher income elasticities for Canada. For instance, their elasticities of the unconditional level with respect to income are 0.47, 0.67, and 0.70 for breakfast, lunch, and dinner away from home, respectively.[7]

The effects of wife's employment are significant and positive on both the probability and level of expenditures on lunch and dinner away from home. Wife's employment does not play a significant role in breakfast expenditure away from home, however. Compared to earlier findings by Yen (1993) based on the 1989 data, these elasticities with respect to wife's employment are rather low. For instance, a one-percent increase in wife's labor hours increases the probability of consuming dinner by only 0.05 percent, the conditional level of expenditure on dinner by 0.08 percent, and the unconditional level by 0.13 percent. It may be that the increased availability of convenience "take-home" foods has led to changes in the market from 1989 to the period 1992-93.

It is sometimes argued that evaluating the effects of discrete variables by elasticities is not strictly correct. For each of the binary variables, the effects on probability, conditional level, and unconditional level of consumption are calculated as the finite changes in these components of consumption as the value of the variable changes from zero to one, *ceteris paribus*.[8] Table 5 presents the results. For example, relative to other groups, homeowners are about 5.8 percent more likely to consume breakfast and, conditional on consumption, spend $4.48 more per household during the two-week period. Overall, the effect on the unconditional level suggests homeowners spend $5.40 more per household during the two-week period. The effects of other dummy variables can be interpreted in the same manner.

Similar to findings by Soberon-Ferrer and Dardis (1991), but contrary to those by Yen (1993) on total FAFH, home ownership has significant and positive effects on the probability and levels of consumption of all types of meals away from home. The positive effects of home ownership may relate to the greater financial stability among home owners than others.

Overall, the effects of other variables differ across meal types. The effects of the education variables are particularly notable. Wife's education (high school and college) has significant and positive effects on both the probability and levels of consumption on all types of meals. Thus, households with a better educated wife are more likely to consume FAFH by all types of meal and, conditional on consumption, also spend more than others. Previous findings on the effects of education are mixed. Our positive effects of education are in agreement with findings by Reynolds and Goddard (1993) and Soberon-Ferrer and Dardis (1991), but differ from those reported McCracken and Brandt (1987) and Yen (1993), all on total FAFH. In particular, Soberon-Ferrer and Dardis (1991) report a positive effect of education and McCracken and Brandt (1987) find education insignificant. Yen (1993) reports that the better educated are more likely to consume FAFH but consume less conditional on consumption and consequently the effects of education on the unconditional level of consumption are insignificant due to cancellation.

Relative to others, white households are more likely to consume breakfast and dinner away from home and, conditional on consumption, also consume more. The positive effects of white are also consistent with previous findings by McCracken and Brandt (1987), Soberon-Ferrer and Dardis (1991), and Yen (1993) on total FAFH. We find that race does not play a role in the consumption of lunch away from home.

The regional dummy South has significant and positive effects on the probability and levels of consumption, suggesting that urban households in the South spend more on FAFH by all meal types, than do their rural counterparts. Positive effects are also observed for Midwest on breakfast and

dinner. The effects of regional dummies may reflect the effects of prices, among other contributing factors. Seasonal effects are relatively small and statistically insignificant.

Concluding Remarks

This study investigates FAFH consumption using an econometric model that accommodates zero observations in the sample. Parameterization of the model allows for separate decision processes on participation and level of consumption, and the stochastic specification accommodates nonnormality and heteroscedasticity of the error terms. Results suggest that the double-hurdle parameterization and the heteroscedastic and nonnormal error specification are all justified. Income effects are all statistically significant and positive. The roles of demographics and region are also important. Overall, the effects of most variables differ on the consumption of different types of meals away from home.

