A CROSS-SECTIONAL ANALYSIS OF NONFARM WORK OF FARM OPERATORS

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INTRODUCTION

A sizable and increasing share of the personal income of U. S. farm families is derived from nonfarm sources. Currently the share of personal income from nonfarm sources is approximately equal to the share from farm sources. Most (70-75 percent) of the nonfarm personal income of farm families consists of earnings from off-farm work.²

Off-farm work has been viewed traditionally as an intermediate step in the adjustment process of farm-family labor leaving agriculture. The adoption of new and improved inputs in U. S. agriculture has caused a reduction in the demand for the services of labor in agriculture. Farm people have responded with a massive emigration from agriculture; the farm population declined 62 percent between 1946 and 1970.³ However, a recent study by Hanson [9] suggests that off-farm work is a stable and permanent characteristic of those farm families that remain in U. S. agriculture.⁴

The objective of this paper is to perform a static economic analysis of the supply of nonfarm working time of farm operators. The research is part of a more comprehensive study of the supply of nonfarm

¹ Footnotes are attached at the end. They can be detached for reading convenience.

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labor of farm-family members. By increasing our knowledge about the factors that explain the variation in the supply of nonfarm work of farm-family members, we hope to gain insights into the factors that affect the size of the income from nonfarm sources of farm families.

The layout of this paper is as follows: Section two contains a summary of historical data on the sources of farm-family income and on days of off-farm work of farm-family members. In section three, the static supply of labor by an individual is developed, using a household production-consumption model. In this model decisions about hours of work are made in a family context so that an individual's hours of market work depend on his (her) wage rate and variables peculiar to him (her), on the wage rate and variables peculiar to other family members, and on common family variables. Section four contains a description of the data, empirical specification of the model, and a discussion of the results. Section five presents the conclusions and implications.

HISTORICAL BACKGROUND

A sizable share of the total income of farm people is from nonfarm sources, and this share has been rising. The nonfarm share has increased steadily from 23 percent in 1946 to 45.5 percent in 1970. Currently the share of income from nonfarm sources is approximately equal to the share from farm sources. Given the decline between 1946 and 1970 in the population, number of farms, and number of persons per farm by 62 percent, 50 percent, and 23 percent respectively, the increase in the nonfarm share is quite remarkable. Also during the period 1946 to 1970 average income per farm from nonfarm sources increased by sixfold and average income per farm from farm sources doubled; consequently, average total income per farm tripled during this period (all in current dollars, see Table 1).
Most (70-75 percent) of the nonfarm income of farm people consists of earnings from off-farm work. The share of income from nonfarm sources consisting of wage and salary income has been relatively stable between 1946 and 1970; consequently, the share of wage and salary income in total income of farm families has been increasing (see Table 1).

Consistent with a rising relative importance of wage and salary income is the rising rate of participation of farm-family members in off-farm work at nonfarm jobs. The percentage of all farm operators that worked off the farm any number of days has increased from 26.8 percent in 1944 (38.9 percent in 1949) to 46.3 percent in 1964. For farm operators who worked off the farm for 200 days or more, the percentage has increased from 14.2 percent to 26.1 percent. Although the number of farm operators declined by 46 percent between 1944 and 1964, the number of farm operators who worked off the farm any number of days and the number who worked 200 days or more were nearly the same in these two years (see Table 2). However, the largest number of farm operators were working at off-farm jobs in 1954.

There is evidence that the off-farm labor force participation rates of other members of the farm operator's household is rising; however, the data are relatively scarce. The percentage of farm operators who reported that other household members were working off the farm (on another farm and at nonfarm jobs) increased from 16 percent in 1954 (22 percent in 1959) to 28 percent in 1964. Other evidence comes from the Current Population Surveys. For married women (husband present), who have a farm residence, the labor force participation rate outside of agriculture has increased from 16 percent in March 1959 to 26 percent in March 1971 (Table 3).
### TABLE 1

INCOME OF THE FARM POPULATION FROM FARM AND NONFARM SOURCES, UNITED STATES, SELECTED YEARS

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Farms (1,000)</td>
<td>5,967</td>
<td>5,648</td>
<td>4,654</td>
<td>3,962</td>
<td>3,340</td>
<td>2,924</td>
</tr>
<tr>
<td>Farm Population (&quot; )</td>
<td>25,403</td>
<td>23,048</td>
<td>19,078</td>
<td>15,635</td>
<td>12,363</td>
<td>9,712</td>
</tr>
<tr>
<td>Number of Persons per Farm</td>
<td>4.3</td>
<td>4.1</td>
<td>4.1</td>
<td>3.9</td>
<td>3.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Income of Farm Population ($ mil.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19,619</td>
<td>19,936</td>
<td>17,661</td>
<td>19,232</td>
<td>25,032</td>
<td>29,247</td>
</tr>
<tr>
<td>From Farm Sources</td>
<td>15,068</td>
<td>13,673</td>
<td>11,464</td>
<td>12,079</td>
<td>14,987</td>
<td>15,030</td>
</tr>
<tr>
<td>From Nonfarm Sources</td>
<td>4,551b</td>
<td>6,263</td>
<td>6,197</td>
<td>7,153</td>
<td>10,045</td>
<td>13,308</td>
</tr>
<tr>
<td>Nonfarm Wage and Salary Income</td>
<td>(23.2)b</td>
<td>(31.4)</td>
<td>(35.1)</td>
<td>(37.2)</td>
<td>(40.1)</td>
<td>(45.5)</td>
</tr>
<tr>
<td>Average Income per Farm ($)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3,311</td>
<td>3,530</td>
<td>3,795</td>
<td>4,854</td>
<td>7,494</td>
<td>10,002</td>
</tr>
<tr>
<td>From Farm Sources</td>
<td>2,543</td>
<td>2,421</td>
<td>2,463</td>
<td>3,049</td>
<td>4,487</td>
<td>5,451</td>
</tr>
<tr>
<td>From Nonfarm Sources</td>
<td>768</td>
<td>1,109</td>
<td>1,332</td>
<td>1,805</td>
<td>3,007</td>
<td>4,551</td>
</tr>
</tbody>
</table>

