MARKET TIME SUPPLY OF NON-HOUSEHOLD-HEAD HIRED FARM WORKER

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Traditional models in the agricultural labor literature have examined agricultural labor supply in terms of a labor-leisure trade-off by a single individual. This work examines the question of total annual market days in farm and nonfarm work of secondary family workers engaged in hired farm work. The underlying model is one of home production-consumption. A trade-off of market days between wife and older children in a family is hypothesized. Empirical results are mixed, generally supporting a trade-off in the supply of market days in a family between nonstudents and wives, but not between students and wives.

INTRODUCTION

Workers in agricultural labor markets have been of public interest and concern for several decades. The number of farm workers, both unpaid (operators and their families) and hired, has been declining since the early 1900's for a number of reasons. Farm mechanization and other labor-saving technologies have decreased the demand for labor. The supply of hired farm workers has decreased as farm workers have migrated from rural areas in response to higher wages and better working conditions in urban employment. Current questions of interest to policy makers include impacts of present economic and social trends—increasing rural farm and nonfarm wage rates, an aging population, increasing family incomes, increasing education levels, decreasing family sizes—on labor supply, or more specifically, total market time supply of hired farm workers.

Most research on agricultural labor has treated farm workers as an aggregate of individuals and has emphasized only one form of employee market activity—farm work.[1] Two developments have made it possible for a family micro level approach to be taken in the analysis of market time supply of agricultural wage workers: (1) data on market time and other characteristics of hired workers including information about other members in the worker's household have become available in recent years, and (2) economic models have been developed which account for the effect of household interaction on individual market time decisions.

These two developments have been utilized in this paper to obtain a more detailed picture of workers' characteristics and to estimate their supply response of annual market days in farm and nonfarm work to exogenous stimuli.[2] The types of workers examined are relatively homogenous subgroups of U.S. agricultural wage workers—wives, students residing in a family, and nonstudents residing in a family. These represent a significant segment of the larger category of all nonheads of households who comprise a majority of hired farm workers.[3]

The family model of market time supply has previously been applied to husbands and wives across all occupations (see Ofek; Rea; and Smith). With respect to agriculture, some work has been done with off-farm work by farm operators (Huffman 1973a; Sexton) and with off-farm work by farm operators' wives (Huffman 1973b; Sexton).

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GENERAL ECONOMIC MODEL

The market time supply model underlying this study is a family model and applies production theory and consumption theory to explain family time allocation decisions (see Becker; Gronau). Unlike the single person case, "the distribution of leisure, market work, and home work for each family member as well as among family members is determined not only by tastes and by biological or cultural specialization of functions, but by relative prices which are specific to individual members of the family" (Mincer).

In a production-consumption model, the family is viewed as if it were a firm which consumes its own output. Traditional theory of consumer behavior relies on differences in tastes as an explanation of behavioral differences. Utilizing theory of production permits incorporation of variables (assumed exogenous) which influence production efficiency. In a production-consumption model, market goods and services are combined with home time of family members to produce commodities which enter directly into the family utility function. The relationship between home time of a given household member and family consumption of home commodities is directly analogous to the derived demand for a factor of production. Assume household production functions are such that an increase in demand for a home produced commodity i increases the demand for home time of individual i used in producing commodity i. It follows that home time of i (the negative of market time in a dichotomous world of market-nonmarket time) may be treated as a function of economic variables affecting household production decisions.

Time allocation of a family member between home and market work is influenced by substitution possibilities in two activities of production and consumption. In production, members may substitute between their own time and purchased market goods or among purchased market goods. In consumption, the family may alter the proportion of home commodities produced by one individual and commodities produced by another.

An example will illustrate forces affecting family decisions of member time allocation. For simplicity, we assume only the mother and child produce home commodities.[4] Also for simplicity, assume each produces a single home commodity from a single basket of market goods. For this example, consider an increase in home productivity of the mother in utilizing market goods and home time that does not alter the ratio of her time to purchased market goods.[5] With respect to market time supply of the child, there is a pure substitution effect between two home commodities of mother and child which may be positive (complements in consumption) or negative (substitutes in consumption). With increased home productivity of mother, cost of mother commodity has declined and the family will either reduce consumption of child commodity (substitutes) or simultaneously increase consumption of both producer commodities (complements). Increased home productivity of mother

also results in an income effect that enables the family to consume more home commodities with the same money income and home time of its members.[6]

For empirical applications, the primary implication of the household consumption-production model is that differences in market wages alone will not determine which of two home producers is more expensive in home production. To omit characteristics associated with home production will misspecify market time supply equations.

