Analysis of Housewives' Grocery Shopping Behavior in Taiwan: An Application of the Poisson Switching Regression

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ABSTRACT

The purpose of this study is to empirically investigate Taiwanese married women's grocery shopping behavior in relation to their labor force participation status. In this study, focus is limited to their grocery shopping frequency which is meant to be a proxy for an input to household production, i.e., food at home. A Poisson switching regression model is developed to estimate parameters of married women's shopping behavior. The results show that the labor force participation status does have a great impact on time allocation behavior.

Key Words: household production, labor supply rationing, Poisson switching regression, shopping frequency, time allocation.

One of the most important social and economic trends since the turn of the century has been the increasing number of women entering the work force. The participation of women, especially housewives, in the labor force has accelerated due to the advent of better technologies in market production and household production, and a new social structure. The pace at which women enter the labor force is especially dramatic in newly industrialized countries because of these countries' rapid economic growth. Coupled with the increased participation of women in the labor force are substantial changes in the structure, income, expenditures, lifestyle, and resource allocations of dual-income families.

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Because labor supply and household production share the same time budget constraint and have the same opportunity cost (i.e., the wage rate), labor supply is expected to have tremendous impacts on the allocation of time to household production, especially for married women. For example, Juster and Stafford found that married women spend increasingly less time on household production, while the opposite is true for married men. One implication, in terms of household production, is that the roles of married men and married women are becoming more similar.

This study examines the impacts of married women's labor force participation on their grocery shopping behavior. The broader issue of housewives' time allocation behavior has been addressed by a number of researchers. Yen used a Box-Cox double-hurdle model to study working wives' expenditures on food away from home. He found expenditure to be an increasing function of both working women's income and working hours. Based on the

household production framework, Soberon-Ferrer and Dardis investigated the impacts of housewives' participation in the labor force on household expenditures for services. Their results show that most household production-related variables, such as husband's and wife's wage rates and work hours, have positive and statistically significant effects on household expenditures for services for households with full-time as well as part-time working housewives. Demographic variables, however, produced different impacts across the two groups of households. Also adopting the household production approach, McCracken and Brandt estimated household expenditures on food away from home and reported that a housewife's value of time (i.e., wage rate) has a significant impact on various food-away-from-home expenditures.

A common feature of each of the above studies is the utilization of expenditure data. By doing so, a certain aspect of household production can be captured, i.e., the substitution between household-produced goods and market goods as the opportunity cost of time changes. However, the use of expenditure data confers a disadvantage: the income effect on commodity demand from labor force participation and the wage rate may blur the substitution effect of time allocation to be examined in the household production context. As wage rate increases, the consumption of food at home and away from home will increase due to the positive income effect. In other words, the positive effect of wage rate on food away from home may be due to the income effect of increasing food consumption and/or the substitution effect of time allocation. Consequently, the tradeoff between market work and time input to household production may not be obvious from results based on expenditure data.

A more thorough study of household time allocation is provided by Solberg and Wong. In their analysis of households with working husbands and wives, they discovered (among other findings) that the opportunity cost of time of the wife has a negative impact on time input to household production, while it has insignificant effects on labor supply and leisure

demand. The tradeoffs among the various time-use categories also are identified in their results. However, since the Solberg and Wong data relate only to working women (as in Soberon-Ferrer and Dardis), the possibility of nonlinear labor force participation effects is not accounted for. Nonlinearity effects of participation may arise because working and nonworking housewives face different time constraints, since there is one less time-use category to compete for nonworking housewives' total time endowment. Nonlinearity also may be caused by rationing in time allocation—e.g., the nonnegativity constraint in labor supply that nonworking housewives may face.

It is quite clear from previous studies that housewives' labor supply behavior engenders a positive effect on their demand for services/commodities which serve as surrogates for their household production. As in previous studies, our analysis examines the tradeoff in the allocation of time between market work and household production by explicitly recognizing that the various types of time use are under one single time constraint. However, unlike previous studies, we analyze both working and nonworking housewives' value of time to uncover their differential effects on household production behavior. Although this research is empirical in nature, its conceptual framework is developed based on a household production model. For empirical implementation, a Poisson switching regression model is estimated to investigate housewives' household production behavior. The empirical work is carried out based on a sample of Taiwanese households. Their grocery shopping frequency is used to approximate their time input to the household production process. Thus, this study avoids the disadvantages of using expenditure data, which have been used in most previous studies, and so is able to capture the tradeoff in time allocation more precisely. The results reveal drastic differences between working and nonworking housewives in their household production behavior.