The fact that there are significant differences in the contribution of income and other demographic factors in predicting meal expenditure patterns is consistent with models of consumer behavior which recognize constraints on household members' time and differences in production of the household meal commodities. Although previous estimation of total FAFH captures the overall effects of income, wife's labor force participation and other demographics, the differences associated with the probability and the level of expenditure of specific meals suggest consideration of meals separately for the development of selected consumer education programs and specific marketing strategies targeted at food choices over food-away-from-home items. For example, the relatively high and positive (unconditional) elasticities for the age group with younger workers (19-44) at lunch suggest targeted marketing opportunities for expanded lunch away from home; the negative elasticities for children less than 18 for breakfast expenditures suggest that households with children are not likely groups to support an expanded away-from-home breakfast market. Convenience foods for preparation at home may better suit these households.

Whether these results continue to hold as lifestyles change and meal and snacking patterns evolve in response to changes in work and household demands is a question that cannot be resolved by the type of analysis presented here. Currently, the share of household food expenditure directed to away-from-home sources is relatively large, both in the U.S. and Canada. However, "take-out food" options have been increasing recently, meeting new needs for convenience without costs associated with time in consuming FAFH. The evidence presented here suggests that there are differences in the away-from-home market determined by time-of-day or meal type. As options are considered for collecting the type of data needed to describe food consumption and expenditures, both at home and away from home, increasing attention will need to be paid to the availability and form of products which meet consumers' interest in convenient food, and to appropriate representation of the sources and types of meals consumed.

ENDNOTES

1. Expenditures on items such as snacks, nonalcoholic beverages, catered affairs, and meals at boarding school away from home are excluded. School lunches are included in lunch, however.

2. Variables used in the labor supply equation are: number of children under seven years old, wife's age, husband's wage earnings, and dummy variables indicating wife's education (high school and college), race (white), home ownership, and regions. Prediction with the Tobit model is discussed in Maddala (1983). Parameter estimates of the labor supply equations are available from the authors.

3. Income and homeowner status (and possibly the education variables) could potentially be highly correlated. However, as discussed later, these variables are all significant and therefore multicollinearity may not present too much of a problem.

4. Another option, without excluding households with only one-week information, is to treat information from each week as a separate observation. The major problem with this approach is that the explanatory variables for each household do not vary from one week to the other. Consequently, without explicitly accounting for the error structure, variations in weekly consumption are picked up by the error terms, causing correlations among the errors.

5. Bryant (1988) and Yen (1993) exclude households with nonworking husbands. Soberon-Ferrer and Dardis limit the sample further to households with working husbands and wives, which allows the use of both husband and wife's employment variables. Given the

important role of employment in the consumption of FAFH, however, the exclusion of households with a nonworking husband or nonworking wife is unlikely to be random.

6. Estimation of the models without exclusion led to only a slight increase in the log-likelihood value. Parameter estimates from these alternative specifications are available from the authors.

7. Elasticities are not decomposed in Reynolds and Goddard (1993). In addition, the income variable they used includes wage earning of wives, where ours does not.

8. It is also useful to assess the significance of the effects of discrete variables. A discrete effect is considered statistically significant if the corresponding calculated "elasticity" (not reported here) is statistically significant.

Table 1. Sample statistics of FAFH by meal type (unit = U.S. $ per two weeks)

	Full sample		Consuming households		
Expenditure	Mean	Std. dev.	Mean	Std. dev.	N[a]
Breakfast	$4.54	$11.00	$11.58	$15.08	1611
Lunch	21.94	30.37	28.66	31.81	3149
Dinner	29.66	41.25	40.33	43.39	3025
Sample size	4113				

SOURCE: Compiled from BLS 1992 and 1993 Consumer Expenditure (Diary) Surveys.

[a] Size of consuming sample.

Table 2. Sample statistics of explanatory variables

Variable	Mean	Std. dev.
Household composition (no. of members)		
Age ≤ 6	0.60	1.06
Age 7-18	0.57	0.90
Age 19-44	1.22	0.98
Age 45-64	0.62	0.84
Age ≥ 65	0.37	0.74
Income (U.S.$00/2 wk.)	11.40	10.19
Wife's employment (hrs./wk.)		
Observed	20.67	19.66
Predicted[a]	19.35	11.11
Dummy variables (yes=1; no=0)		
Homeowner	0.74	
White	0.90	
Wife high-school educated[b]	0.48	
Wife college educated[c]	0.44	
Spring (reference)	0.25	
Summer	0.23	
Fall	0.26	
Winter	0.27	
Rural (reference)	0.13	
Urban		
Northeast	0.18	
Midwest	0.21	
South	0.27	
West	0.21	
Sample size	4113	

SOURCE: See Table 1.