THEORETICAL VARIABLES

This general economic model suggests a market time supply equation for each home producer which contains wage rates of both members, home productivity measures, and nonwage income. More specifically, market time (T_i) is a function of exogenous variables of own wage rate (W_i), wage rate of other household member (W_j), own marginal productivity of time (δ_i) and market goods (γ_i) in production of household commodities, marginal productivity of time (δ_j) and market goods (γ_j) of other household member in production of household commodities, and family income (V) not earned as wages or salary by members i or j.

Study Variables

In the empirical application of the theoretical model, variables are defined as follows:

Days worked (T_i) is reported days worked at hired farm work plus days worked for wages and salary at nonfarm work.

Own wage (W_i) is daily average earnings for member i in farm work plus wage and salary earnings in nonfarm work, adjusted for regional cost-of-living differences.[7]

Other wage (W_j) is market participation of other family member and schooling of other family member. Market participation is a dummy variable equal to 1 if member j employed last week (at date of interview), looking for work last week, or employed in farm work in 1972, and equal to 0 otherwise.

Own home productivity (γ_i, δ_i,) is schooling, age, sex, number of older family members, and number of younger family members. Schooling is years of formal schooling completed by member i. Age is age of member i. Sex is a dummy variable equal to 1 if female and 0 if male. Number of older family members is number of relatives of head (excluding wife) 14 years of age and over present in household. Number of younger family members is number of relatives of head under 14 years of age present in household.

Other home productivity (γ_j, δ_j) is not included directly.

Nonwage earnings (V) is total money income of family minus wage earnings of worker i.

Work restriction is a dummy variable equal to 1 if member i is 16-25 years of age and 0 if member i is 14-15 years of age.

Discussion

Days Worked (T_i): In response to changes in exogenous factors, individuals vary annual days spent in work. It is assumed a period of one year is long enough to reflect nontransitory market-nonmarket time allocation responses to variations in exogenous variables. Thus, inferences can be made regarding permanent hired farm worker market time supply responses to various social and economic changes.

Own Wage (W_i): The impact on market time of an individual due to an increase in own wage is theoretically uncertain. Assuming an increase in quantity of home produced commodities by family member i is associated with an increase in home time of i, there are two consumption effects of interest, a pure income effect (usually assumed to be negative, thus decreasing market time) and a pure substitution effect (positive by definition, thus increasing market time). It is expected that the substitution effect will outweigh the income effect over most ranges, especially in lower ranges of the wage rate. In other words, plotting market wage rate against market time, market time supply functions are expected to slope upward and to the right. An inverse relationship has been found, however, in some empirical studies of wives and young household members.[8]

Other Wage (W_j): The effect of an increase in value of time of j on market days of i can not be predicted *a priori.* Market wage is assumed to be positively correlated with education. Market participation of market work or looking for work is an additional adjustment.[9] This accounts for the higher shadow price of time (reservation wage) by an individual not in the labor market, education (market wage rate) constant.[10]

Own Home Productivity (γ_i, δ_i): Expected sign of the schooling term is uncertain, depending on its impact on individual substitution in production (between home time of member i and purchased market goods used by i in producing a commodity) versus family substitution in consumption (between commodity of family member i and all other commodities). In other words, education may not only increase quantity demanded by the family for a more efficient home producer's commodity (increasing home time of i), but enable individual i to substitute purchased market goods for home time in production (decreasing home time of i).

In the wife market time supply model, age is included for reasons analogous to education, to reflect differences in home and market productivities. As for schooling, the sign of age is theoretically indeterminant, but it seems reasonable that age would have less effect on home production factor mix of time and market goods than education. Thus, holding market productivity constant by including daily wage (W_i), an increase in age is expected to be linearly associated with decreased market time. Wives 62 years of age and older are not included in the study sample.

In "child" market time supply models, sex of individual is hypothesized to reflect differences in home training. Because females have traditionally received more training by mothers in household chores, e.g., cooking, cleaning, and child care, they are expected to be more productive in home activities and spend fewer days in market work.