The remainder of this article proceeds as follows. A model of household production is developed that incorporates housewives' labor

force participation behavior. Based on the behavioral model, the econometric model—the Poisson switching regression model—is specified. This is followed by a discussion of the estimation results and concluding comments.

A Model of Household Production

To shed light on the empirical study of grocery shopping frequency, a household production model is set up in this section. Following Becker, the consumer optimization problem is embedded in a household production framework. It is assumed that a household produces two nonmarket goods, l and f, both of which respectively take time (t_l and t_f) and purchased material (m_l and m_f) as inputs, so that $l = l(t_l, m_l)$, and $f = f(t_f, m_f)$. The two goods f and l, respectively, can be thought of as, say, food services and leisure activities. For the sake of brevity, it is assumed that the husband's labor supply, and hence total labor income, is exogenous, and only the wife is responsible for time input to household production.

The household's problem is to solve the following:

Maximize: $u = U(l, f)$,

subject to: $Y_m + A + p_w T$

$\qquad = p_w(t_l + t_f) + m_l p_l + m_f p_f$,

where u and $U(\cdot)$ denote maximum attainable utility and household utility function, respectively. Y_m and A represent the husband's labor income and unearned household income, respectively; p_w is the wife's wage rate, and T is total time endowment; and p_i is price of material input m_i. For ease of exposition, the dual problem of cost minimization is analyzed:

Minimize: $x = p_w(t_l + t_f) + m_l p_l + m_f p_f$,

subject to: $U(l, f) = u$.

This problem will yield a cost function:

(1) $x = C(p_l, p_f, p_w, u)$.

From this, we can solve for l and f:

$l = l(p_l, p_f, p_w, u)$,   and

$f = f(p_l, p_f, p_w, u)$.

Input demand functions can be derived as the cost function's price derivatives:

(2) $d_i^c = \partial C/\partial p_i = d_i^c(p_l, p_f, p_w, u)$,   and

$(d_i, p_i) \in \{(t_l, p_w), (t_f, p_w), (m_l, p_l), (m_f, p_f)\}$.

Equation (2) describes compensated demands. If cost function (1) is inverted to derive u, and this u (as a function of x, p_l, p_f, and p_w) is substituted into the compensated demand system in (2), the uncompensated demand system is obtained as follows:

(3) $d_i = d_i(p_l, p_f, p_w, x)$.

In general, with input demands and/or labor supply not constrained, an input demand function does not involve other inputs as arguments. However, if any of the input demands or labor supply are constrained, input demand functions will be different and, in particular, they will be a function of the constrained inputs, so that

(4) $\tilde{d}_i = \tilde{d}_i(p_l, p_f, p_w, x, \bar{d}_j)$,

where $\bar{d}_j$ is the vector of constrained inputs and/or labor supply. Note that, in addition to having an added argument $\bar{d}_j$, equation (4) may be different from (3) in the functional form in general. Moreover, separate functional specifications of demands for constrained and unconstrained households are appropriate if leisure and nonleisure consumption are not weakly separable (see Browning and Meghir for a test in the context of commodity demand). This was first noted by Pollak, with further elaboration by Deaton and Muellbauer and by Neary and Roberts, who both provide a detailed analysis of the functional forms of labor supply and commodity demand with rationed and unrationed labor supply.

Nonparticipation in the labor force is common among housewives. Constraints in labor supply imply that leisure demands are constrained. Figure 1 illustrates a case of con-

Consumption
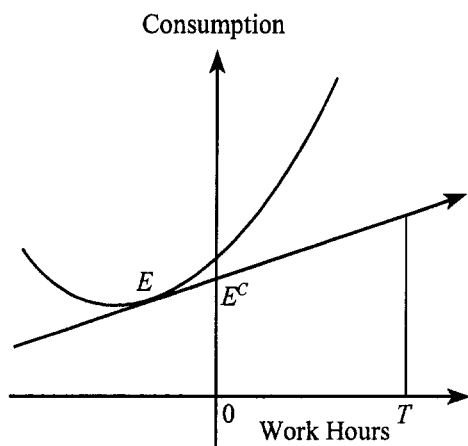
Figure 1. Corner solution in labor supply

strained labor supply with a binding nonnegativity constraint. In figure 1, T represents the total time endowment and E represents the tangent point between the budget line and the indifference curve. With a nonnegativity constraint in the quantity of labor supply, the constrained optimal point is at point E^C, which corresponds to a constrained labor supply of zero hours with leisure being equal to total time endowment T.