a. Income from farm sources is net-farm income, adjusted to include government payments, value of home consumption, gross rental value of farm dwellings, and adjustments for inventory changes.

b. Income from nonfarm sources as a percentage of total nonfarm income.
TABLE 1
Notes Continued

c. Nonfarm wage and salary income as a percentage of total nonfarm income.

### TABLE 2

OFF-FARM WORK\(^a\) BY FARM OPERATORS, UNITED STATES, 1944-1964

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Farm Operators (1,000)</td>
<td>5,859</td>
<td>5,386</td>
<td>4,783</td>
<td>3,708</td>
<td>3,158</td>
<td>2,730</td>
</tr>
<tr>
<td></td>
<td>(100.0)</td>
<td>(100.0)</td>
<td>(100.0)</td>
<td>(100.0)</td>
<td>(100.0)</td>
<td>(100.0)</td>
</tr>
<tr>
<td>Number of Farm Operators Working Off Farm (1,000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,570</td>
<td>2,093</td>
<td>2,154</td>
<td>1,664</td>
<td>1,462</td>
<td>1,482</td>
</tr>
<tr>
<td></td>
<td>(26.8)</td>
<td>(38.9)</td>
<td>(45.0)</td>
<td>(44.9)</td>
<td>(46.3)</td>
<td>(54.2)</td>
</tr>
<tr>
<td>1 to 49 Days</td>
<td>313</td>
<td>574</td>
<td>571</td>
<td>380</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.3)</td>
<td>(10.7)</td>
<td>(11.9)</td>
<td>(10.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 to 99 Days</td>
<td>178</td>
<td>261</td>
<td>249</td>
<td>176</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.0)</td>
<td>(4.9)</td>
<td>(5.2)</td>
<td>(4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 to 199 Days</td>
<td>244</td>
<td>313</td>
<td>306</td>
<td>230</td>
<td>189</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>(4.2)</td>
<td>(5.8)</td>
<td>(6.4)</td>
<td>(6.2)</td>
<td>(6.0)</td>
<td>(8.0)</td>
</tr>
<tr>
<td>200 Days or more</td>
<td>835</td>
<td>944</td>
<td>1,027</td>
<td>878</td>
<td>824</td>
<td>871</td>
</tr>
<tr>
<td></td>
<td>(14.2)</td>
<td>(17.5)</td>
<td>(21.5)</td>
<td>(23.7)</td>
<td>(26.1)</td>
<td>(31.9)</td>
</tr>
</tbody>
</table>

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\(a\). Days worked off the farm include both days worked at nonfarm jobs and on other farms. For 1964, days worked on other farms were 4 percent of the days worked off the farm.

\(b\). Figures in parentheses are percentages of the total number of farm operators.

### TABLE 3

LABOR FORCE PARTICIPATION RATES FOR FARM MARRIED WOMEN (HUSBAND PRESENT), U. S., SELECTED DATES

<table>
<thead>
<tr>
<th>Item</th>
<th>March 1959</th>
<th>March 1965</th>
<th>March 1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Married Women (Husband Present):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Labor Force (Percent)</td>
<td>26.5</td>
<td>31.1</td>
<td>36.9</td>
</tr>
<tr>
<td>Employed Outside of Agriculture (Percent)</td>
<td>15.9</td>
<td>19.7</td>
<td>26.2</td>
</tr>
</tbody>
</table>

Thus it is clear that knowledge about the factors that determine wage and salary income of farm families will add to our understanding of the determinants of nonfarm income of farm families. Next we turn to theoretical considerations for hours of work.

THEORETICAL CONSIDERATIONS

The theory of the supply of working time of individual family members emerges from the pioneering work on the theory of household behavior by Becker [3] and Mincer [11]. Their approach treats the household as the basic decision-making unit. Given the utility and production functions, the household faces the task of maximizing household satisfaction (consumption decisions) and of allocating market goods and consumption time of the household members to the production at minimum cost (production decisions) of the commodities or activities that the household members ultimately consume. The demand for consumption time of household members is a derived demand arising from the demand for commodities; and since each family member is assumed to allocate all of his (her) time between consumption and work, the model provides a framework for analyzing the supply of working time of each family member.8,9

Assume that the household receives utility from consuming two commodities (or activities) Z_1 and Z_2:

1. \( U = U(Z_1, Z_2) \),

which are produced by combining market goods \( (X_i) \) and consumption time of family members, the husband \( (t_i) \) and the wife \( (t'_i) \):