Age structure of "children" in the household is divided at 14 years of age as a result of data limitations. An increased number of young "children," those under 14 years, is hypothesized to decrease market time of wives. This expectation is consistent with the expected response to the high cost of purchased substitutes in child care activities and with results of previous studies (see Boskin; Hall; and Leibowitz). Home commodities of additional older "children," those relatives of household heads 14 years of age and over, are expected to act as gross substitutes in home consumption, increasing wife's market days. In the case of market time supply of "child" 14-25 years old, the expected effects of older or younger relatives in the home are uncertain.

Other Home Productivity (γ_j, δ_j): Home productivity of other family member, like home productivity of a person i, cannot be measured. As noted previously, education may be associated with household productivity. However, in market time supply function of i, education of member j is included as a control variable for market wage rate of j. Thus, increased formal

education of j may reflect increased market and nonmarket productivity, with an expected differential in favor of market activity.

Nonwage Earnings (V): The assumption that home produced commodities are normal leads to an expected negative relationship between nonwage income and labor time supplied to market. Use of other family income (total family income minus wage earnings of the individual of interest) instead of the desired family nonwage income, because of data limitations, is expected to bias the absolute value of the estimated income effect upward. For a given increase in nonwage income, market time of the member of interest is reduced. In addition, market time of the second family member will also decrease since both workers will increase production of normal home commodities. Reduced market time of the second family member reduces the measured increase in income, over-stating market time responses per unit change in income.

Additional Control Variable: Fourteen and fifteen year olds are restricted by law in hours and in type of work where they may be employed. Under the Fair Labor Standards Act, they may not be engaged in wage work (1) during school hours, unless enrolled in a training program, (2) more than three hours a day on school days or 18 hours a week in school weeks, or (3) more than 8 hours a day or 40 hours a week in nonschool weeks (U.S. Department of Labor 1971). Sixteen is the minimum age for employment in agricultural tasks declared hazardous by the Secretary of Labor. Hazardous tasks include operating or assisting to operate large power driven machines or their attachments, e.g., tractor over 20 PTO-horsepower, working with unsafe animals, at heights over 20 feet, in enclosed atmospheres, with blasting agents, with anhydrous ammonia, with toxic agricultural chemicals (U.S. Department of Labor 1970). Such legal restrictions to short-term nonhazardous jobs by 14-15 year olds are expected to reduce annual work days by these younger family members.[11]

DATA

Source of data is the December, 1972, supplement to the Current Population Survey (CPS). This was the most current data available at time of analysis.[12] The CPS is a monthly survey conducted by the Census Bureau of approximately 52,000 occupied U.S. households. This file provides information on individuals 14 years old and over on personal characteristics of age, sex, race, marital status, and educational background. Data are confidential but are retained in a manner such that it is possible to identify members of a family, their relationship to household head, and family income.

In December surveys an additional question is asked: "During 19____, did (name) do any farm work for cash wages or salary, even for one day?" If the answer is yes, supplemental information is obtained regarding days worked at farm work for cash wages or salary, earnings in farm work, migration, type of farm work, major activity during the year, total days worked at nonfarm work, and total cash wages or salary from nonfarm work. One or more family members of a single family may have been engaged in farm work. A survey total of 1,988 individuals from 1,574 families were identified as hired farm workers in 1972.

EMPIRICAL RESULTS

The theoretical economic model specified in the previous section is estimated using ordinary least squares multiple regression analysis. Separate regressions are run for wives, students 14-25 years of age, and nonstudents 14-25 years of age. Participation in formal schooling is employed as a criterion for dividing the "children" sample for two reasons: (1) the decision to be a student or nonstudent is endogenous in family decision making and (2) students and nonstudents are expected to behave differently to changes in explanatory variables.

Independent variables in the formulated model explain 23 percent of variation in market days of wives, 14 percent of variation in market days of student relatives 14-25 years old, and 28 percent of variation in market days of out of school relatives 14-25 years old (Table 1). Many variables included in reported models are not significantly different from zero, even at .10 level. These variables are not deleted, however, because (1) economic theory suggests they should be included, (2) their effects may be of interest to other researchers, and (3) omission is expected to bias estimates of remaining coefficients.