A nonnegativity constraint is only one of the constraints which may be responsible for zero labor supply. Others include (a) institutional constraints, e.g., a minimum number of work hours may be required (see Ham); and (b) fixed costs.[1] Different constraints may lead to zero or nonzero hours of labor supply; however, in this study, the focus is on constraints which lead to zero labor supply due to its prevalence among housewives.

Empirical Modeling

The double-hurdle framework has been widely used to account for constraints in labor supply for modeling female labor force participation. For example, Blundell and Meghir conducted a comprehensive review of the literature and applied the double-hurdle model to their study of female labor supply. However, in modeling

commodity demand, the different properties of demand with and without labor supply constraints are seldom heeded (exceptions are Blundell and Walker, and Browning and Meghir). The incorporation of zero labor supply within a commodity demand model is particularly important under a household production framework, and is reported in the literature to be empirically relevant.

The existence of constraints in labor supply has a significant bearing on the empirical modeling strategy one should adopt. If labor supply is constrained to zero, total time input to household production is constrained to be equal to total time endowment, i.e., $t_l + t_f = T$. Equations (3) and (4) together suggest that different function forms for household production input demands should be formulated for the cases with and without constraints in labor supply. While the unrationed input demand functions are given by (3), when the labor supply of the wife of a household is restricted to zero, the input demand function becomes:

$$(5) \qquad \tilde{d}_i = \tilde{d}_i(p_l, p_f, \hat{p}_w, x),$$

where $\hat{p}_w$ is the shadow price of t_l and t_f.[2] The constrained inputs t_l and t_f do not enter equation (5) because only the total time input to household production is constrained to T. However, a different functional form for nonworking housewives (constrained) is needed due to the possible nonseparability between labor supply and household production input demands. Since $\hat{p}_w$ is not observable, its value is usually imputed for empirical analysis based on predictions derived from those who are working.

Data

The empirical analysis is based on data collected in a survey of consumers in the Taipei, Taiwan metropolitan area. The survey, funded by the Institute of Economics of Academia

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[1] Substantial costs, monetary or psychic, may be incurred in order to participate (see Cogan for empirical evidence).

[2] As in the case of restricted labor supply, $\hat{p}_w$ is also the shadow price of t_l and t_f in the case of unrestricted labor supply.

Table 1. Descriptive Statistics of the Sample

Variable	Definition	Mean/(Std. Dev.)		
		Nonworking	Working	Full Sample
SHOPPING FREQUENCY	Monthly grocery shopping frequency	17.045 (8.509)	14.012 (8.320)	15.646 (8.488)
FAMILY	Family size	4.649 (1.714)	5.163 (2.410)	4.905 (2.114)
AGE	Age of respondent	44.889 (9.251)	39.430 (7.694)	42.102 (8.952)
AGE²	Age squared	2,100.0 (817.740)	1,613.6 (635.590)	1,852.5 (772.530)
CHILD	Number of children under age 12	1.065 (1.316)	0.927 (1.014)	1.007 (1.177)
EATOUT	1 = eating out more than once per week; 0 = otherwise	0.366 (0.483)	0.510 (0.502)	0.444 (0.498)
SICK	1 = family members having chronic disease; 0 = otherwise	0.235 (0.426)	0.212 (0.410)	0.220 (0.415)
EDU	Years of education of respondent	8.229 (3.894)	10.536 (4.285)	9.503 (4.137)
HINCOME	Total income of husband	39,526.00 (29,467.00)	36,275.00 (24,334.00)	38,298.00 (27,490.00)
CITY	1 = residence within city limits; 0 = otherwise	0.373 (0.485)	0.391 (0.490)	0.385 (0.487)
SUPERM	1 = shop mostly at supermarkets; 0 = otherwise	0.078 (0.270)	0.185 (0.390)	0.132 (0.339)
ln*WAGE*	Log of value of time; equals log of wage rate if working, equals log of predicted wage rate otherwise	5.270 (0.470)	4.831 (0.768)	4.998 (0.876)
No. observations		153	151	304

