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A sample of Iowa farm couples is used to evaluate whether off-farm labor supply decisions respond to permanent and transitory components of farm income. Off-farm labor supply of both spouses declines in response to increases in permanent farm income. Farm wives also reduce off-farm labor supply in response to positive transitory farm income shocks. Consequently, one mechanism farm households use to smooth their goods consumption when facing fluctuating farm income is to modify their consumption of leisure. Ability to smooth goods consumption does not imply the absence of liquidity constraints among farm households unless leisure consumption is also smoothed.

Key Words: Frisch equations, off-farm labor, farm income, transitory shocks, permanent shocks

Farm households face large fluctuations in farm income due to weather and price shocks. In principle, farm households should be able to use futures markets, forward contracts or insurance markets to lessen the household's exposure to price or yield risk. In addition, government intervention in farm gate prices through price supports or loan deficiency payments should moderate the magnitude of the fluctuations. However, evidence suggests that variability in farm level net farm income has not diminished since 1933 (Mishra and Sandretto, 2001).

If they are unable to avoid large swings in farm income, households can still avoid similarly large fluctuations in consumption. As first empirically described by Brady (1952) and Reid (1952) and later formalized by Friedman (1957), households may want to consume out of permanent income rather than current income.[1] By borrowing against future production or past savings, a household can smooth its consumption path relative to its income stream. However, doing this requires easy access to credit markets for either borrowing or lending as needed.

Liquidity constraints are typically presumed to be most serious for households in developing countries and in rural areas. Nevertheless, tests of the permanent income hypothesis have typically found evidence supportive of the theory when analyzing consumption choices of rural households in India (Jacoby and Skoufias, 1998), Thailand (Paxson, 1992), and the United States (Langemeier and Patrick, 1990, 1993). In contrast, it is often more difficult to reject liquidity constraints in consumption patterns of urban households in developed countries (Hall, 1978; Altonji and Siow, 1987; Zeldes, 1989).

In contrast to the tests based on the consumption patterns of agricultural households, tests that focus on the capital investment or livestock inventory decisions of farm households have generally found evidence of liquidity constraints, at least in trough periods of the business cycle and for younger farm households (Bierlen and Featherstone (1998); Bierlen, Barry, Dixon and

Ahrendsen(1998); Bierlen, Ahrendsen and Dixon (1998); Benjamin and Phimister (2002)). Particularly intriguing is that the findings of Bierlen and his colleagues supporting credit constraints are based on the same households that Langemeier and Patrick use to demonstrate the lack of credit constraints. While separability arguments have been used to divorce farm production decisions from farm consumption decisions, it seems implausible that a farm household can be credit constrained in its capital and inventory decisions but not its consumption decisions.

This paper explores a plausible explanation for how farm production decisions could be subject to liquidity constraints, even while consumption decisions appear to be consistent with the permanent income hypothesis. Researchers have argued that farmers adjust their livestock inventories or capital investments to absorb farm income shocks. We argue that farm leisure consumption decisions are another avenue by which farm households can absorb farm income shocks.

Evidence that farm households adjust their labor supply in response to unforeseen income shocks has been found in developing country settings. Skoufias (1993) found that adult time on the farm in India responded to the weather and size of output. Jacoby and Skoufias (1997) report that child time in school responded negatively to unanticipated negative shocks to household income in rural India. Skoufias and Parker (2002) found that negative shocks to household income in urban Mexico led to increased labor supply by adult women in the household. These papers suggest that in the absence of perfect credit markets, farm households can alter their consumption of leisure in order to smooth shocks to farm income.

Farm households have increasingly relied on off-farm income to supplement the returns to their farming operations. Data from Iowa in Table 1 show typical patterns. Across all farm households with a husband and a wife, 71% have at least one spouse working off the farm and 43% have both spouses working off the farm. The probability of having one or both spouses working off the farm rises for younger couples: 65% of the youngest farm households have both spouses working off the farm compared to 54% for couples where the husband is aged 55-64.

It is also apparent that off-farm income smooths the path of total income for farmers. Mishra and Sandretto (2001) found that off-farm income has served to lower total variability in farm household income, even though farm income itself has not fallen in variability. Carriker et al (1993) found that the marginal propensity to consume out of nonfarm income was larger than the marginal propensity to consume out of farm income, consistent with a potential role of off-farm income as a short-term supplement to farm income necessary to smooth commodity consumption streams. Mishra and Goodwin (1997) found that farm off-farm labor responds positively to higher probability of farm income shocks. However, previous studies have not tested explicitly whether the adverse shocks to farm income cause off-farm labor supply to increase in the United States.[2]

This study addresses that issue in the context of Iowa farm households. We adapt the two-person household model used to analyze off-farm labor supply of husbands and wives[3] to the question of how unanticipated farm income shocks affect the farm household's allocation of time off the farm. We find that farm wives are significantly more likely to work off-farm after suffering an unforeseen adverse shock to their farm operations. Farm husbands' off-farm labor supply is not sensitive to farm income shocks. However, the permanent component of farm income had similar effects on both farm spouses, with probability of working off-farm declining as expected farm income rises. These results suggest that farm households use reductions in the consumption of leisure to replace income lost from adverse shocks to farm income. As a result, farm households are not perfectly insured against transitory farm income fluctuations. Previous conclusions that these households can smooth consumption and hence do not face liquidity constraints may have been misled by ignoring leisure as an element of the consumption stream.