The over-all question to be asked is, does the family consumption-production model yield significant insights, in a statistical and policy sense, into market time supply behavior of hired farm workers? Results of the application are mixed.

Wives demonstrate a significant (.10 level, two-tailed test) positive response of market days to wages (elasticity of .35, evaluated at mean daily wage) and a negative response to increased nonwage earnings (elasticity of −.38, evaluated at mean of family income minus wife wage and salary earnings). Variables included to reflect trade-off in home time between wife and oldest household relative—other wage, schooling—are not significant. Wives do exhibit a significant change in market days to changes in own home productivity factors of number of older family members (increased market days) and number of younger family members (decreased market days).[13]

Nonstudents show no significant response to a change in daily wage, but do have the predicted reduction in market days for an increase in nonwage earnings. Trade-off in home time and home production between wife and nonstudent is partially supported, with nonstudent decreasing market time when wife enters the market. Factors hypothesized to affect home productivity have differing directional effects on time allocation. Being a female decreases annual market days by 73, while increased schooling and increased number of youngsters in the household increase market time. If interpretation of the schooling effect is correct (see the discussion under study variables), schooling has a dramatic impact reducing amount of time per home commodity. The market time constraint proxy is also highly significant (.01 level).

Students, like nonstudents, decrease annual market days with an increase in family income. Students exhibit a significant negative response to increased market wages. Student own wage elasticity is −.51.[14] The positive and significant effect of wife years of schooling on market days of student suggests home commodities of the two household members are complements, not substitutes, in home consumption. In place of a wage rate, years of schooling serves as a proxy for market wage of wife. In the wife labor supply equation, there is a positive response in market days to increased market wage. In the student labor supply equation, the student also increases market days with an increase in market wage of wife.

Like their nonstudent counterparts, students significantly increased market days with an increase in years of schooling or a decrease in market work restrictions. Years of formal education is likely serving as a proxy for all factors involved in building human capital in young persons. But it is only one of many inputs. There are also inputs from parents in guiding students in

TABLE 1: ESTIMATED MARKET TIME SUPPLY EQUATIONS FOR WIVES AND YOUNG FAMILY MEMBERS IN THE HIRED FARM LABOR FORCE (DEPENDENT VARIABLE: T_i-ANNUAL DAYS WORKED)

Variable	Wives	In school (14-25 years old) relatives of household heads	Out of school (14-25 years old) relatives of household heads
Constant	138.825	−45.435	41.076
	(1.856)	(2.117)	(.703)
Own wage (W_i)	2.354	−2.639	.538
	(2.063)	(5.164)	(.483)
Other wage: (W_j)			
Market participation of other family member	2.452	3.537	−66.248
	(.111)	(.646)	(3.696)
Schooling of other family member	−3.921	3.704	−3.941
	(.769)	(3.439)	(1.324)
Own home productivity: (γ_i, δ_i)			
Schooling	1.698	7.471	9.718
	(.529)	(3.678)	(2.068)
Age	−1.328		
	(1.081)		
		−8.667	−73.455
Sex		(1.230)	(2.619)
Number of older family members	19.147	1.790	−8.908
	(2.066)	(.700)	(1.205)
Number of younger family members	−10.035	.585	14.350
	(1.795)	(.312)	(2.295)
Nonwage earnings (V)	−.00436	−.00097	−.00351
	(1.855)	(2.118)	(2.543)
Control variable:			
		18.437	119.430
Work restriction		(2.404)	(2.747)
Summary statistics:			
Number of observations	77	593	115
R^2	.23	.14	.28
Mean Y	74.8	61.3	167.1
Own wage elasticity[a]	.35	−.51	—[b]
Income elasticity	−.38	−.16	−.17

Note: t-value associated with regression coefficients are in parentheses below the estimated coefficients.

Source: Current Population Survey, December 1972.

[a]Wage and income elasticities calculated at sample means of daily earnings and nonwage earnings (total money income of family minus wage earnings of member i).

[b]Coefficient not statistically significant from zero; t-value of .483.

"around the home or farm" type jobs, from peer association in a wide variety of activities, and from market employment prior to the period of observation. These other inputs are obviously omitted from the empirical model because data are not available. The role of such learning in the home production model is to reduce home time by reducing amount of home time required per final commodity produced by a student. To attribute all increased market days to formal education alone ignores the contribution of other sources of informal or on-the-job education. The absolute magnitude of the effect of a year of formal education on market days is likely biased upward.