2. \( Z_i = f_i(X_i, t_i, t'_i; \beta_i, \gamma_i), i = 1,2, \)

where \( f_i \) is homogeneous of degree one and \( \beta_i \) and \( \gamma_i \) are efficiency
parameters that are associated with the husband and wife respectively. The household is assumed to maximize its utility function subject to a production function constraint and a constraint on full income. The full income constraint arises from the combination of the time constraint and money income constraint. The household cannot allocate more time to consumption \( t_c \) and work \( t_w \) than the total number of hours (24 hours per day per household member) that each family member has available:

\[ T = t_c + t_w = t'_c + t'_w. \]

Likewise, its expenditures on market goods are restricted to the earnings of the husband and wife plus nonearnings income \( \alpha \), i.e., to total family money income \( I \):

\[ I = V + Wt_w + W't'_w = \sum P_i x_i. \]

where \( W \) and \( W' \) are the wage rates of the husband and wife respectively and \( P_i \) is the price of market good \( x_i \). Since household members can exchange time for market goods at the market wage rate, the time constraint and money income constraint can be converted into a single total resource constraint called full income:

\[ F = \sum p_i z_i = V + T(W + W') = \sum p_i x_i + \sum w' t_i + \sum w t_i. \]

where \( p_i \) is the price (marginal cost and average cost) of \( z_i \). Full income can be interpreted conceptually as the amount of money income that the household would realize if each family member devoted all of his (her) time to work. It is "spent" on the \( z \)'s by purchasing market goods and forgoing earnings.

The following equation, derived in the Appendix, illustrates that a change in the household demand for consumption time of the husband and hence in the supply of his time at work is determined by changes in nonearnings income, wage rates of the husband and wife, prices of market goods, and the efficiency parameters that are associated with the husband and wife:
6. \( E_{tc} = \left( \frac{V}{F} \right)^{ntF} \cdot EV \)

\[
\begin{align*}
&+ \left\{ \frac{k_{z_1}}{k_{tc}} \left( 1 - k_{z_1} \right) \left( \alpha_{t_2} - \alpha_{t_1} \right)^2 \sigma_{z_1z_2} + k_{tw} \cdot ntF + \tau_1 \alpha_{t_1} \sigma_{t_1t_1} \\
&+ (1 - \tau_1) \alpha_{t_2} \sigma_{t_2t_2} \right\} \cdot EW \\
&+ \left\{ \frac{k_{z_1}}{k_{tc}} \left( 1 - k_{z_1} \right) \left( \alpha_{t_2} - \alpha_{t_1} \right) \left( \alpha_{t_1} - \alpha_{t_1}' \right) \sigma_{z_1z_2} + k_{tw} \cdot ntF \\
&+ \tau_1 \alpha_{t_1}' \sigma_{t_1t_1} + (1 - \tau_1) \alpha_{t_2}' \sigma_{t_2t_2}' \right\} \cdot EW' \\
&+ \alpha_x \left\{ \frac{k_{z_1}}{k_{tc}} \left( \sigma_{z_1z_2} - ntF \right) + \tau_1 \left( \alpha_{t_1} \sigma_{x_1} - \sigma_{z_1z_2} \right) \right\} \cdot EP_1 \\
&+ \alpha_x \left\{ \left( 1 - k_{z_1} \right) \left( \sigma_{z_1z_2} - ntF \right) + (1 - \tau_1) \left( \sigma_{z_2} \sigma_{z_1z_2} \right) \right\} \cdot EP_2 \\
&+ \left[ ntF - 1 \right] \cdot E\delta \\
&+ \left[ ntF - 1 \right] \cdot E\gamma
\end{align*}
\]

where \( E = \text{d}(\log) \) operator, i.e., percentage change,

\( ntF \) = the "derived" full income elasticity of demand for husband's consumption time, i.e., \( \left( t_1/t_c \right)^{ntF} + \left( t_2/t_c \right)^{ntF} \),

\( n_{Z_1} \) = the full income elasticity of demand for \( Z_1 \),

\( k_{z_1} \) = share of full income spent on \( Z_1 \), i.e., \( Z_1 \pi_1 / F \),

\( k_{tc} \) = share of full income spent on husband's consumption time, i.e., \( t_c W / F \),

\( k_{tw} \left( k_{tw}' \right) \) = the share of full income derived from husband's (wife's) time at work, i.e., \( W_t / F \),

\( \alpha_{t_1} \left( \alpha_{t_1}' \right) \) = the share of expenditures on husband's (wife's) time in the total cost of \( Z_1 \), i.e., \( t_1 W / Z_1 \pi_1 \),

\( \sigma_{ij} \) = the Allen partial elasticity of substitution,

where \( i, j = Z_1, Z_2, t_1, t_1', t_2, t_2', X_1, \) and \( X_2 \),

\( \tau_1 \) = share of husband's consumption time allocated to the production of \( Z_1 \), i.e., \( t_1/t_c \), 14, 15
Although formidable in appearance, equation 6 is not difficult to interpret. Each line represents the "weighted" effect on the demand for husband's consumption time of a change in nonearnings income, one price (of time or market goods), or productivity variable. The weights consist of substitution effects in consumption and in household production and/or income effects. If the derived income elasticity of demand for husband's consumption time is positive, an increase in nonearnings income increases the demand for husband's consumption time and hence reduces his supply of working time. However unless one is willing to speculate about the size of other parameters, the signs of the elasticity coefficients of the prices and productivity variables are ambiguous.