Theory

The jth farm household is assumed to have a joint utility function that includes the leisure time of the husband, $L_j^h(t)$; the leisure time of the wife $L_j^w(t)$; and household consumption, $C_j(t)$. In each period, the household chooses these items so as to maximize lifetime utility, specified as

$$U(C_j(t), L_j^h(t), L_j^w(t), Z_j(t)) + \beta_j E_t \left\{ V(A_j(t+1), t+1) \right\} \qquad (1)$$

where $Z_j(t)$ is a vector of observed and unobserved household j attributes; β_j is a discount factor; and $V(\cdot)$ is a value function reflecting the optimal future accumulation of household assets as in MaCurdy (1985). The household maximizes (1) subject to constraints on time and on the budget. Normalizing time to 1 per period, the husband's and wife's time constraints are

$$1 = L_j^i(t) + H_j^i(t) + F_j^i(t); \quad i = h, w \qquad (2)$$

where $H_j^i(t)$ is off-farm labor of the ith household member and $F_j^i(t)$ is time on farm. The husband and wife each exhaust available time between on-farm work, off-farm work and leisure activities.

The budget constraint depends on the wage each member can receive in the labor market, $W_j^i(t)$; the value of their time on farm activities as determined by the farm profit function $f(\cdot)$; and the level of assets accumulated by the household at the start of period t, $A_j(t)$. The budget constraint can be written

$$A_j^*(t) - A_j(t) = W_j^h(t)H_j^h(t) + W_j^w(t)H_j^w(t) + f(F_j^h(t), F_j^w(t), K_j) - C_j(t) \qquad (3)$$

where $A_j^*(t)$, the value of assets at the end of period t, determines the level of assets carried into the beginning of the next period by applying the known rate of return r:

$$A_j(t+1) = (1 + r(t+1)A_j^*(t) \qquad (4)$$

The profit function, $f(\cdot)$, depends on husband's and wife's time on the farm and a vector of farm attributes, K_j, that are assumed to be time invariant for simplicity. The profit function is concave in all inputs. In addition, the marginal profit of farm time is assumed to obey

$$\lim_{F^i(t)\to 0} \partial f/\partial F^i(t) \to \infty \qquad (5)$$

where the subscript j has been suppressed. Condition (5) implies that both the husband and the wife will always spend at least some time on farm production. In addition, for both the husband and wife, the marginal profit at zero farm hours is assumed to be strictly greater than the market wage rate so that the husband and wife will always spend time on the farm but may or may not work off-farm.[4]

Maximizing (1) subject to conditions (2-5), we get the first order conditions

$$\begin{aligned} &U_c(t) = \lambda(t) \\ &U_{L^i}(t) = \lambda(t)\, f_{F^i}(t) \geqq \lambda(t)W^i(t); \quad i = h, w \\ &\lambda(t) = (1 + r(t+1)\beta E_t\{\lambda(t+1)\} \end{aligned} \qquad (6)$$

where once again, the subscript j has been suppressed.

The first two conditions are the usual ones derived from the static model of joint household consumption and labor supply.[5] The first condition equates the period t marginal utility of consumption with the marginal utility of wealth. The second condition dictates the off-farm labor supply decision in period t. The first relation, $U_{L^i}(t) = \lambda(t) f_{F^i}(t)$, always holds with equality by assumption (5). However, the second condition, $f_{F^i}(t) \geqq W^i(t)$, will hold with equality only if spouse i works off-farm.

The off-farm labor supply decision is illustrated for the husband in Figure 1 under the simplifying assumption that the wife's labor supply is fixed. The first order conditions imply that the household will allocate the husband's work time so as to equalize the household's marginal utility of the husband's leisure time to the marginal profit from husband's farm time. The optimum will occur at the tangency between the household's indifference curve (not shown) and the budget constraint. If the tangency occurs at a point on the production function where $f_{F^h}(t) > W^h(t)$, then the husband will only work on the farm. This condition will hold as long as optimal farm hours are between 0 and F^h_{max}. At F^h_{max}, the derivative of the farm profit function with respect to F^h equals the husband's market wage. Beyond that, $f_{F^h}(t) < W^h(t)$, and so the household will allocate any additional time to market work: $H^h > 0$ and $F^h = F^h_{max}$. The decision process underlying the household's allocation of the wife's time is symmetric.

