August 2, 1976



# THE VALUE OF THE PRODUCTIVE TIME OF FARM WIVES: IOWA, NORTH CAROLINA AND OKLAHOMA

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Farm wives allocate their time outside of the household to two work activities, farm and off-farm work. Although few studies have attempted to determine the value of the time of farm wives devoted to farm production, the value of their time is important for understanding the level and fluctuation of farm household income and the changing time allocation of farm wives.

This study focuses on assessing the value of time spent by farm wives at farm work. The data on wives' farm work were derived from the 1964 Census of Agriculture. They have deficiencies, but until surveys are revised to better measure the working time of farm wives, these and similar data are the best available. The results of this study show that farm work by farm wives contributes significantly to farm output and that the marginal product of their time at farm work compares favorably with their nonfarm wage.

The paper is organized as follows: First, participation of farm wives in farm work is discussed. Next, the empirical analysis describes the data, empirical model, and the results. The last section presents the implications.

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This paper is to be presented in the session on "The Economics of the Farm Family," American Agricultural Economics Association Meetings, August 16, 1976, Pennsylvania State University.

## PARTICIPATION OF FARM WIVES IN FARM WORK

Much of U.S. agriculture continues to be organized around the institutional structure of the family farm, and husband-wife families are the predominant family type. Modern economic growth and the accompanying adjustments have, however, brought significant changes in farms and farm families. During the past 50 years, growth in the demand for nonagricultural products relative to agricultural products and concommitant adoption of labor-saving agricultural technology have created economic incentives for large numbers of people to leave farming, but those farms that remain have become larger and more mechanized.

In farm households, as well as in nonfarm households, birth rates have fallen during the past two decades, and households have purchased many new durable goods -- some of which are labor saving. Both these factors have contributed to a reduction in the demand for wives' household time, thereby releasing additional time for work outside of the household and (or) for "leisure" time. Furthermore, the evidence shows a rising participation of farm wives in work outside of the household, which is similar to the rising labor force participation of nonfarm wives (U.S. Dept. of Labor).

Farm wives are indeed an important source of labor on farms. But the magnitude and change in this labor input is difficult to assess because of a paucity of data and deficiencies in data that are collected. In the Census of Agriculture, except for 1964, neither the number of wives working on farms nor their hours (or days) of farm work were collected. In other data, many working farm wives are not counted as being employed in agriculture. The primary reason is that most wives working on family farms are classified in the occupation of unpaid family workers, and the Bureau of Labor Statistics (BLS), Bureau of the Census (in the Census of Population), and USDA (in Farm Labor)

fail to count as being employed the unpaid family workers who work less than 15 hours during the survey week. A secondary reason is the timing of surveys, given the seasonality of farm work. For example, the BLS labor force participation rate survey is taken in mid-March, clearly a slack time on most farms. A third reason is that multiple jobholders are classified (BLS and Bureau of the Census) as working in the industry where the largest number of hours is worked. Thus, farm wives with both farm and nonfarm work may be counted as working only in the nonfarm sector.

The special Farm Labor Report of the 1964 Census of Agriculture (U.S. Dept. of Commerce 1968, Tables 3 and 4) does provide comprehensive national estimates of farm work by farm wives. This report uses a broad definition of farm work[1/] and contains data on hours of farm work for 52 survey weeks of a year for all farm household members. These data show an annual average participation rate in farm work by farm wives of 45.8 percent, varying from 37.1 percent in January to 48 percent in June (see Table 1).[2/] Furthermore, contrast the BLS estimate of labor force participation rate in agriculture of wives with a farm residence of 11 percent on March 15, 1965, to the Farm Labor Report estimate of the participation rate of farm wives in farm work of 37 percent for the week ending March 19. Wives reporting farm work, devoted an annual average of 19.9 hours to it per week, varying from 17 hours in January and March to 22.3 hours in July. (Farm operators (who reported farm work) worked an annual average of 41 hours per week.) Thus, although these data show a relatively high rate of participation by farm wives in farm work, the average number of hours of work per week is significant but not large.