Sinica and implemented by the Survey Research Office of Academia Sinica, was conducted in the spring of 1995 through personal interviews. From a targeted number of 400 randomly drawn consumers/respondents who were restricted to being married and to being the principal grocery shopper of the household, there were 379 completed interviews. Respondents were excluded if they did not provide the full information needed for the empirical analysis. Due to potential misreporting of income, those who reported zero total household income were deleted from the data. In addition, only housewives who were under 60 years of age were included in the sample. The sample selection resulted in 304 usable observations.

Since the survey is concerned with household food consumption, the data provide detailed information on the socioeconomic characteristics of the respondents and their families. In this study, the focus is on households' time allocation behavior. However, rather than using expenditures on food away

from home (as in Soberon-Ferrer and Dardis and in McCracken and Brandt), households' monthly frequency of grocery shopping is employed as a proxy for time input of food services production. Frequency data are used to capture households' time allocation pattern because the positive income effect of a wage rate increase on food consumption may blur the resultant tradeoff in time allocation if expenditure data on food away from home are used.

The estimation of the shopping frequency of nonworking housewives requires data on their shadow price of time. However, this information is not available in the data. To derive nonworking housewives' shadow price of time, a regression model that accounts for sample selectivity is estimated for working housewives' wage rate. The model consists of a discrete equation of whether a housewife works or not, and a continuous wage rate equation conditional on a housewife being employed. Correlation is allowed between the two equations. In general, both equations include such variables as age, education, total income of the husband, and location of residence as main regressors. The parameter estimates from the continuous equation are used to predict the shadow price of those who do not work. (The estimation results are available from the authors upon request.) To avoid multicollinearity, the logarithm of the predicted wage rate is used in the regression to explain shopping frequency.

Descriptive statistics of the sample are provided in table 1. The sample statistics show that working housewives, as expected, usually do grocery shopping less frequently than their nonworking counterparts. The higher average value of time for nonworking housewives in the sample is consistent with the notion that nonworking housewives are constrained. In figure 1, at point E^c, the marginal rate of substitution between consumption and work hours representing the constrained value of time is higher than the wage rate which is equal to the slope of the budget line. The higher value of time for nonworking housewives also can be explained by their socioeconomic characteristics. Nonworking housewives in the sample generally are older and less educated; have

a larger family, more children under 12, and more family members with chronic diseases; and their husbands have higher incomes. These characteristics tend to generate a higher value of time.

Poisson Switching Regression for Shopping Frequency

Based on the framework proposed above, housewives' grocery shopping frequency is modeled using a Poisson switching regression model. The model consists of an indicator variable denoted by w, pertaining to whether a housewife works or not, and a monthly grocery shopping frequency variable, denoted by t:

$$t = \begin{cases} t_0, & \text{if } w = 0, \\ t_1, & \text{if } w = 1, \end{cases}$$

where t_0 and t_1, respectively, are the frequency of grocery shopping pertaining to a nonworking housewife and a working housewife. It is assumed that the three variables w, t_0, and t_1 follow Poisson distributions:[3]

$$(6) \qquad \text{Prob}(w = 1) = \exp(-\lambda_w)\frac{\lambda_w^w}{w!}$$

$$= \exp(-\lambda_w)\lambda_w,$$

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[3] The more flexible negative binomial distribution has been experimented with the data. However, the results obtained were not satisfactory in the sense that the parameter estimates are mostly imprecisely estimated, while their signs are in general similar to their Poisson counterparts. The disappointing results with the negative binomial model may arise from the fact that only overdispersion (but not underdispersion) is allowed for under the negative binomial specification—and the Poisson model is a limiting case when the conditional mean of the dependent variable is equal to its variance. A formal statistical test has not been carried out. However, the greater value of the unconditional mean of the shopping frequency compared to its variance seems to support the opposite, i.e., underdispersion, and the negative binomial model may overfit the data. Conversely, overdispersion occurs mainly in the situation when there are more zeros than the assumed underlying distribution can predict. This implies that overdispersion is unlikely to be a problem in the present case, since the shopping frequency variable does not contain any zeros.