For the empirical work later, it is useful to define the household's labor supply decisions in terms of total work time, $T^i(t) = H^i(t) + F^i(t)$. The off-farm labor decision can be specified as

$$\text{if } T^i(t) \leqq F^i_{max}(t), \text{ then } H^i(t) = 0 \qquad (7A)$$

$$\text{if } T^i(t) > F^i_{max}(t), \text{ then } H^i(t) > 0 \qquad (7B)$$

We will return to this specification later.

The third condition in (6) relates the marginal utility of wealth in period (t) to that in period (t+1). As the other first-order conditions all relate solely to period (t), the third condition summarizes the dynamics of the model.

If there were no uncertainty, $\lambda(t)$ would be a known sequence over the lifetime of the household. In practice, the sequence will change over time due to new information on tastes, interest rates, and income. As shown by MaCurdy (1985), changes in the sequences of $\lambda(t)$ will be a random walk with an error term representing new, unanticipated shocks to wealth and hence to the marginal utility of wealth.

Frisch Labor Supply Equations

To operationalize the life cycle model to the case of off-farm labor supply decisions of husbands and wives, we first define the constant marginal utility of wealth, consumer demand, and labor supply functions for each household.[6]

$$C(t) = C(\lambda(t), W^{w}(t), W^{h}(t), f_{F^h}(t), f_{F^w}(t), K, Z(t)) \quad (8A)$$

$$H^{i}(t) = H^{i}(\lambda(t), W^{w}(t), W^{h}(t), f_{F^h}(t), f_{F^w}(t), K, Z(t));\ i = w, h \quad (8B)$$

$$F^{i}(t) = F^{i}(\lambda(t), W^{w}(t), W^{h}(t), f_{F^h}(t), f_{F^w}(t), K, Z(t));\ i = w, h \quad (8C)$$

where the subscript for each household is suppressed. The off-farm and on-farm labor supply equations imply a total hours of work equation of the form

$$T^{i}(t) = T^{i}(\lambda(t), W^{w}(t), W^{h}(t), f_{F^h}(t), f_{F^w}(t), K, Z(t));\ i = w, h \quad (8D)$$

Before proceeding to the empirical specification, it is useful to illustrate how shocks to $\lambda(t)$ will affect $T^i(t)$ and $F^i(t)$ and by implication through equation (7), $H^i(t)$. Consider a permanent, positive shock to farm income caused by a positive farm productivity shock, a permanent increase in average farm prices or a permanent decrease to farm input prices. $\lambda(t)$ will fall because of diminishing marginal utility of wealth, as will all future $\lambda(t'), t' > t$. Rising wealth increases leisure consumption, so total work hours $T^i(t)$ decline. However, $f_{F^i}(t)$ will rise while $W^i(t)$ is unchanged, so $F^i_{max}(t)$ will rise. Consequently, condition (7A) will more likely be satisfied, and probability of off-farm work will decrease. Permanent, negative shocks to farm income will have the opposite effect, raising $T^i(t)$, lowering $F^i_{max}(t)$ and increasing the probability that (7B) is satisfied.

A temporary shock to farm income caused by weather or price shocks that do not affect the expectation of future weather or prices will have similar but weaker predicted effects on off-farm labor. A positive shock to farm income that does not affect the marginal profitability of farm time will lower $T^i(t)$ through the reduction in $\lambda(t)$, but $f_{F^i}(t)$ will be unchanged. Once again, condition (7A) will be more likely to be satisfied because of lower $T^i(t)$, but the added effect attributable to higher expected farm productivity will not occur.

These predictions presume that these transitory shocks have an impact on current period farm income. Previous research on the permanent income hypothesis concentrated on the consumption response to transitory income shocks summarized in equation (8A). A common finding for farm households in the United States (Friedman, Reid, Langemeier and Patrick) and in developing countries (Paxson, Jacoby and Skoufias) is that transitory income shocks do not affect farm household consumption paths. Some have argued that this suggests that farm households can insure themselves against income shocks, whether through financial intermediaries that provide insurance (e.g. government price supports, futures markets, or crop insurance) or through self-insurance (savings, community risk pooling arrangements). However, if these insurance markets immunize the farm household from transitory shocks, then there should be no response of labor supply to these shocks as summarized in (8B-8D). It may be that the mechanism households use to adjust to transitory farm income shocks is by altering consumption of leisure so as to maintain their goods consumption path. Jacoby and Skoufias found that rural household in India use child labor to adjust to income shocks, while Skoufias and Parker found that female labor supply responds to income shocks in Mexican urban households. A similar finding for farm households would call into question the conclusion that U.S. farm households are insured against transitory income shocks.