The impact of number of younger family members on wife and nonstudent suggests commodities of the two are gross substitutes. With an increase in number of younger family members, wife increases and out of school nonhead decreases market days. If young children less than 14 years of age are an input in wife commodity but not out of school nonhead commodity, then an increase in young children will be associated with reduced market days of wife. The quantity of her home commodities has increased. And, she will replace the out of school nonhead as a home producer. Thus, the negative sign on number of younger family members in the out of school nonhead equation can be explained by increased home time of wife.

SUMMARY AND IMPLICATIONS

Empirical results for number of children in the family suggest a continued downward trend in U.S. birth rate will have an uncertain impact on annual market days of wives working as hired farm workers. There will be an expected increase in annual market days of out of school (14-25 years old) relatives of household heads. A decrease in number of young children in the family significantly increases market days of wives, who now have fewer child care obligations in the home. However, a decrease in number of older children in the home tends to decrease market time of the wife. While there is a significant increase in market days of out of school (14-25 years old) relatives of household heads as number of young children in the family declines, there is no apparent impact from a decline in number of older relatives.

An increase in mean level of urban and rural schooling levels is likely to be associated with increased market days of young family members engaged in hired farm work. It is not possible to determine from the analysis if there are any differential effects on farm *versus* nonfarm days. Student and nonstudent relatives of household heads spend a significant number of additional days in market employment as education increases. Although wives do not significantly alter market days as their level of formal education changes, their increased schooling is associated with increased market days of student nonheads in the family.

Analysis results also indicate that increases in family prosperity will decrease annual market days of secondary family members, all else unchanged. Increases in family income (other than own wage and salary earnings) will decrease market days of wives, of in school relatives of household heads and of out of school relatives of household heads. In addition to expected impacts of government programs of income transfers, implications can be drawn regarding family market days and private sector economic activity. During periods of steadily increasing real wages and full employment by household heads, other family members engaged in hired farm work will withdraw time from market and allocate it to home activities. Likewise, in periods of rising unemployment of household heads and decreasing family incomes, wives and other relatives will increase

market work days. For instance, increased certification of foreign workers in U.S. agriculture may tend to displace household heads and increase market time by wives and other young family members.

Reconsideration of legislative restrictions to voluntary market work by young people is implied. The private welfare costs of "protecting" teenagers under 16 years of age by preventing employment in certain designated farm and nonfarm jobs or tasks may be quite high to families at low levels of income. Likewise, "helping" farm workers by imposing effective minimum wages will have a similar effect by causing unemployment among some low skilled young workers. Market work is not only a source of income, but may also be viewed by many families as a productive on-the-job investment activity for young teenagers.

Final conclusions of the analysis apply to changes in annual market days of hired farm workers in response to changes in market wage rates. Evidence indicates that worker reaction varies among farm wage earner subgroups. Increases in rural wages are expected to increase annual market days of wives of household heads. Young nonheads not in school, on the other hand, will likely demonstrate no change in market days supplied as wage rates increase. Their student counterparts are expected to exhibit a significant decrease. Thus, a *ceteris paribus* change in wage rates may have an important impact on the composition of the hired farm work force supply in terms of the share of market days worked by various employee subgroups.

FOOTNOTES

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[1]Previous studies of the aggregate supply of labor to U.S. agriculture have examined differing phenomena: (a) the simultaneous effects of supply and demand forces for all agricultural labor (e.g., Gisser; Wallace and Hoover); (b) the interrelatedness of labor demand among groups of farm workers—farm operators, unpaid family members, and hired workers (Tyrchniewicz and Schuh); (c) the farm hired work force alone, with and without seasonal subdivisions (Glover; Schuh). During the 12 year period of 1965-1976, over 40 percent of the farm workers also did nonfarm wage work (U.S. Department of Agriculture).

[2]How individuals will allocate their market time among alternative market occupations is not addressed. Hypothesized explanations of multiple job holding generally include technological or institutional constraints in a primary job, with remaining voluntary market time being in part-time employment (Sexton). The role of constraints in the time allocation of our sample group is uncertain, since most did not hold a full time primary market job.