(7) $\quad \text{Prob}(t_0 | w = 0) = \dfrac{\lambda_0^t}{[\exp(\lambda_0) - 1]t!}$,

and

(8) $\quad \text{Prob}(t_1 | w = 1) = \dfrac{\lambda_1^t}{[\exp(\lambda_1) - 1]t!}$.

In the empirical work, to account for observable individual heterogeneity, the Poisson parameters are specified to be:

$$\lambda_{wi} = \exp(x_{wi}\beta_w),$$
$$\lambda_{0i} = \exp(x_{ti}\beta_0),$$
$$\lambda_{1i} = \exp(x_{ti}\beta_1),$$

where i is the index for individual observations; x_{wi} and x_{ti} are vectors of socioeconomic characteristics; and β_w, β_0, and β_1 are vectors of coefficients. The likelihood function of the model is given by

(9) $\quad L = \displaystyle\prod_{i=1}^{N} \{[1 - \text{Prob}(w_i = 1)]$

$\quad\quad\quad \times \text{Prob}(t_{0i} | w = 0)\}^{1-w_i}$

$\quad\quad\quad \times \{\text{Prob}(w_i = 1) \times \text{Prob}(t_{1i} | w = 1)\}^{w_i}.$

Note that the possible correlations between w_i and t_{0i}, and w_i and t_{1i} are not identified due to the structure of the Poisson distribution (see Kocherlakota and Kocherlakota, pp. 87–90). It is due to this property of the model that the likelihood function (9) can be rewritten as

$$L = L_w \times L_0 \times L_1,$$

$$L_w = \prod_{i=1}^{N} [1 - \text{Prob}(w_i = 1)]^{1-w_i}$$

$$\quad \times \text{Prob}(w_i = 1)^{w_i},$$

$$L_0 = \prod_{i=1}^{N} \text{Prob}(t_{0i} | w_i = 0)^{1-w_i},$$

$$L_1 = \prod_{i=1}^{N} \text{Prob}(t_{1i} | w_i = 1)^{w_i},$$

where L_w, L_0, and L_1 are independent. As a result, equations (6)–(8) can be estimated separately. This facilitates a test of the switching regression model against the simpler model

where t_{0i} and t_{1i} are pooled in a single Poisson regression assuming $\beta_0 = \beta_1$.

The Poisson switching regression model is a generalization of the double-hurdle Poisson model proposed by Mullahy. In Mullahy's model, the indicator variable is defined by whether or not the variable of interest is greater than zero; in the present model, the indicator variable is whether a housewife works or not. Further, in the current model, there are separate regression equations corresponding to $w = 0$ and $w = 1$, respectively, while there is only one regression equation which applies when the dependent variable is greater than zero.[4]

Results

The results of the Poisson switching regression estimations are presented in table 2. The estimation results of the participation equation are shown in the last column of the table. They are in accord with previous results (i.e., Mroz, based on U.S. data; and Tan and Yu, based on Taiwanese data). For example, age (*AGE*), husband's income (*HINCOME*), and value of time (ln*WAGE*) have a negative effect on participation in the labor force, while the effect of education (*EDU*) is positive.

For the purpose of comparison and specification testing, the results from full sample estimation of the frequency of grocery shopping also are presented. The specification test of the switching regression model against the full sample counterpart is by means of the likelihood-ratio test. Denoting the log-likelihood from the full sample Poisson estimation of shopping frequency by L_p, the test statistic is derived as:

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[4] As pointed out by a referee, it is debatable whether the switching regression model can be classified as a general case for the double-hurdle model. It is worth noting, however, that the two models may differ in spirit, but they are similar in structure in the sense that a different regime for the continuous dependent variable corresponds to a different value for the discrete dependent variable. That is, in a double-hurdle model, a zero regime for the continuous dependent variable corresponds to a zero for the discrete dependent variable.