Empirical Formulation

To estimate the Frisch off-farm labor supply equation, we need to insert (8B) and (8D) into equations (7A-B). The first item of business is to develop an approximation for the unobservable $\lambda(t)$. Following MaCurdy (1985), we can write

$$\ln(\lambda_j(t)) = a_j(t) + \ln(\lambda_j(t-1)) + \varepsilon_j(t) \tag{9}$$

where $a_j(t)$ is a household-specific effect reflecting the jth household's interest rate and discount factor and $\varepsilon_j(t)$ is the household's forecast error in projecting the marginal utility of wealth. Given the stochastic nature of farm production and prices, we assume that these forecast errors are dominated by fluctuations in farm profits. The value of $\varepsilon_j(t)$ is observed at the beginning of period t and used to make updated projections of $\ln(\lambda_j(t+1))$. $\varepsilon_j(t)$ will have two components, $\varepsilon_j^T(t)$ is composed of one-time shocks to the marginal utility of wealth and $\varepsilon_j^P(t)$ is a permanent innovation to the marginal utility of wealth.

Consider a profit function

$$\pi_j(t) = \gamma_0 + \gamma_1 K_j + \gamma_2 HK_j + \gamma_3 S_j(t) + e_j(t) \tag{10}$$

where $\pi_j(t)$ is net farm income, K_j is a vector of fixed farm capital, HK_j is a vector of fixed household human capital, and $S_j(t)$ is a vector of time t specific transitory shocks that may influence farm profits in period (t). We take $\varepsilon_j^P(t) = \gamma_0 + \gamma_1 K_j + \gamma_2 HK_j$ as an estimate of the permanent component of the marginal utility of wealth, $\ln(\lambda_j(t-1))$. We use $\varepsilon_j^T(t) = \gamma_3 S_j(t)$ as an estimate of the transitory shock, $\varepsilon^T_j(t)$. The error term in (10) may have either transitory or permanent components.

Using our estimates of permanent and transitory components of $\ln\lambda(t)$ from equation (10), we approximate (8B) and (8D) by

$$\begin{aligned} \ln F^i_j(t) &= \alpha^i_0 + \alpha^i_1 X_j(t) + \alpha^i_2\varepsilon^P_j(t) + \alpha^i_3\varepsilon^T_j(t) + \psi^i_j(t); i = h, w \\ \ln T^i_j(t) &= \beta^i_0 + \beta^i_1 X_j(t) + \beta^i_1\varepsilon^P_j(t) + \beta^i_3\varepsilon^T_j(t) + \eta^i_j(t); i = h, w \end{aligned} \tag{11}$$

where $X_j(t)$ is the vector of all variables that enter the reduced form equations in (8A-D) other than $\lambda(t)$. $\psi^i_j(t)$ and $\eta^i_j(t)$ are error terms that will include errors in the estimation of the permanent and transitory components of the marginal utility of wealth, the household-specific effect, $a_j(t)$, as well as unmeasured random variation in farm and total hours. Because the errors in estimating $\varepsilon^T_j(t)$ and $\varepsilon^P_j(t)$ will be common across the husband and wife, the error terms in their labor supply equations should be positively correlated.

We do not estimate (11) directly, but rather the off-farm labor supply equation

$$\begin{aligned} &\text{Prob}\{\ln(T^i_j(t)) - \ln(F^i_j(t))\} > 0 \\ &= \text{Prob}\{(\beta^i_0 - \alpha^i_0) + (\beta^i_1 - \alpha^i_1)X_j(t) + (\beta^i_2 - \alpha^i_2)\varepsilon^P_j(t) + (\beta^i_3 - \alpha^i_3)\varepsilon^T_j(t) > \xi^i_j(t)\}; i = h, w. \end{aligned} \tag{12}$$

where $\xi^i_j(t) = -(\eta^i_j(t) - \varphi^i_j(t))$. For simplicity, we assume that $\xi^i_j(t)$ are distributed bivariate normal with $\rho_{hw} > 0$ representing the correlation in the errors between the husband and wife. Under normality, we can estimate (12) using a bivariate probit specification.

Data Description

The data on individual, household and farm characteristics were obtained from a survey of 276 Iowa farmers and their spouses conducted in August 2000. Means, standard deviations, and definition of the variables included in the survey are given in Table 2. The survey elicited information on farm husband's and wife's ages and education levels, demographic composition of the household, and information on the type and size of the farm operation.

There are three endogenous variables: farmer and spouse off-farm labor supply and farm income. Off-farm labor supply for spouse i is measured by a dummy variable taking the value of one if i works off the farm. The husband and wife were each asked if they worked off-farm for pay and the number of hours per week worked.