[3]Between 1962 and 1974, 61 percent of the total farm wage force and 72 percent of the casual (less than 25 days) farm wage force were not heads of household, e.g., they were children, wives, grandparents (U.S. Department of Agriculture).

[4]In the empirical application home producers are assumed to be the wife ("mother") and the oldest relative of the household head ("child"). This requires that male household heads are only a source of income. They either do not engage in household production, or, if they do, their home production activities are independent of other household members. If this assumption is false, omission of the husband's wage and "home productivity" in labor supply equations of wife and oldest relative 14-25 years of age will bias estimates of included coefficients.

[5]This assumption is not crucial to the empirical work. It does serve to simplify the example. With fixed coefficients in production between home time and market goods, substitution occurs only in family consumption between mother commodity and child commodity for a given change in exogenous factors. Predictions of effects for market time supply parameters will be correct from a model of fixed production coefficients as long as substitution in consumption effects (between mother and child commodities) outweigh substitution in production effects (between home time of mother and market goods or home time of child and market goods). Even with such a rigid assumption as fixed production coefficients, it is only possible to predict with theoretical certainty a negative income effect (decreased market time for increased nonwage earnings) and negative own home productivity effect (decreased market time for increased home productivity).

[6]This pure income effect is identical to an increase in nonwage earnings.

[7]Own wage rate refers to the market wage rate or opportunity cost of home time of an individual. Regional cost-of-living adjustments were made recognizing that across regions in the United States, the quantity of labor required to consume a given basket of market goods and services varies (U.S. Bureau of Labor Statistics). It can also be argued that more appropriate wage measures are permanent wages (i.e., wages for any given year is a transitory measure of the permanent wage rate) or that after-tax earnings should be utilized. Regression results using an imputed wage rate indicated no significant market time response to the permanent wage measure (.10 level, two-tailed test) for any of the three groups examined. There was a sign reversal in the case of out of school relatives, 14-25 years old. Use of a tax-adjusted wage rate had no effect on the signs of significant wage rate coefficients; the sign of the wage rate for out of school "children" did change from positive to negative (not significantly different from zero, .10 level).

[8]Examples of research suggesting negatively sloped market time supply curves for wives include Cohen *et al.* and Huffman 1973b. Negative supply responses to increased wage rates for students is supported by Leigh and for black male nonstudents by Boskin.

[9]Included as looking for work were individuals who indicated looking for work last week, at time of survey, was what they were doing most.

[10]As noted by an anonymous reviewer, using market participation of j as a determinant of i's labor supply decision may impart a simultaneity not accounted for in a single equation model. The alternative is to impute a continuous market wage rate from an estimated wage function. Wage functions are generally based on years of education and other personal characteristics of a sample of individuals engaged in market work (Hall; Boskin; Leibowitz; DaVanzo *et al*). For j^{th} family members not engaged in market work, their imputed value of time is biased downward. Extent of bias resulting from simultaneity problems of using a dichotomous variable of labor force participation by j in i's market time supply equation is unknown, but expected to be small.

[11]It can be argued the study age variable used to capture work restrictions also reflects supply phenomena, e.g., uniqueness of home commodities produced by young teenagers or acquisition of market oriented human capital over time. The analysis does not permit isolating demand versus supply restrictions to labor supply and both may be present.

[12]In employing cross sectional data, it is assumed there are no significant structural changes in supply over time. In other words, behavorial coefficients estimated for one time period apply to following time periods. Time series data in addition to cross sectional data would be necessary to account for relevant structural changes in supply that may occur through time.

[13]The poor statistical results for characteristics of oldest relative in the family likely reflects the divergence between theory and application. The theoretical model is based on a household with two family members other than the male head producing commodities. The empirical work includes households with several older relatives (mean for 77 households, 1.90).

[14]An alternative model of time allocation among market-investment-consumption may be necessary to explain student behavior to market wages. It is possible that family capital constraints result in students not engaging in full-time human capital investment activities. The purpose of student market work may be to finance education. If earnings increase the student is able to reduce market time and increase time in education. There is the possibility of a simultaneity bias in reported equations. Increased current wages increase expected wages after education. The decision to increase education reduces current market time. As noted in footnote 7 an imputed daily wage was also tried. The imputed coefficient was also negative, with an own wage elasticity of −.59, but was not significant at the .10 level (t-value of 1.283).

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