Data on the participation of farm wives in farm work for other years are unavailable. Thus, a trend cannot be established. But I hypothesize that the long-term trend in wives' participation in farm work has been upward, although

TABLE 1

Labor Force Participation by Farm Wives on Family Farm: U.S.

| Month | Rate[a/] | Hours/week for wives working |
|---|---|---|
| April, 1965 | 41.2 | 18.7 |
| May | 46.9 | 20.1 |
| June | 48.0 | 21.9 |
| July | 47.4 | 22.3 |
| August | 45.7 | 21.9 |
| September | 44.2 | 20.6 |
| October | 43.9 | 21.0 |
| November | 42.1 | 20.2 |
| December | 38.4 | 17.4 |
| January, 1966 | 37.1 | 17.1 |
| February | 36.8 | 17.2 |
| March | 37.8 | 17.1 |
| Average, annual | 42.8 | 19.9 |

Source: U.S. Dept. of Commerce 1968, Tables 3 and 4.

a/ See footnote 2.

not as rapid as the labor force participation rate for all women, with cycles about the trend caused by disturbances -- major wars, business cycles, and cycles in farm profits -- in the farm and nonfarm labor markets. The increasing mechanization of agriculture -- especially size, versatility, and power accessories of tractors -- and mechanization of livestock feeding have made physical strength less important for many farming activities. Tractors with radios and with air-conditioned cabs have improved the quality of working conditions, especially in crop production. The steadily falling number of hired workers and of teenage children in farm households leaves only wives on many farms to provide human assistance with two-person farming activities. The generally increasing size of farm businesses and the dynamic economic environment facing farmers have increased the expected return from accurate and complete business records, and farm wives do much of the farm-business record keeping.[3/] Also, as more farm husbands take full or part-time off-farm jobs (U.S. Dept. of Commerce 1967, p. 514-518; 1973, p. 178), wives are left to supervise and do the farming.

We cannot, however, forget that the off-farm labor force participation rate of farm wives has risen significantly -- from 16 percent in March, 1959, to 26 percent in March, 1971 (U.S. Dept. of Labor). Thus, increasing hours of off-farm work may account for all the increase in hours of nonhousehold work by farm wives.

## THE EMPIRICAL ANALYSIS

The productive value of farm wives' time in farm work is to be assessed by estimating an aggregate production function. The data, empirical specification of the model, and the empirical results are presented and discussed.

The Data

The observations are per-farm county averages for all 276 Iowa, North Carolina, and Oklahoma counties. Observations from these three states were chosen because, in these states, agriculture continues to be an important industry, the family farm continues to be the predominant institutional structure, and because these states represent different geographic regions of the U.S. -- Midwest, Southwest, and Southeast -- which have different on-farm and off-farm work opportunities for farm wives.

County tables from the 1964 Census of Agriculture are the primary data. Farm outputs and inputs are measured as flows. Output by final product type is gross product and is measured as value of sales, home consumption, rental value of farm dwellings, government farm program payments, and net increase in farm inventories. The inputs of husband, wife, and hired labor are derived from flow data on actual numbers of days worked on farms.[4/] Man (woman) days of farm work per year are derived from adjusted weekly hours of farm work by farm operators (nonoperator household members) and from annual expenditures on hired labor.[5/] Education of farm husbands (wives) is an index derived as an income weighted average of the number of farm operators (wives of farm operators) in seven different schooling completion classes.

The land-and-building input is measured as the rental on the current value of farm land and buildings; the fertilizer and seed input is measured as price weighted primary plant nutrients plus expenditures on seed. Machinery services are the rental on an inventory of a selected group of machines on farms in 1964 plus expenditures on petroleum products. The livestock input is measured as the rental on the inventory of breeding stock plus expenditures on purchased livestock and feed. An agricultural extension input is derived from unpublished Federal Extension Service data for 1960 as the annual average number of one-tenth

man-days spent on crop and livestock activities by agricultural extension agents.