The other endogenous variable is farm income, which must be decomposed into permanent and transitory components. The survey asked the respondent about their level of net farm income in 1999. This was measured by the farmer's selection of a dollar range in which the farm income fell, where the ranges included varied from less than $25,000 to more than $200,000. Farmers were disproportionately located in the bottom two farm income groupings, with two-thirds in the bottom group and one-quarter in the next lowest group. There were farmers in each of the other farm income groups. Nevertheless, the limited variation could have proven problematic in deriving precise estimates of the permanent and transitory income components, a problem that did not prove severe in the actual estimation below.[7]

The derivation of the permanent component of farm income requires information on time-invariant farm physical capital and farmer human capital. These measures were collected in the survey. The farm physical capital measures include total landholdings and the acreage in crop land and pasture land. The type of farm operation is represented by a series of dummy variables indicating if the farm has hogs, beef cattle, dairy cattle, or other animal agriculture. The farm’s location in the state and the proportion of acreage owned are also included under physical capital. Measures of human capital include the age and years of schooling of the farm husband and wife.

Transitory shocks to farm income included both weather and price shocks. Weather shocks were measured by the 1999 rainfall by month relative to the average over the previous ten years. County rainfall estimates from 1989 to 1999 were obtained from the Iowa Environmental Mesonet . The price shock measure was specific to each farm operation mix. Data on Iowa prices of corn, soybeans, hogs, cattle, milk, and other commodities from 1989 to 1999 was available from the USDA's Iowa Agricultural Statistics. The farm-specific price is the weighted sum of these prices where the weights were the share of total farm income from each commodity. In other words, if s_{jk} is the share of the kth farm commodity in farm j's income and p_{kt} is the kth commodity price in year t, the expected price for farm j across all commodities is $\sum_{t}^{T}\sum_{j}(s_{jk}p_{kt})/T$. The price shock for the farm is the ratio of the 1999 farm-specific weighted price to the average farm-specific weighted price over the previous ten years. This can be interpreted as the farm's proportional price surprise.[8]

The other county-specific variables that were merged into our survey data included a measure of local farmland price obtained from the Iowa State University Agricultural Land Value Survey. In addition, the proximity of the county to a metropolitan area was measured by a dummy variable indicating if the county was not adjacent to an urban county.

Results

We first estimated equation (10) to derive estimates of the permanent and transitory innovations to wealth for the farm household. These estimates are reported in Table 3. Expected farm income was driven primarily by the size of the farm. Farm income rose at an increasing rate with the number of acreage in crops, suggesting increasing returns to scale over the range of farm sizes in the sample. Cash grain farmers earned more than hog and cattle farmers. Farm income did not vary by age or education of the farmer or spouse in this sample, and it did not vary by area of the state or by the proportion of land owned versus rented.

Rainfall deviations from the norm did not explain variation in farm income, either individually or jointly. While 1999 was modestly drier than average, the lower than average rainfall occurred in April when rain disrupts planting. Consequently, the lack of income effects attributable to weather shocks was presumably due to the lack of important weather deviations in that crop year. On the other hand, price surprises had a large impact on farm incomes in 1999. Not surprisingly, farmers whose operations were heavily weighted toward commodities with positive price shocks experienced positive farm income shocks.

For each farm, the sum of the first 15 coefficients in Table 3 times their respective variables generates our measures of $\varepsilon_j^P(t)$ and the remaining 6 terms are used to generate $\varepsilon_j^T(t)$.[9] These were inserted into our bivariate probit estimating equation (12). Results are reported in Table 4. Reported standard errors correct for the two-step estimation process using a bootstrapping procedure with 100 replications.

The labor supply equations mimic earlier findings from studies using static models of off-farm labor supply, although not all coefficients are precisely estimated. Probability of working off farm rises at a decreasing rate in the age of both the husband and the wife. The peak probability of working off-farm occurs at age 47 for the husband and age 45 for the wife and declines thereafter. Husband's schooling raises the probability of his own off-farm labor but reduces probability of his wife working off-farm, although the coefficients estimates are not precise. Symmetric effects of wife's schooling on her own and her husband’s labor supply are obtained with a large impact of wife's education on her off-farm labor supply. In addition, the error terms in husband's and wife's equations are significantly and positively correlated as required by the theory

Keeping in mind that we hold the components of farm income constant, larger farms raise the probability of off farm labor for both husband and wife, albeit the effects do not differ significantly from zero. Taken literally, the coefficients imply that if there are two farms making the same expected profit, we would expect greater off-farm labor participation from the farm couple on the larger of the two farms. Husbands on farms raising livestock are less likely to work off-farm, as are husbands on farms more distant from the city. Neither of those factors affect the off-farm labor supply of wives. Presence of children has no impact on off-farm labor decisions of either spouse.

This brings us to the main topic, which is the impact of the permanent and transitory components of farm income. The permanent component should have a negative effect on off-farm labor supply. If the farm is fully insured against transitory farm income fluctuations, then the transitory shock should have no effect on off-farm labor. However, if the farm is liquidity constrained or not fully insured, then transitory shocks may have an effect. The permanent components do have large and significant negative effects on the off-farm labor supply of both the husband and the wife. The null hypothesis of equal off-farm labor supply responses to ε^P for the husband and the wife could not be rejected. Therefore, we find strong evidence that farm households condition their off-farm labor supply decisions on the expected profitability of their farm operations.