Table 2. Results of Poisson Switching Regression Estimations

Variable	Shopping Frequency			Participation
	Nonworking	Working	Full Sample	
Constant	5.714**	3.790**	3.865**	19.749**
	(7.586)	(7.489)	(12.601)	(4.162)
FAMILY	0.053**	0.083**	0.042**	0.325**
	(3.957)	(5.767)	(5.453)	(3.447)
AGE	−0.089**	−0.036*	−0.052**	−0.354*
	(−3.859)	(−1.531)	(−3.740)	(−1.950)
AGE²	0.001**	0.25E-3	0.56E-3**	0.004*
	(3.865)	(0.863)	(3.448)	(1.833)
CHILD	0.039**	0.020	0.020	0.010
	(1.995)	(0.770)	(1.417)	(0.059)
EATOUT	0.025	−0.129**	−0.062	—
	(0.544)	(−2.548)	(−1.864)	
SICK	−0.015	0.075	0.067*	−0.212
	(−0.323)	(1.437)	(1.945)	(−0.534)
EDU	0.038**	−0.025**	−0.016**	0.626**
	(2.494)	(−2.987)	(−2.996)	(7.385)
HINCOME	−0.11E-5	0.78E-8	0.39E-6	−0.36E-4**
	(−1.232)	(0.007)	(0.634)	(−4.613)
CITY	−0.117**	0.159**	0.038	−0.063
	(−2.564)	(3.256)	(1.196)	(−0.179)
SUPERM	−0.271**	0.080	−0.090*	—
	(−3.126)	(1.257)	(−1.799)	
ln*WAGE*	−0.323**	−0.068*	−0.014	−3.556**
	(−2.970)	(−1.827)	(−0.704)	(−6.925)
Log-likelihood	−656.343	−636.726	−1,331.617	−125.752

Notes: Numbers in parentheses are asymptotic *t*-statistics. Single and double asterisks (*) denote significance at the 10% and 5% level, respectively.

$$t_{\chi^2} = -2 \times (L_p - L_0 - L_1),$$

which is χ^2 distributed with 12 degrees of freedom. With a χ^2 statistic of 77.0964, which is statistically significant at the 1% level, the switching regression model is supported by the estimation results.

The switching regression results suggest that the value of time has a negative effect on shopping frequency for both working and nonworking groups of housewives. However, the effect of the value of time on shopping frequency does differ with housewives who did not participate in the labor force, where the results show a much more negative reaction to a higher shadow price of time. This suggests that nonworking housewives have more freedom to allocate their time.

The difference in the parameter estimates for the wage rate (ln*WAGE*) is also due to the difference in the nature of the wage rate for working women and the estimated wage rate for nonworking women. For working women, their wage rate represents the market opportunity cost of time, which also equals their shadow price of time. A change of the wage rate invokes both substitution and income effects. The lower responsiveness of working women to a change in the wage rate is attributable to the possibility of a steepening in their labor supply curve at a higher wage rate because income effect becomes more important.

Small and negative elasticities of female labor supply have been found in many studies. For example, based on U.S. household data, Mroz obtains mostly inelastic or even backward-bending female labor supply functions; Tan and Yu also report an inelastic labor supply function for Taiwanese housewives. The implication of a steepening or backward-bending female labor supply curve is that proportionally less additional time will be devoted to market work as the wage rate of a working woman increases. In other words, as wage rate increases, a working housewife will allocate proportionally less household production time for market work. This is because the positive income effect offsets part of the negative substitution effect. Conversely, while the substitution effect of an increase in wage rate will suppress the demand for leisure and household production time, the income effect may boost a housewife's demand for leisure and household production time. However, a nonworking woman's value of time does not have an income effect component. That is, an increase in a nonworking housewife's value of time conjures up a purely negative substitution effect. Thus, the absence of a positive income effect for the time value of nonworking housewives may help explain why the negative value of the coefficient of (ln*WAGE*) for nonworking housewives is larger in absolute value than that for working housewives.

Both working and nonworking housewives go shopping more frequently if they have a bigger family (*FAMILY*). However, while working housewives are not so responsive to demographic characteristics, such as their age and its squared term (*AGE* and *AGE*^{2}),[5] and to the number of children under the age of 12 in the household (*CHILD*), for nonworking housewives, shopping frequency decreases with *AGE* and increases with *CHILD*. The coefficients pertaining to nonworking wives are larger in magnitude, too. This finding supports the conjecture that nonworking housewives have more freedom to allocate their time.