The arithmetic mean value of annual days worked by Iowa wives of 105 (Table 2) is much larger than for wives of North Carolina (40) and Oklahoma (64).

The Empirical Specification

The empirical specification of the production function is:

$$(1)\quad \ln Y_{ij} = \alpha_{IA}D_1 + \alpha_{NC}D_2 + \alpha_{OK}D_3 + \sum_{\ell=1}^{k-3} \alpha_\ell \ln X_{ij\ell} + \rho \sum_{\ell=1}^{k-3} \beta_\ell \ln X_{ij\ell} + \mu_{ij},$$

where $\rho$ = the share of final livestock output in total output, $E\mu_{ij}^2 = \sigma_i^2$, and $D_i$ is a 1-0 state dummy variable. The specification permits the input-output relationship to vary by product mix of output and the intercept and variance of the disturbance of the function to differ across states. The appropriate estimation procedure for (1) is weighted (generalized) least squares.

The Empirical Results

The results from fitting equation (1) to the 276 observations of per-farm county averages are reported in Table 3. All the estimated $\alpha$'s are positive and significantly different from zero, except for the coefficient of fertilizer and seed input. The input coefficients, $\alpha_\ell + \rho\beta_\ell$, (and partial elasticity of output with respect to $X_\ell$) for wife labor and three of the other inputs differ significantly by product mix of output. For wife labor, the input coefficient declines as $\rho$ increases. By assuming that variable factors are paid proportionally to their marginal product and total payments just exhaust output, the estimate implies that the factor cost share of wife labor is largest on crop farms and declines as the relative importance of livestock output increases. The results also yield implications on factor ratios. As $\rho$ increases, the cost minimizing ratio of wife to hired labor increases, but the ratios of wife labor to other inputs decline.[6/]

TABLE 2

SUMMARY STATISTICS, 1964

| Variables | Arithmetic Means (Standard Deviation) | | | |
|---|---|---|---|---|
| | Whole Sample (n=276) | Iowa Counties ($n_1$=99) | N. Carolina Counties ($n_2$=100) | Oklahoma Counties ($n_3$=77) |
| Aggregate Output ($/yr) | 11,987.0 (6,676.0) | 17,772.2 | 8,466.6 | 8,884.7 |
| Crop Output | 5,659.7 (3,659.1) | 5,297.0 | 6,049.6 | 4,663.0 |
| Livestock Output | 6,327.7 (5,170.8) | 11,915.0 | 2,417.0 | 4,221.7 |
| Land & Buildings ($/yr) | 2,680.3 (2,236.6) | 5,297.0 | 983.1 | 1,520.2 |
| Fertilizer & Seeds ($/yr) | 560.2 (355.1) | 743.8 | 542.8 | 346.8 |
| Machinery ($/yr) | 1,754.6 (779.9) | 2,513.2 | 1,188.0 | 1,515.2 |
| Livestock ($/yr) | 3,620.7 (3,068.4) | 6,438.6 | 1,437.4 | 2,833.2 |
| Hired Labor (days/yr) | 59.7 (53.6) | 34.4 | 97.0 | 43.7 |
| Farm Husband (days/yr) | | | | |
| Days Own Farm Work | 194.0 (68.2) | 275.9 | 142.4 | 155.7 |
| Days Off Farm Work | 66.2 | 43.2 | 68.9 | 101.6 |
| Total Days Worked | 260.2 | 319.1 | 211.3 | 257.3 |
| Farm Wife (days/yr) | | | | |
| Days Own Farm Work | 70.1 (28.3) | 104.9 | 40.4 | 63.8 |
| Days Off Farm Work | 44.6 | 31.4 | 60.5 | 40.9 |
| Total Days Worked | 114.7 | 136.3 | 100.9 | 108.7 |
| Education (years) | | | | |
| Farm Husband | 9.2 (1.25) | 10.2 | 7.8 | 9.7 |
| Farm Wife | 10.0 (1.13) | 10.9 | 8.8 | 10.3 |
| Extension (one-tenth day/yr) | 1.85 (2.01) | 0.64 | 3.18 | 1.69 |
| $\rho$ | 0.506 (0.220) | 0.66 | 0.33 | 0.53 |