For example, consider the effect of an increase in the husband's wage rate on the household demand for his consumption time. The real full income compensated substitution effect between $Z_1$ and $Z_2$ is negative; the substitution effects between husband's time and other factors (wife's time and market goods) in the production of each $Z$ is negative; but the income effect is positive. As in the traditional model, we do not obtain a clear prediction of the effect of an increase in the husband's wage rate on his hours of work.17

One feature distinguishing the household production-consumption model from the traditional work-leisure model is the separation of the wage rate and education effects on the hours of work. The model assumes that education can affect household decisions (by affecting the efficiency of household production) independent of its well known affect on wage rates. Thus it is meaningful to speak of a change in education levels holding wage rates constant.

Thus the household production-consumption model provides a theory of the supply of working time of the husband. His hours of work depend on his wage rate and his education, on the wage rate and education of his
wife, on nonearnings income of the household, and on the prices of market goods. Although the theory provides only weak predictions about the expected signs of the coefficients of the variables, the model can be tested to see if the variables explain the supply of working time. In the next section we proceed to an empirical test of the model in analyzing the supply of nonfarm working time of farm operators.

THE DATA, EMPIRICAL SPECIFICATION OF THE MODEL, AND RESULTS

The results of a preliminary empirical analysis of the supply of nonfarm time at work of farm operators follows. The estimates are based upon county aggregate data for a cross section of Iowa, North Carolina, and Oklahoma counties. The Data

The observations for estimating the supply of nonfarm labor consist of 276 counties from Iowa, North Carolina, and Oklahoma. These three states are ones where agriculture continues to be an important industry. They represent different geographic sections of the U. S. - Midwest, Southwest, and Southeast - and provide diverse opportunities for nonfarm work.

The primary data source is the Census of Agriculture, 1964. It provides a rich source of raw data for constructing empirical measures of the variables that are required for estimating the supply of nonfarm working time. These data do have a defect in that they are for county aggregates, and the model was formulated at the household (or family) level. Hopefully this level of aggregation will not create serious aggregation bias. Also the theory yields equations that are expressed in the percentage rate of change form, and the data are in absolute levels. However by mathematically integrating equation 7, we can
convert the model into log level form. This transformation does not alter the signs of the variables. 19

The Variables

The empirical measure of the dependent variable is the "average number of days of work at nonfarm jobs per farm operator." It is constructed by dividing the aggregate days farm operators worked off the farm at nonfarm jobs by the number of farm operators.

Several empirical measures of the nonfarm wage rate of the husband and wife can be constructed depending on what is judged to be the appropriate size of the local labor market. 20 It might be the state or some region within the state, but my choice is the county. In addition to (i) the aggregate number of days of off-farm work at nonfarm jobs of farm operators, the Census of Agriculture reports (ii) the aggregate number of days of off-farm work at nonfarm jobs of "other persons" in the farm operator's household, (iii) the aggregate wage and salary income of all persons in the farm operator's household, and (iv) the aggregate nonfarm income of persons other than the farm operator. An empirical measure of the average daily wage for nonfarm work of farm operators is (iii) less (iv) divided by (i) and of wives is (iv) divided by (ii).

However not all of the nonfarm income of other persons is from wage and salary income. Aggregate data that are available at the state level (but are unavailable at the county level) indicate that 26.6 percent, 18.8 percent, and 24.8 percent of the nonfarm income of other persons are from nonearnings sources for Iowa, North Carolina, and Oklahoma respectively. 21 Thus the average wage rate of farm operators is underestimated and the average wage rate of the wives is overestimated by using the above empirical measures, and the degree of under- and overestimate varies across the states. In an attempt to improve the estimates
of the daily wage rates, the aggregate nonfarm income of other persons for each county was multiplied by the appropriate state factor in constructing the wage rates. 22

Farm-household nonearnings income is measured by two variables. The first, average net-farm income, is calculated by subtracting aggregate current expenditures from the aggregate value of farm products sold and dividing by the number of farms. 23 Net-farm income is a return to farm-family human capital that is employed on the farm and to material capital including land; consequently, it is not a pure form of nonearnings income. However, the return to human and nonhuman capital cannot be easily separated. The second is the average "other" income per farm. It is constructed by subtracting the aggregate wage and salary income of all persons in the farm operator's household from aggregate nonfarm income of all persons and dividing by the number of farms.

The efficiency parameters associated with the husband (β) and wife (γ) are measured by mean years of schooling. For farm operators, mean years of schooling are constructed directly from the distribution of farm operators by years of schooling completed. 24 Mean years of schooling of wives are constructed from the distribution of all persons 25 years and older in the farm operator's household by years of schooling completed and the distribution of farm operators by years of schooling completed. 25 However, knowledge of the educational distribution of farm operators who are under 25 years of age is required. I proceeded under the arbitrary assumption that they had an average level of education that was equal to the average level of education of all farm operators for the county. Using this assumption, the average level of education of the wives of farmers is measured as the average level of education of all persons other than farm operators in the farm operator's household who were age 25 and over. 26
Three additional variables are added to the empirical model. They are: the number of children 5 years of age and under, the closeness of the farm to nonfarm jobs, and state dummy variables. It is well known that the presence of young children in the household places a relatively heavy demand on the consumption time of adult family members, especially of the wife. To incorporate the effect of their presence on the supply of time at work, the variable, average number of children 5 years of age and under per farm-operator household, is added to the model. It is constructed by dividing the aggregate number of persons 5 years old and under in the farm operator's household by the number of farms.