[a] Predicted from ML Tobit estimates of wife's labor supply equation.
[b] Includes high-school graduates and those with some years of high school.
[c] Includes those with a college degree, some college education, and post-graduate education.

Table 3. ML estimation of IHS double-hurdle model: food expenditures away from home by meal type

	Breakfast			Lunch			Dinner		
Variable	Partic.	Level	Het.	Partic.	Level	Het.	Partic.	Level	Het.
Constant	−3.06	−8.01**	2.28**	2.85**	−4.69**	2.42**	−2.536	−7.40*	2.96**
	(1.97)	(1.89)	(0.08)	(1.11)	(2.28)	(0.07)	(1.907)	(3.90)	(0.07)
Age ≤ 6	0.63*	0.65**	−0.01	−0.04	−0.73**	0.01	0.551	−1.42**	−0.00**
	(0.38)	(0.30)	(0.02)	(0.17)	(0.33)	(0.02)	(0.462)	(0.52)	(0.02)
Age 7-18	0.05	−0.60**	−0.03	−0.12	1.14**	0.03	0.024	−0.68	0.01
	(0.17)	(0.28)	(0.02)	(0.18)	(0.31)	(0.02)	(0.261)	(0.47)	(0.02)
Age 19-44	−0.02	0.60	−0.01	−0.50**	1.73**	0.06**	1.140**	−1.04	0.05*
	(0.28)	(0.46)	(0.03)	(0.13)	(0.53)	(0.03)	(0.551)	(0.82)	(0.03)
Age 45-64	2.61**	−0.68	0.08**	−0.56**	1.02	0.10**	0.986	−1.42	0.10**
	(0.69)	(0.55)	(0.04)	(0.25)	(0.66)	(0.03)	(0.654)	(1.04)	(0.03)
Age ≥ 65	2.68**	−2.99**	0.14**	−1.03**	−0.74	0.12**	0.479	−4.80**	0.12**
	(0.85)	(0.81)	(0.04)	(0.33)	(0.86)	(0.04)	(0.741)	(1.43)	(0.04)
Income	0.22**	0.11**		0.14**	0.30**		0.230**	0.47**	
	(0.04)	(0.02)		(0.03)	(0.03)		(0.084)	(0.05)	
Wife's emp.	0.24**	−0.05		0.00	0.08*		0.032	0.14*	
	(0.08)	(0.04)		(0.02)	(0.04)		(0.042)	(0.08)	
Homeowner	−3.16**	2.01**		0.78**	2.02**		2.313**	4.13**	
	(0.90)	(0.48)		(0.32)	(0.75)		(0.835)	(0.99)	
White	2.22**	1.50**		0.49	1.23		0.477	6.99**	
	(0.849)	(0.71)		(0.31)	(0.94)		(0.527)	(1.43)	

	0.15	2.38**	−1.19	4.77**	−0.732	7.75**
	(0.46)	(0.89)	(0.81)	(0.92)	(0.734)	(1.71)
Wife college	1.68**	3.33**	−0.51	7.92**	0.632	12.16**
	(0.72)	(0.95)	(0.92)	(1.02)	(0.932)	(1.84)
Summer	−2.63**	0.04	−0.35	−0.89	0.185	−0.20
	(0.65)	(0.61)	(0.36)	(0.79)	(0.474)	(1.12)
Fall	3.96	−0.64	0.46	−0.87	2.914*	−0.91
	(3.00)	(0.53)	(0.44)	(0.70)	(1.742)	(1.06)
Winter	−2.79**	−0.24	−0.29	−0.25	−0.028	−1.01
	(0.59)	(0.59)	(0.33)	(0.70)	(0.455)	(1.08)
Northeast		0.68		0.44		3.58**
		(0.70)		(0.80)		(1.41)
Midwest		1.76**		0.77		3.92**
		(0.66)		(0.75)		(1.33)
South		1.60**		1.91**		3.48**
		(0.65)		(0.71)		(1.28)
West		0.99		0.26		3.04**
		(0.68)		(0.73)		(1.35)
θ		0.11**		0.07**		0.04**
		(0.01)		(0.00)		(0.00)
Log-likelihood		−8135.69		−15575.5 1		−16183.3 8