The temporary farm income shock also has a negative effect on off-farm labor supply, and it is significantly negative for the wife.[10] The wife's response to ε^T differs significantly from that of the husband, suggesting that time use of farm wives reacts more elastically to transitory fluctuations in farm income. This finding implies that farm households absorb negative farm income shocks in part by increasing off-farm labor hours and reducing hours of leisure consumed, particularly by farm wives.

Table 5 contains the labor supply elasticities computed from the bivariate probit coefficients, evaluated at sample means.[11] Probability of off-farm labor supply declines with own age and increases with own education. Cross effects of education on spouse's labor supply are very small. These effects are common in the static off-farm labor supply literature. Our main interest is in the off-farm labor supply responses to ε^P and ε^T. While we know of no other comparable estimates of labor supply responses to transitory and permanent farm income shocks based on U.S. micro data, these will provide a frame of reference for other studies.[12] Clearly, the permanent component of farm income has a strong negative effect on off-farm labor supply of both spouses. However, the elasticities with respect to transitory shocks to farm income are also large enough to suggest quite flexible flows into and out of off-farm labor, particularly for farm wives.

Summary and Conclusions

This study shows that the long-standing findings in the U.S. and elsewhere that the consumption of goods by farm households was consistent with the permanent income hypothesis may be incorrect. In particular, off-farm labor supply and implied consumption of leisure appear to respond significantly to farm income shocks, consistent with the findings of liquidity constraints in farm inventory and investment decisions. Our results suggest that farm households insulate themselves from adverse farm income shocks in part by adjusting off-farm labor.

This study must be viewed as suggestive in that it only has access to a single cross-section. A definitive test would require longitudinal data. A long series of repeated observations on individual farms would allow greater variation in weather conditions that would help in identifying the impact of rainfall shocks on farm income. Repeated observations would also allow fixed-effect estimation that would be an alternative method for controlling the unobservable marginal utility of wealth. Our reliance on the correlation in the error terms between the husband's and wife's off-farm labor supply equations may not fully control for the time-invariant household effect. Finally, longitudinal data would allow us to observe if spells of off-farm labor are short and driven by transitory income shocks, or if once farm households enter off-farm labor the attachment becomes permanent. Nevertheless, our results are consistent with previous static empirical models of off-farm labor supply in the U.S. and with findings from developing country data sets that labor supply responds to income shocks, even if consumption does not.

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Figure 1: Hours allocation of the husband (h), holding the time allocation of the wife fixed.