The closeness of the farm to nonfarm jobs will clearly affect the supply of time to nonfarm work. If the farm is close to the source of nonfarm jobs, the commuting costs (both direct outlays and the value of time spent commuting) will be less than if the farm is farther away. The empirical measure of "closeness" of the farm to nonfarm jobs is the average number of persons employed in retail trades, manufacturing, and local governments per farm. It is constructed by summing the aggregate number of paid employees in retail trades (Census of Business, 1963 - Retail Trade, Area Statistics, Table 3), of all employees in manufacturing (Census of Manufacturing, 1963 - Area Statistics, Vol. III, Table 4), and of total employees of local governments in county areas (Census of Governments, 1962, Vol. III, Table 27) and dividing by the number of farms.

State dummy variables are introduced to capture regional (and state) differences in the price of market goods and services.

Table 4 identifies the variables. Table 5 presents the simple correlation coefficients of the variables.

Results

The results from estimating an aggregate supply function of nonfarm
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
<th>Mean</th>
<th>Sd</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWF</td>
<td>Days of nonfarm work of farm operators</td>
<td>68.0</td>
<td>34.4</td>
<td>15.6</td>
<td>166.1</td>
</tr>
<tr>
<td>WAGEF</td>
<td>Daily wage rate of farm operators at nonfarm work</td>
<td>16.7</td>
<td>3.7</td>
<td>6.7</td>
<td>31.1</td>
</tr>
<tr>
<td>WAGEW</td>
<td>Daily wage rate of wives at nonfarm work</td>
<td>14.2</td>
<td>2.6</td>
<td>8.1</td>
<td>28.4</td>
</tr>
<tr>
<td>NETFI</td>
<td>Net-farm income</td>
<td>5172.1</td>
<td>3322.9</td>
<td>-55.1</td>
<td>13,265.0</td>
</tr>
<tr>
<td>OI</td>
<td>Other household income</td>
<td>1213.4</td>
<td>521.1</td>
<td>363.0</td>
<td>5,763.9</td>
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<tr>
<td>EDF</td>
<td>Education of farm operators</td>
<td>9.2</td>
<td>1.3</td>
<td>6.5</td>
<td>12.1</td>
</tr>
<tr>
<td>EDW</td>
<td>Education of wives of farm operators</td>
<td>10.0</td>
<td>1.1</td>
<td>7.7</td>
<td>12.8</td>
</tr>
<tr>
<td>CHILD</td>
<td>Children ≤ 5 years of age</td>
<td>.250</td>
<td>.112</td>
<td>.030</td>
<td>.651</td>
</tr>
<tr>
<td>DIST</td>
<td>Closeness to nonfarm jobs</td>
<td>4.4</td>
<td>9.4</td>
<td>.24</td>
<td>73.4</td>
</tr>
<tr>
<td>MAGE</td>
<td>Mean age of farm operators</td>
<td>50.7</td>
<td>2.4</td>
<td>45.0</td>
<td>57.5</td>
</tr>
<tr>
<td>Variables</td>
<td>WAGEF</td>
<td>WAGEW</td>
<td>NETFI</td>
<td>OI</td>
<td>EDF</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>DWF</td>
<td>0.022</td>
<td>-0.391</td>
<td>-0.811</td>
<td>-0.206</td>
<td>-0.180</td>
</tr>
<tr>
<td>WAGEF</td>
<td>0.139</td>
<td>0.221</td>
<td>0.180</td>
<td>0.497</td>
<td>0.462</td>
</tr>
<tr>
<td>WAGEW</td>
<td>0.451</td>
<td>0.530</td>
<td>0.487</td>
<td>0.515</td>
<td>0.288</td>
</tr>
<tr>
<td>NETFI</td>
<td>0.384</td>
<td>0.490</td>
<td>0.560</td>
<td>0.570</td>
<td>-0.140</td>
</tr>
<tr>
<td>OI</td>
<td>0.583</td>
<td>0.592</td>
<td>0.085</td>
<td>-0.072</td>
<td>-0.198</td>
</tr>
<tr>
<td>EDF</td>
<td>0.923</td>
<td>0.158</td>
<td>0.005</td>
<td>-0.246</td>
<td></td>
</tr>
<tr>
<td>EDW</td>
<td>0.215</td>
<td>-0.039</td>
<td>-0.307</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHILD</td>
<td>-0.168</td>
<td>-0.767</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
working time of farm operators, using the classical least squares estimation procedure, are presented in Table 6. In general the results are good. The coefficients have plausible signs; most have large t-values; and the $R^2$ is large, .79. A test of the null hypothesis that the household production-consumption model has no power for explaining variations in the nonfarm working time of farm operators is rejected at the one percent level. 31

The really important variables in the supply equation - WAGEF, NETFI, EDF, and DIST - have coefficients that are statistically significant at the one percent level. The positive coefficient of WAGEF (farmers' nonfarm wage rate) suggests that the summation of the positive substitution effects in consumption and in production of each Z is larger than the negative income effect on hours of work for an increase in the husband's wage rate. Thus the supply curve of nonfarm working time is upward sloping. The point estimate of the elasticity of supply is .23. As expected, increasing net-farm income has a strong negative effect on the supply of nonfarm work. This suggests that if net-farm income were to decline, then nonfarm work would increase; hence the relative importance of income from nonfarm sources to farm families would increase.