The three right most columns of Table 3 provide estimates of an agricultural production function for Iowa, North Carolina, and Oklahoma, respectively. The coefficients of each function are evaluated at the mean value of $\rho$ for each state subsample. The estimates of the scale parameter ($h_j$) for the functions are significantly larger than unity. Thus, for all three states, the results imply economics of scale in agricultural production. In addition, the scale parameter is largest for North Carolina and smallest for Iowa, but none of the differences is statistically significant. Differences in the intercepts for the three functions do not imply efficiency differences; they are largely the result of procedures used in deriving the variables.

## IMPLICATIONS

A major postwar change in the U.S. economy has been the rising labor force participation rate of married women. An immediate consequence is larger household incomes and larger quantities of goods and services produced and consumed. For farm households, increased hours of work by wives requires allocative decisions on working time. Additional hours could be used to increase the total quantity of available farm resources or to permit a substitution of wife for hired labor and other inputs. Alternatively, additional hours of work could be devoted to nonfarm wage work. A comparison, however, of the implied marginal products from this study of wives' time, adjusted for economics of scale of about 1.5, with the nonfarm wage rate of farm wives (Table 4) shows that farm family incomes in Iowa and Oklahoma (North Carolina) would have been larger in 1964 if additional hours of wives' time had been allocated to nonfarm work (farm work).[7/] The reader is cautioned that none of the differences between marginal products and wage rates is statistically significant. One does, however, puzzle at the reasons for the large differences across the three states

TABLE 3

ESTIMATE OF AN AGGREGATE AGRICULTURAL PRODUCTION FUNCTION FOR IOWA, NORTH CAROLINA, AND OKLAHOMA: 1964

| Input | Regression coefficient (t-ratios) | Implied Coefficients (t-ratios) $\bar{\rho}_{IA}$=.66 | $\bar{\rho}_{NC}$=.33 | $\bar{\rho}_{OK}$=.53 |
|---|---|---|---|---|
| Land & Buildings[a/] | 0.073<br>(2.28) | 0.073<br>(2.28) | 0.073<br>(2.28) | 0.073<br>(2.28) |
| Fertilizer & Seeds | 0.022<br>(1.02) | 0.022<br>(1.02) | 0.022<br>(1.02) | 0.022<br>(1.02) |
| Machinery | 0.441<br>(9.73) | 0.441<br>(9.73) | 0.441<br>(9.73) | 0.441<br>(9.73) |
| Livestock | 0.132<br>(5.11) | 0.488<br>(23.02) | 0.310<br>(15.42) | 0.418<br>(21.11) |
| Hired Labor | 0.214<br>(7.52) | 0.045<br>(2.23) | 0.130<br>(7.30) | 0.078<br>(4.48) |
| Husb. man-days × Edf. | 0.419<br>(8.67) | 0.313<br>(6.36) | 0.366<br>(7.55) | 0.334<br>(6.83) |
| Wife woman-days × Edw. | 0.196<br>(2.92) | 0.090<br>(1.36) | 0.143<br>(2.15) | 0.111<br>(1.68) |
| Extension | 0.015<br>(3.16) | 0.015<br>(3.16) | 0.015<br>(3.16) | 0.015<br>(3.16) |
| ρ × Livestock | 0.539<br>(14.40) | | | |
| ρ × Hired Labor | -0.256<br>(-4.94) | | | |
| ρ × Husb. man-days × Edf. | -0.161<br>(-11.15) | | | |
| ρ × Wife woman-days × Edw. | -0.161<br>(-11.15) | | | |
| $D_1$ | -4.462<br>(-4.11) | -4.462 | | |
| $D_2$ | -4.226<br>(-4.11) | | -4.226 | |
| $D_3$ | -4.429<br>(-4.19) | | | -4.429 |
| $R^2$ = .999 | $\hat{h}_j$ | 1.472 | 1.485 | 1.477 |
| | (s.e.) | (0.075) | (0.076) | (0.075) |
| | $\hat{\sigma}_j^2$ | 0.0045 | 0.0186 | 0.0080 |
| | $\hat{\hat{\sigma}}_j^2$ | 0.0037 | 0.0217 | 0.0075 |