Previous studies suggest that households

with working housewives tend to substitute food consumed away from home for food consumed at home. This is borne out by the present results. If a household with a working housewife ever eats out more than once in a usual week (*EATOUT* = 1), the frequency of grocery shopping decreases significantly. However, for households with nonworking housewives, the effect of *EATOUT* is not statistically significant. The statistical insignificance of *EATOUT* indicates that eating out is not for the purpose of time saving. Rather, eating out is perhaps a leisure activity for households with a nonworking housewife, so that whether or not they eat out more than once a week does not significantly affect the frequency of grocery shopping.

Neither the presence of chronically sick household members (*SICK* = 1) nor the income of the husband in the household (*HINCOME*) affects the shopping frequency for working or for nonworking housewives. A working housewife has a significantly lower shopping frequency if she has more years of education (*EDU*). This negative effect of *EDU* on working housewives' shopping frequency has to do with their labor supply behavior: better educated housewives tend to work more, so that less time is spent on household production. In support of this explanation, this negative effect of *EDU* is not found in nonworking housewives' shopping behavior. The number of years of education of a nonworking housewife (*EDU*) boosts her frequency of grocery shopping significantly. This finding can be attributed to a greater emphasis on health and quality of food services by better educated housewives.

Another variable which exerts different influences on the shopping frequency of working housewives and nonworking housewives is whether or not the household is located in the urban area (*CITY* = 1). Other things being equal, an urban working housewife shops more frequently than a working housewife who resides within the suburbs. Conversely, a nonworking housewife shops more frequently if her household is located in the suburban area. The opposite effect of *CITY* for these respondent groups is attributable to the different time constraints faced by working and

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[5] The coefficient for *AGE* is statistically significant only at the 10% level.

nonworking housewives. In the urban area, shopping facilities are often more numerous and are located closer to residential areas, which makes shopping trips less time consuming and affords working housewives the opportunity to shop more frequently. This may imply that urban working housewives spend less time per grocery shopping trip and make more trips per month, but use less time per month on grocery shopping than their suburban counterparts. For nonworking housewives, the availability of better grocery shopping facilities in the urban area (especially supermarkets) appears to be an important factor that leads to lower shopping frequency because more time can be spent shopping in a single location.[6] Thus, urban nonworking housewives may spend more time per trip, but less total grocery shopping time than their suburban counterparts.

The negatively significant effect of *SUPERM* (i.e., whether shopping mostly at supermarkets or not) for nonworking housewives lends support to our conjecture that urban nonworking housewives' lower shopping frequency is due to the better availability of supermarkets in the urban area. In addition, the insignificance of *SUPERM* for working housewives is also consistent with the explanation of the positive significant "density" effect of *CITY* on working housewives' shopping frequency. The results pertaining to *CITY* and *SUPERM* support once again the hypothesis put forth here that, due to different employment status, the shopping behaviors of working and nonworking housewives are sensitive to different factors and they may react to the same factor differently.

Conclusion

In this study, a household production model is used to account for constraints in labor supply. Labor supply constraints lead to different functional forms of demand for household

production inputs. Also, an empirical investigation on household production is carried out heeding the implications derived from the conceptual framework. The focus of the investigation is on housewives' time allocation behavior. Housewives' grocery shopping frequency is used as a proxy for their time input to household production. The use of grocery shopping, rather than expenditure on food away from home, confers the advantage that the tradeoff in time allocation is not blurred by the positive income effect of an increase in the wage rate on food consumption.

Housewives' shopping frequency is modeled as Poisson processes by means of a Poisson switching regression model which allows shopping behavior of working and nonworking housewives to be different parametrically. The empirical results capture this subtle difference vividly. An important finding is that nonworking housewives' response to an increase in their shadow price of time is (negatively) stronger than that for working housewives. This may be due to the positive income effect of the shadow price for working housewives on household production input demands. The Poisson switching regression specification is supported by a likelihood-ratio test with parameter equality restriction for working and nonworking housewives being imposed in the null hypothesis.

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[6] In the suburban or rural areas of Taiwan, traditional marketplaces (which operate early in the morning and in the evening only) are the most common shopping venues.

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