The positive coefficient of EDF (farmers' education), holding his wage rate constant, has a clear interpretation in the household production-consumption model. An increase in his education increases the efficiency of household production and reduces the quantity of all inputs (including his consumption time) required to produce any given bundle of Z's. However the rise in efficiency increases real full income; hence it increases the demand for all (noninferior) inputs including consumption time. The positive coefficient suggests that the net effect is a reduction in his consumption time and hence an increase in the supply of nonfarm working time. The positive coefficient also suggests that the derived full income elasticity
of demand for husband's consumption time in farm families is less than one \( (\eta_{EF} < 1) \). Other plausible interpretations of the effect of EDF are: (1) that farmers with more education have more and better information about important farming and nonfarming activities, including opportunities for nonfarm employment. Hence holding the wage rate constant, farmers with more education work more days at nonfarm work.\(^{33}\) (2) That farmers with more education produce any given level of net-farm income with less of their working time and more of other farm supplied factors of production, and hence they have more time to allocate to consumption and nonfarm work.

The "closeness" (DIST) of the farm to nonfarm jobs is a remarkably strong variable, given the crudeness of its construction. Its positive sign, indicating that the closer the farm (and farmer) to nonfarm jobs, the larger is the number of days of nonfarm work, suggests that commuting costs (both direct outlays and the value of time spent commuting) are an important determinant of the supply of nonfarm work of farmers. DIST can also be interpreted as a measure of the information about or "availability" of nonfarm jobs. Hence increasing the information about or the availability of nonfarm work increases the number of days of nonfarm work.

Now turn to the variables that are directly associated with the wife, WAGEW and EDW. The negative (and statistically significant) coefficient of the wife's wage rate indicates that an increase in the wage rate of the farm-operator's wife will reduce the hours of nonfarm work supplied by the farmer. The point estimate of the "cross" elasticity is \(-.28\). In the household production-consumption model the influence of the wife's education, holding her wage rate constant, also has a clear interpretation. An increase in her education increases the efficiency of household production
and reduces the quantity of all inputs (including husband's consumption time) required to produce any given bundle of Z's. However the rise in efficiency increases real full income; hence it increases the demand for all (noninferior) inputs including husband's consumption time. The negative coefficient of EDW suggests that the net effect is an increase in husband's consumption time (or perhaps an increase in farm working time) and hence a decrease in the supply of nonfarm working time. The negative coefficient also suggests that the derived full income elasticity of demand for husband's consumption time is slightly greater than unity. The latter is a contradiction with the implication from the coefficient of EDF. 34

The number of young children in the farm operator's household has a statistically significant (at better than the one percent level) negative effect on the days of nonfarm work. It is well known that the presence of young children in the household places a relatively heavy demand on the consumption time of the wife. Hence the presence of young children reduces the labor force participation rate of women. These results suggest that the presence of young children in the farm household also has a strong depressing effect on the days of nonfarm work of males (farmers). Thus an increase in the number of young children in the farm household reduces the hours of nonfarm work of the farm operator and hence increases his hours of consumption time and/or his hours of farm work.

However, the performance of CHILD is too good. It must be capturing to some extent the effect of other variables (which are excluded from the regression) that are highly correlated with it. A large and not unexpected negative correlation (−.77) does exist between the average
TABLE 6

AN ESTIMATE OF AN AGGREGATE CROSS-SECTIONAL SUPPLY FUNCTION OF NONFARM WORK OF FARM OPERATORS, COUNTY DATA FOR IOWA, NORTH CAROLINA, AND OKLAHOMA, 1964\(^a\) (N = 275\(^b\))

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Coefficients</th>
<th>t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAGEF(^c)</td>
<td>0.227</td>
<td>2.476</td>
</tr>
<tr>
<td>WAGEW(^c)</td>
<td>-0.281</td>
<td>-2.342</td>
</tr>
<tr>
<td>NETFI(^c)</td>
<td>-0.294</td>
<td>-12.194</td>
</tr>
<tr>
<td>O1(^c)</td>
<td>0.013</td>
<td>0.203</td>
</tr>
<tr>
<td>EDF</td>
<td>0.117</td>
<td>2.971</td>
</tr>
<tr>
<td>EDW</td>
<td>-0.043</td>
<td>-1.077</td>
</tr>
<tr>
<td>CHILD</td>
<td>-0.999</td>
<td>-5.124</td>
</tr>
<tr>
<td>DIST(^c)</td>
<td>0.117</td>
<td>6.259</td>
</tr>
<tr>
<td>D(_1)</td>
<td>-0.362</td>
<td>-6.362</td>
</tr>
<tr>
<td>D(_2)</td>
<td>-0.118</td>
<td>-1.530</td>
</tr>
<tr>
<td>INTERCEPT</td>
<td>6.208</td>
<td>12.282</td>
</tr>
</tbody>
</table>

\(R^2\)  \(\quad .786\)

\(^a\) Dependent variable is the log of DWF.

\(^b\) One observation was excluded because it had a negative value for NETFI.

\(^c\) Variable enters the regression in the log form.
age of farm operators and CHILD. A relatively low average age of farmers in a county suggests that young farmers have been replacing old farmers. This may indicate that agriculture in such a county has a relatively bright future; consequently, the young farmers may be "investing" a relatively large amount of their time in the farm business and little in nonfarm work. The simple correlation between mean age of farm operators and NETFI is -.72 (see Table 5).