NOTE: These weighted least-squares estimates of the parameters of the production function are based on averages for 276 counties of Iowa, North Carolina and Oklahoma. β's which had small t-values when all coefficients were estimated were constrained to being zero, and the two stage weighted least squares estimation procedure was repeated. Weights are the $\hat{\sigma}_j^2$s.

[a/] Variables are in natural logarithms, except for extension and ρ, which are in level form.

in the marginal products of wives' time.

Even if mean changes in family income are the same for additional hours of farm and nonfarm work of wives, other effects will differ. The return from added farm work is more difficult to identify than regular wage payments for nonfarm work because it is obtained as net farm income (a residual), which is a return to several "unpaid" factors and is subject to large annual variation due to abnormal weather conditions and output prices. Because variation in nonfarm wage income and net farm income are not highly correlated, additional hours of nonfarm work by wives opposed to farm work will reduce the variance in farm household income. If households face significant credit rationing or are risk averse to variation of income, they may prefer added nonfarm work for wives even when the expected nonfarm wage is less than the expected marginal product of wife's time from farm work.

Although the labor force participation of wives is increasing, wives continue to allocate large numbers of hours to work in the household, and this complicates decisions on skill acquisition through formal training. Wives who work both outside and inside the household are "multiple" job holders and should invest in skills that raise the productivity of their time in both activities. For example, when outside work is nonfarm work, skills for nursing and elementary school teaching are useful in both the household and market. When outside work is farm work, overlapping skills seem less likely.

The results of this study do permit a comparison between the marginal product of education of farm wives at farm and nonfarm work. The average education index gives the income that the average education mix of wives in a state would generate in nonfarm labor income in 1959. If nonfarm wage rates rose 10 percent between 1959 and 1964, then the marginal product of education in 1964 should be about 1.1. Thus the relatively small marginal products of wives' education

TABLE 4

MEAN MARGINAL PRODUCTS FOR
REPRESENTATIVE FARMS, 1964

| Variables | Geometric Means (Subsamples) | | | Marginal Products[a] (St. errors) | | |
|---|---|---|---|---|---|---|
| | Iowa | N. Carolina | Oklahoma | Iowa | N. Carolina | Oklahoma |
| Estimate of mean output (1964 $/yr) | 17,038.9 | 6,621.5 | 6,991.0 | | | |
| Land & Buildings (1964 $/yr) | 5,045.1 | 907.6 | 1,320.4 | 0.247<br>(0.12) | 0.533<br>(0.24) | 0.387<br>(0.17) |
| Fertilizer & Seeds (1964 $/yr) | 710.9 | 414.6 | 289.6 | 0.527<br>(0.51) | 0.351<br>(0.34) | 0.531<br>(0.56) |
| Machinery (1964 $/yr) | 2,488.5 | 1,075.0 | 1,370.0 | 3.020<br>(0.31) | 2.716<br>(0.28) | 2.250<br>(0.23) |
| Livestock (1964 $/yr) | 5,799.7 | 975.4 | 2,527.1 | 1.434<br>(0.06) | 2.104<br>(0.14) | 1.156<br>(0.05) |
| Labor | | | | | | |
| Hired (man-days/yr) | 32.0 | 70.6 | 38.0 | 23.96<br>(10.76)<br>[10.90][b] | 12.19<br>(1.67)<br>[6.60] | 14.35<br>(3.20)<br>[9.10] |
| Husband (man-days/yr) | 273.7 | 140.4 | 153.1 | 19.49<br>(3.06)<br>[16.71] | 17.26<br>(2.29)<br>[13.67] | 15.25<br>(2.23)<br>[15.96] |
| Wife (woman-days/yr) | 104.7 | 39.9 | 63.8 | 14.65<br>(10.76)<br>[13.84] | 23.73<br>(11.04)<br>[11.48] | 12.16<br>(7.25)<br>[12.84] |
| Education (1959 $/yr) | | | | | | |
| Husband | 5,594.8 | 5,104.0 | 5,648.6 | 0.953<br>(0.15) | 0.475<br>(.06) | 0.413<br>(0.11) |
| Wife | 3,043.4 | 2,775.7 | 2,994.0 | 0.504<br>(0.37) | 0.341<br>(0.16) | 0.259<br>(0.16) |
| Extension[c] | 0.64 | 3.18 | 1.69 | 255.58<br>(82.77) | 99.32<br>(32.17) | 104.87<br>(33.96) |
| $\hat{h}_j$ | | | | 1.472 | 1.485 | 1.477 |