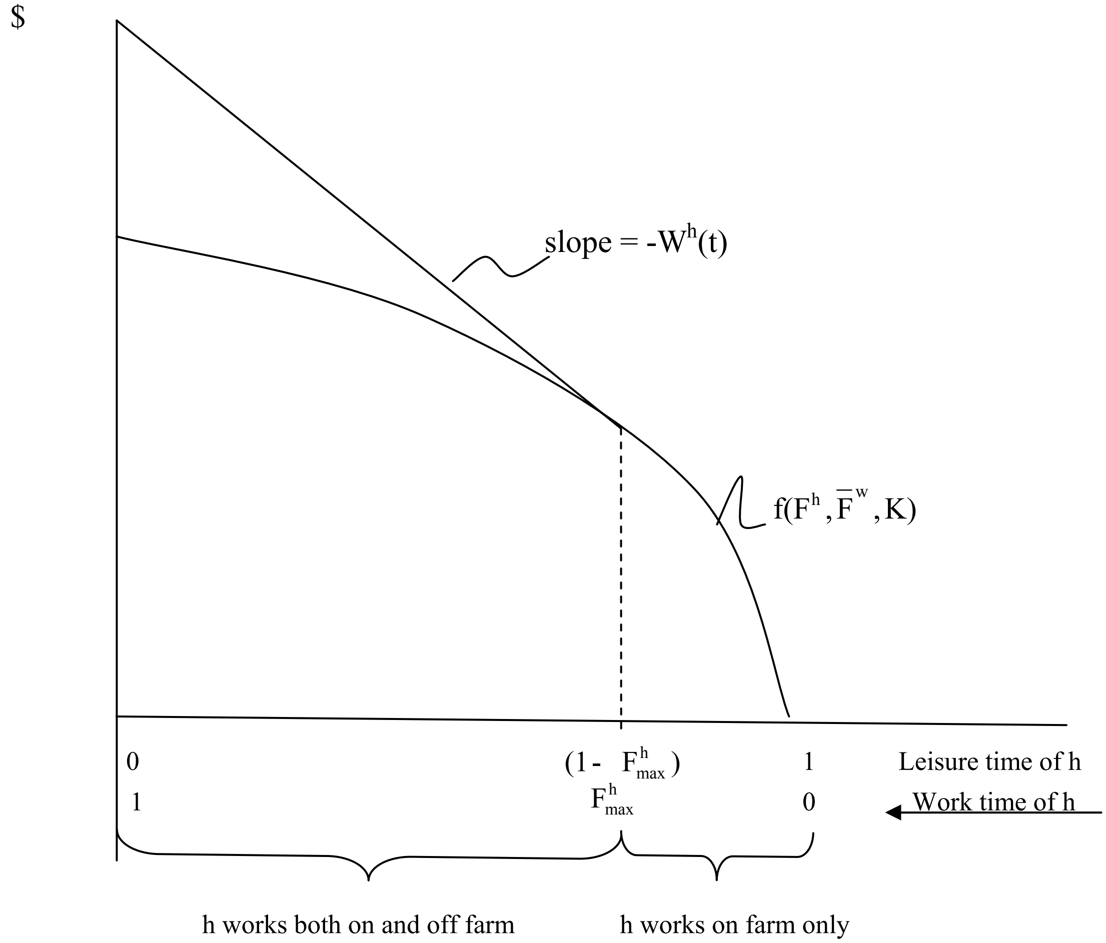

Table 1. Off-Farm Work Status by Age of Husband[a]

Off-farm Work Status	**<45**	**45-54**	**55-64**	**>64**	**Total**
Both work off farm	47 (65.2)	45 (58.4)	24 (54.2)	3 (4.4)	119 (43.1)
Husband only works off farm	4 (5.5)	6 (7.8)	8 (13.6)	9 (13.2)	27 (9.8)
Wife only works off farm	9 (12.5)	20 (26.0)	12 (20.3)	9 (13.2)	50 (18.1)
Neither works off farm	12 (16.6)	6 (7.8)	15 (25.4)	47 (69.1)	80 (29)
Total	72 (100)	77 (100)	59 (100)	68 (100)	276 (100)

[a]Top number is the number of households in the age/labor supply category and the percentage of households in the age category is reported in parentheses.

Table 2. Data Definitions and Descriptive Statistics, Iowa Farm Household, 1999

Variable	Variable Description	Mean	Standard Error
Net Farm Endogenous Income	Farm income category	1.878	1.21
HusOfFm	Husband works off farm (0=no, 1=yes)	.529	.50
WifeOfFm	Wife Works off farm (0=no, 1=yes)	.634	.48
Exogenous			
HusAge	Husband's age (year)	54.35	13.44
HusEdu	Husband's education (year)	13.00	1.79
WifeAge	Wife's age (year)	52.23	13.02
WifeEdu	Wife's education (year)	13.31	1.45
Children	Number of children under age 18	0.79	1.16
LnFarmAc	Log(acres of land))	5.42	1.39
LnCropld	Log(Crop land acres)	4.88	1.92
LnPastld	Log(Pasture acres)	1.99	2.01
HogFarm	Hog farm	.141	.348
CattleFarm	Cattle farm	.351	.478
DairyFarm	Dairy farm	.029	.168
OtherFarm	Other livestock farm	.054	.227
Ratiown	Ratio of owned to total land	.606	1.02
South	Southern Iowa County (1-south 0-north)	0.431	0.496
West	Western Iowa County (1-west 0-east)	0.496	0.501
DRainApr	Derivation from average rainfall: April	-2.686	1.439
DRainMay	Derivation from average rainfall: May	-0.441	1.784
DRainJun	Derivation from average rainfall: June	0.0432	1.365
DRainJul	Derivation from average rainfall: July	-0.944	3.147
DRainAug	Derivation from average rainfall: August	0.596	1.682
Lvstck	If farm has any type of livestock	0.504	0.501
Dist Metro	Distance from Metro (0-2)	1.344	0.734
UFPShk	Unit free price shock (measures change in value of production)	-0.226	0.067
ε^P	Permanent Income Shock	4.95	1.410
ε^T	Temporary Income Shock	-1.84	0.503
ρ	Correlation in off-farm labor supply error terms between husband and wife		

Table 3. Ordered Probit Estimates of Net Farm Income equation (10).

	Coefficient
HusAge	.025
	(.031)
WifeAge	.005
	(.031)
HusEdu	.056
	(.058)
WifeEdu	-.048
	(.071)
LnFarmAc	.019*
	(.451)
LnCropld	.435**
	(159)
LnPastld	.062
	(.060)
LnFarmAc2	.045**
	(.017)
HogFarm	-.407
	(.275)
CattleFarm	-.596*
	(.309)
DairyFarm	-.298
	(.516)
OtherFarm	.181
	(.363)
Ratioown	-.102
	(.251)
South	-.280
	(.291)
West	-.141
	(.240)
RainDfApril	.053
	(.077)
RainDfMay	.028
	(.056)
RainDfJun	-.008
	(.074)
RainDfJul	-.018
	(.041)
RainDfAug	-.060
	(.064)
UFPShk	7.089**
	(2.53)

N = 266
Log likelihood = -203.2
Pseudo R2 = 0.2233
*Significant at 10% level; **Significant at 5% level.