"Other" income performed poorly in the regression. This is not surprising given the substantial errors that typically arise due to under- and nonreporting of this form of income.

The "Intercept" estimates the constant term in the supply equation for Oklahoma. The coefficients of the dummy variables $D_1$ and $D_2$ estimate the change in the constant term for Iowa and North Carolina respectively. The coefficients imply that holding "other things equal" a larger number of days of nonfarm work is supplied by farmers in Oklahoma. The state dummies were originally introduced to capture the effect of regional differences in the price of market goods and services. The cost of living is probably higher in Iowa and North Carolina than in Oklahoma. If so, this would suggest than an increase in the price of market goods reduces the supply of nonfarm working time of farmers. However, the dummies may be capturing other differences among the states that affect the number of days of nonfarm work.

CONCLUSIONS AND IMPLICATIONS

A sizable and rising share of the total income of farm people is from nonfarm sources. Most, 70-75 percent, of the income of farm families from nonfarm sources consists of earnings from off-farm work. Consistent with the above changes in the sources of farm-family income
is the rising rate of participation of farm-family members in off-farm work.

The household production-consumption model provides a strong theoretical foundation for analyzing the supply of working time. For the husband, his supply of working time depends on his wage rate and education, on the wage rate and education of his wife, on nonearnings income of the household, and on the prices of market goods. Although theory provides only weak predictions about the signs of the coefficients of the variables, the model can be applied to data and tested to see if the variables explain the supply of working time.

Empirical results from an analysis of the supply of nonfarm working time of farm operators using cross-sectional county aggregate data for Iowa, North Carolina, and Oklahoma are:

1. That the empirical specification of the household production-consumption model possesses strong power for explaining variations in the nonfarm supply of working time of farm operators. This lends support to the hypothesis that decisions about the hours of work in farm families are made in a family context where production is one of the activities of the household.

2. That the estimated elasticity of supply of nonfarm working time by farm operators is .23. Furthermore, there is no support for the hypothesis that the supply of nonfarm working time by farm operators is backward bending. Increases in farmers' nonfarm wage rate will increase the days of nonfarm work and hence will increase the relative importance of nonfarm income to farm families.

3. That increasing the wives' nonfarm wage rate reduces the days of nonfarm work of farm operators. The point estimate of the cross wage elasticity is -.28. Hence if wage rates at nonfarm work of the wives of
farm operators have been increasing relative to the nonfarm wage rate of farm operators (as they almost certainly have with the general rise in relative wages of and decrease in discrimination against women), then ceteris paribus the days of nonfarm work of farm operators will decline. Since the days of nonfarm work of farm operators have been increasing, we can infer that other things have not been equal.

4. That increasing net-farm income reduces the days of nonfarm work of farm operators. Thus for farm operators who have a small net-farm income, nonfarm work is an activity that increases family income. If net-farm income were to decline, then income from nonfarm sources would become relatively more important to farm families.

5. That increasing the education of the farm operators and decreasing the education of their wives increases the days of nonfarm work of farmers. Thus, other things equal, farm operators who have high levels of education and have wives with low levels of education do work more days at nonfarm jobs than similar farm operators who are married to wives who have high levels of education. In the household production-consumption model, the effect of education on hours of work arises from the effect of education on the efficiency of household production. However, the education of farm people may have additional effects (other than on wages and efficiency of household production) on the supply of nonfarm working time by creating skills for analyzing and interpreting information, including the evaluation of nonfarm job opportunities, thereby improving allocative efficiency. In addition, the absolute size of the coefficient of farmers' education is larger than the coefficient of their wives' education. Hence, if the level of education of farm operators and their
wives were to increase by the same amount, then *ceteris paribus* the days of nonfarm work of farm operators would increase and nonfarm income would become relatively and absolutely more important to farm families.

6. That increasing the closeness of farmers to nonfarm jobs and hence reducing the direct costs and indirect costs of commuting time increases the days of nonfarm work. This supports the hypothesis that the location of farms relative to the location of nonfarm jobs is an important factor for determining the relative importance of nonfarm income (especially earnings income) of farm families. Also, it suggests that rural development programs, geared to increasing the number of nonfarm jobs in rural areas, would increase the days of nonfarm work of farm operators, and thus increase the relative importance of nonfarm income to farm families.
REFERENCES


FOOTNOTES

1 I am indebted to Michael Boehlje and Ronald Moomaw for helpful comments and suggestions.

2 Schultz [12, p. 848] chides the profession for failing to analyze this important development.

3 Although a sizable net reduction in the farm population has occurred, people continue to enter farming. Some of the new entrants use off-farm work as a source of income while entering agriculture.

4 In an earlier study Gardner [6] analyzed the determinants of U.S. farm family income inequality at the state level and found that off-farm work contributed to a reduction in long-run income inequality.

5 Note that aggregate income from nonfarm sources tripled between 1946 and 1970; however, aggregate income from farm sources was unchanged.

6 Note that off-farm work includes both work on other farms and work at nonfarm jobs.

7 The source is the Census of Agriculture.

8 When production is added to the activities of the household, we can draw upon the theory of the firm for constructing models to explain the behavior of households and of individual family members. The production-consumption model yields much richer implications than the traditional theory of consumption (including the work-leisure model) about variables that affect the behavior of individual family members. For example, the household production-consumption model permits the systematic incorporation of the effects of education, climate, and advertising on household and individual member's behavior by introducing them as environmental variables that affect the efficiency of household production. The traditional theory of consumption must rely on a change in tastes to incorporate their effects on behavior (see Becker [2, p. 47-48]).