[a] Marginal products are calculated from the minimum variance unbiased estimate of conditional mean output (Goldberger) using geometric means of inputs and $\hat{\sigma}_{1j}$s (Table 3). Standard errors are calculated using the equation for exact variance of products (Goodman).

[b] The numbers in brackets are cost per day in 1964 of respective type of labor. For hired labor the cost is the state average daily wage rate (USDA 1965), and for husbands and wives, the cost is the geometric average daily wage rate for off-farm work by farm husbands and wives, respectively (U.S. Dept. of Commerce 1967).

[c] Arithmetic mean for input.

suggest that investment in wives' formal education raises their productivity more rapidly at nonfarm than at farm work. However, for wives with low levels of education, the effect of expanded coverage of minimum wage legislation probably has increased their quantity of farm work. Being self-employed or working as an "unpaid" family worker are ways of circumventing the unemployment effects of minimum wage legislation. But as education levels of farm wives rise, this effect should diminish.

In conclusion, it is clear that farm wives participate in and are productive at farm work. However, I challenge others to obtain new and better data and to attempt to determine the value of the productive time of farm wives so that we may gain a better understanding of the level and fluctuation of farm household income and allocation of time of farm wives.

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FOOTNOTES

* The author is Assistant Professor of Economics, Iowa State University. T. W. Schultz and John Miranowski provided helpful comments on an earlier draft. G. Wozniak provided computational assistance. Journal Paper No. J-8585 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 2078.

1/ Farm work is: farm work or chores, work in fields, milking, care and feeding of livestock and poultry, care and repair of equipment and buildings, keeping farm records, planning and supervising farm work.

2/ The labor force participation rate is calculated as the ratio of the number of farm wives working to the number of farm operators working during the survey week for farm operators and wives who worked on their own farm and were not paid a wage. This is not a conventional definition of labor force participation, but it seems appropriate here.

3/ This conclusion is reached from a report prepared for an entirely different purpose (Schreier).

4/ Estimates of the partial elasticity of substitution between these labor inputs are not particularly large (Huffman 1976b).

5/ The variables are defined the same as in Huffman (1976b), except for land-and-buildings input and the grouping of fertilizer, seed, and livestock into two input classes. See Huffman (1976a) for more details on derivations and sources.

6/ Setting marginal rate of substitution of $X_i$ for $X_j$ in production and exchange equal, the sign of $\frac{\partial(X_i/X_j)}{\partial\rho}$ is determined by the sign of $(\beta_i\alpha_j - \alpha_i\beta_j)$.

7/ The off-farm wage rate (Table 4) is the opportunity cost of wife's time only when she works at nonfarm jobs and when hours of off-farm work are

flexible. If the wife does not work at off-farm work, the opportunity cost of time is the value of the marginal household utility of her time in household activities.