Table 4. Bivariate probit estimation of the off-farm labor participation equation (12).

	Husband	Wife
Variable		
Hus Age	.188**	
	(.070)	
(Hus Age^2)/100	-.199***	
	(.063)	
Wife Age		.237**
		(.097)
(Wife Age^2)/100		-265**
		(.090)
Hus Edu	.071	-.082
	(.075)	(.082)
WifeEdu	-.026	.265**
	(.083)	(.079)
Children	.006	-.058
	(.123)	(1.38)
Ln Farm Ac	.281	.364
	(.242)	(.242)
Lvstk	-.775**	.289
	(.272)	(.316)
Dist Metro	-.221	-.044
	(.147)	(.147)
ε^P	-.642**	-.673**
	(.223)	(.237)
ε^T	-.141	-.822**
	(.316)	(.337)
ρ	.336**	
	(.118)	
N	266	
Log Likelihood	-247.9	

Bootstrapped standard errors reported in parentheses.
* Significant at 10% level; ** Significant at 5% level.

Table 5. Estimated off-farm labor supply elasticities[a]

	Husband	Wife
Own Age	-0.41	-0.57
Hus Edu	0.46	-.029
Wife Edu	-.001	0.95
Children	.002	-0.01
Ln Farm Ac	0.14	0.10
Lvstk	-0.19	0.04
Dist Metro	-0.15	-0.02
ε^P	-1.59	-0.90
ε^T	-0.13	-0.41

[a]Evaluated at sample means from Table 2, using coefficients from Table 4.

Endnotes

[1] Brady showed that farm household savings behavior was more responsive to current income than nonfarm households. Reid showed that farm household consumption was less sensitive to current income than nonfarm households. Both tests are consistent with farm households attempting to smooth consumption because of higher variance in income streams. Reid refers conceptually to permanent and transitory income components in explaining why farm households would have a smaller elasticity of consumption with respect to current income, but the formal derivation of the permanent income hypothesis is credited to Friedman.

[2] A difficulty with tying increased off-farm labor supply to higher variance of farm income is that the causality may be reversed. Farm households that engage in off-farm labor may experience higher variation in farm income because poorer farmers are more likely to work off farm, because types of farm operation that are conducive to off-farm labor are subject to larger price or yield shocks, or because off-farm labor lowers time available for farm monitoring or management.

[3] Examples of the literature examining the labor supply decisions of farm husbands and wives in the face of fully anticipated income include Huffman and Lange (1989), Lass, Findeis and Hallberg (1989), Tokle and Huffman (1991), Weersink (1992), Weersink and Weerhewa (1998) and Abdulai and Delgado (1999).

[4] This is not overly restrictive, as hours on the farm operation would include all management, accounting, and financial decisions regarding the farm's operation as well as the animal and crop production activities themselves. It is likely that both farm wives and their husbands participate in at least some of these functions, if not all.

[5] See for example Huffman and Lange (1989) or Tokle and Huffman (1991).

[6] These are known as Frisch functions. See Blundell and MaCurdy (1999) for a review of the use of Frisch functions in labor supply estimation.

[7] In future replications, survey design may want to consider smaller income ranges, at least at the lower tail of the distribution of net farm incomes.

[8] We also tried an alternative measure that separated out each commodity weighted price deviation between 1999 and its average over the previous ten years. Results in the second stage were similar in sign to those using the aggregated price shocks. We worried that when the price shock was separated out by commodity, it would be clouded by type of farm, because the size of the same commodity price shock would vary by the importance of that commodity in the farm's sales. For example, if the farm did not raise a commodity, the measured farm price shock would be zero. To the extent that the measured price shock partially controlled for type of farm, permanent components of farm income would pollute our estimate of the transitory shock. Therefore, we prefer the aggregated price shock measure.

[9] The predicted values are continuos and ignore the estimated break points in the ordered probit. The units are not directly interpretable other than higher values imply higher income.

[10] When we used the alternative specification of the transitory price shock mentioned in footnote 7, both husband's and wife's off-farm labor supply responded had significant negative responses to transitory income shocks.

[11] We also computed analytically derived elasticities. Magnitudes exceeded the reported elasticities in Table 5 by from one-quarter to one-third, but qualitative interpretations were unchanged

[12] Huffman (1979) reported estimates of elasticities of off-farm days worked with respect to transitory farm income, using county-level data from the 1964 Census of Agriculture. His estimates were -0.15 and significant for husbands, but 0.02 and insignificant for wives.