9 Gardner [7] employs a similar model to analyze the fertility behavior of North Carolina rural families.

10 Consumption time includes time spent eating, sleeping, and contemplating and time allocated to meal preparation, leisure, recreation, personal care, sex, care and training of children, etc.

11 The environment in which household production occurs affects the efficiency of household production. Two important environmental variables are the husband's and wife's formal education.
Primes are used as superscripts to indicate variables that are associated with the wife.

For a linear homogeneous production function, marginal cost and average cost are equal and are independent of the level of output.

Since each individual is assumed to allocate all of his (her) time between working and consuming, and increase (decrease) in consumption time implies a decrease (increase) in working time:

$$7. \quad E_t = -(\frac{t_c}{t_w}) E_t.$$ 

The effect of a change in the efficiency parameters is introduced as Hicks neutral technical change. Also the rates of efficiency change associated with the husband (wife) are assumed to be the same in the production of both $z_1$ and $z_2$.

At cost minimization it is well known that the summation of the weighted (by share of a factor's cost in total cost) partial elasticities of substitution is zero and that the own partial elasticity of substitution is negative (see Allen [1, p. 503-508]). For two commodities, $k_{z_1} \sigma_{z_1} + k_{z_2} \sigma_{z_1} = 0$, $\sigma_{z_1} < 0$, and $k_{z_2} = 1-k_{z_1}$

$$\sigma_{z_1} = -\left[\frac{k_{z_2}}{k_{z_1}}\right] \sigma_{z_1} \sigma_{z_2} < 0.$$ 

Similarly for three factors of production,

$$\alpha_{t_1} \sigma_{t_1} + \alpha_{t_2} \sigma_{t_2} + \alpha_{t_3} \sigma_{t_3} = 0$$

and $\alpha_{t_1} < 0$ so $\alpha_{t_1} \sigma_{t_1} = -\left[\alpha_{t_1}\right] \sigma_{t_1} \sigma_{t_1} < 0$.

However the real full income compensated effect of an increase in the husband's wage rate on the demand for his consumption time is negative and hence on the supply of hours of work is positive.

For farm households in 1964 the farm operator was the major supplier of days of work to nonfarm jobs and the major source of wage and salary income. He was responsible for 64 percent of the total number of days worked off the farm at nonfarm jobs of all persons in the farm operator's household and for 69 percent of the wage and salary income (Census of Agriculture).

The fundamental assumption is that the parameters are constant over the observed range of the activities.

The assumption is that each farm household faces a perfectly elastic demand for the nonfarm labor services of its individual members. Hence the wage rate can be taken as exogenous to the household. Also I assume that the nonfarm wage rates of the farm operators and their wives measure the opportunity cost of time of the husbands and wives respectively.

The source is the Census of Agriculture.
The aggregate number of days of off-farm work at nonfarm jobs and aggregate nonfarm income of other persons also includes days worked and earnings for household members other than wives of farm operators.

Current expenditures include expenditures for feed for livestock and poultry; seeds, bulbs, plants, and trees; fertilizer and fertilizing material; gasoline and other petroleum, fuel and oil for the farm business; machinery hire, custom and contract work; and hired farm labor and purchases of livestock and poultry.

Weights are 2, 4, 8, 10, 12, 14, and 16.2 for the respective schooling completion classes: 0-4, 5-7, 8, 9-11, 12, 13-15, and 16 or more.

Sources are the Census of Agriculture.

This group does include persons other than wives of farm operators.


Source is the Census of Agriculture.

Commuting time can be entered systematically into the household production-consumption model, thereby elaborating the theory of the allocation of time. See Gronau [8] for an analysis of the value of time in passenger transportation.

Ideally one would like a weighted (by number of jobs) average of the distance of farms in the county from the geographical location of nonfarm jobs. Giving a strict interpretation of the closeness variable, one can view it as a measure of the average density per farm of nonfarm jobs in the county. Increasing the average density would reduce the average distance of the farmers from nonfarm jobs. However, we know that nonfarm jobs are not uniformly distributed throughout the county. They tend to be concentrated in a few towns and cities. Bryant [4], analyzing the variation in income of farmers, constructed a variable to measure the distance of a county from SMSA's of different sizes. However his variable fails to capture the importance of nonfarm jobs located outside SMSA's.

The calculated value of the F statistic with 10 and 264 degrees of freedom is 96.7. The tabled value of the F with 10 and 264 degrees of freedom is 2.40 at the 1 percent level.

This interpretation assumes that Hicks neutral technical change is the correct specification of the effect of husband's efficiency parameter on household production and that the education of the husband serves as a good proxy for his efficiency parameter.

This interpretation is consistent with the growing belief that allocative ability is one of the important skills created by education. See Welch [15] and Huffman [10].

However the coefficient of EDW is statistically significant at only
the 30 percent level. We could perhaps be asking too much of the data by attempting to estimate coefficients for the highly correlated variables EDF and EDW (see Table 5).

This effect is contrary to the results of Smith [13] for the nonfarm population. In analyzing the life cycle allocation of time in a family context, he found that the presence of small children in the household increased the hours worked by the male.

Tolley [14] has analyzed the replacement of one kind of human capital with another in studying management entry into U. S. agriculture.