Note: Asymptotic standard errors are in parentheses.
** Significant at 5%
* Significant at 10%

Table 4. Elasticities with respect to continuous explanatory variables

	Breakfast			Lunch			Dinner		
Variable	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level
Age ≤ 6	−0.038**	−0.036*	−0.074**	−0.012**	−0.019	−0.032*	−0.015**	−0.029**	−0.044**
	(0.015)	(0.021)	(0.028)	(0.006)	(0.014)	(0.017)	(0.007)	(0.013)	(0.016)
Age 7-18	−0.036**	−0.054**	−0.090**	0.012**	0.055**	0.067**	−0.008	−0.005	−0.014
	(0.013)	(0.022)	(0.025)	(0.005)	(0.014)	(0.016)	(0.006)	(0.013)	(0.015)
Age 19-44	0.065	0.029	0.094	0.030	0.213**	0.243**	−0.040*	0.032	−0.008
	(0.047)	(0.063)	(0.081)	(0.021)	(0.050)	(0.056)	(0.021)	(0.047)	(0.054)
Age 45-64	−0.026	0.076**	0.051	−0.003	0.114**	0.111**	−0.033**	0.044	0.011
	(0.029)	(0.037)	(0.051)	(0.012)	(0.029)	(0.034)	(0.013)	(0.027)	(0.033)
Age ≥ 65	−0.090**	0.036	−0.054	−0.022**	0.044**	0.022	−0.045**	−0.002	−0.047*
	(0.026)	(0.027)	(0.041)	(0.010)	(0.022)	(0.026)	(0.011)	(0.021)	(0.027)
Income	0.120**	0.083**	0.203**	0.090**	0.190**	0.280**	0.095**	0.165**	0.260**
	(0.024)	(0.017)	(0.041)	(0.008)	(0.017)	(0.025)	(0.009)	(0.016)	(0.024)
Wife's emp.	−0.081	−0.057	−0.138	0.039*	0.085*	0.124*	0.047*	0.082*	0.129*
	(0.068)	(0.048)	(0.116)	(0.021)	(0.046)	(0.067)	(0.026)	(0.046)	(0.072)

Note: Asymptotic standard errors are in parentheses.
** Significant at 5%
* Significant at 10%

Table 5. Average effects of binary variables

	Breakfast			Lunch			Dinner		
Variable	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level	Prob.	Cond. level	Uncond. level
Homeowner	0.072*	$1.36*	$1.30*	0.045*	$2.83*	$3.37*	0.058*	$4.48*	$5.40*
White	0.054*	1.01*	0.95*	0.027	1.73	2.05	0.102*	7.08*	8.56*
Highschool	0.083*	1.48*	1.36*	0.114*	5.48*	6.43*	0.120*	7.15*	8.66*
College	0.118*	2.17*	2.03*	0.177*	10.25*	12.00*	0.178*	12.32*	14.85*
Summer	0.001	0.03	0.03	−0.019	−1.30	−1.54	−0.003	−0.23	−0.28
Fall	−0.023	−0.45	−0.43	−0.017	−1.26	−1.46	−0.012	−1.03	−1.24
Winter	−0.009	−0.17	−0.17	−0.006	−0.37	−0.44	−0.014	−1.14	−1.37
Northeast	0.024	0.45	0.42	0.009	0.60	0.71	0.050*	3.84*	4.63*
Midwest	0.064*	1.22*	1.17*	0.016	1.09	1.27	0.055*	4.24*	5.10*
South	0.058*	1.10*	1.06*	0.039*	2.80*	3.26*	0.049*	3.73*	4.49*
West	0.036	0.66	0.62	0.005	0.35	0.41	0.043*	3.22*	3.89*

* Significant at 5%. See endnote 8.

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