Off-farm income and farm capital accumulation: a farm-level data analysis

by

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Paper presented at the July 23-26, Annual Meeting of the American Agricultural Economics Association, Long Beach, California, 2006.

Abstract

This paper test farm households' joint decisions to work off-farm, and their investments in farm capital respectively, using a farm level data set involving 252 sole proprietorships in Southwestern Minnesota. Time series are collected from the period 1993 through 2002 and estimation is done using a recursive two-step simultaneous censored equations model. Strong support is found for endogeneity of farm capital in an off-farm reliance model. Off-farm income, on the other hand, has no explanatory power in a farm capital model. In addition, evidence of true state dependence in off-farm income reliance is supported by the data.

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Introduction

Off-farm work and off-farm investment by farm households has increased steadily over several decades. Census data for 2000 reveals a threefold increase in off-farm work since 1987, with net farm income constituting less than a third of the household income in 1999 (Mishra *et al*., 2002). The primary reasons for the increased reliance on off-farm income are to: spread income risks, increase total income (Mishra and El-Osta, 2001 and references therein), and stabilize consumption possibilities over time.

Off-farm labor participation of farm households have been extensively analyzed (e.g. Lass, Findeis, Hallberg, 1991) and recent work has addressed off-farm income and investments in farm and nonfarm assets (Andersson et al., 2005); wealth accumulation of farm households (Mishra and El-Osta, 2005); the allocation of investments funds by farm households (Mishra and Morehart, 2001; Serra, Goodwin, and Featherstone, 2004; Davies et al., 2005). Less attention, however, has been directed at integrating capital accumulation with labor allocation. Recognizing the endogeneity of capital stock in analyses of off-farm income is particularly important in a period of structural change within the agricultural sector. Off-farm work participation and investments in farm capital influences the farmer's earnings and contributes to accumulation of human and physical capital. Ahituv and Kimhi (2002) used an Israeli data set for 1971 and 1981 and formulated household off-farm labor decision as a multinominal choice model. They report a strong negative association between off-farm labor supply and farm capital stock, indicating that the two variables can move in opposite directions because capital increases the marginal productivity of family labor, and the other way around. We are not aware of any other work that has conducted a joint analysis of farmer's decisions to work off-farm, and their investments in farm capital.

The purpose of this paper is to test farm household joint decisions to work off-farm, and their investments in farm capital using a farm level data set involving 252 sole proprietorships

in Southwestern Minnesota (Southwestern Minnesota Farm Business Management Association). Time series are collected from the period 1993 through 2002 and estimation is done using a recursive two-step simultaneous censored equations model. An important advantage from this data set is that we observe the differences in the behavior of the farm household over a relatively long time period. 165 proprietorships are represented in the data set with 4 or more consecutive observations. This allows us in particular to address the issue of persistence of farm households in a true off-farm labor state dependence, in which past behavior has a casual connection with present behavior. Work by Ahituv and Kimhi (2002); Corsi and Findies (2000) have found support for true state dependence but both of these studies are limited to involve data from only two non-consecutive time periods. Evidence of true state dependence would imply rigidity in off-farm labor adjustment.

Empirical models and estimation strategy

Farm household models suggest that farm production and off-farm labor decisions are likely to be simultaneous (Nakajima, 1986; Phimister and Roberts, 2002). Following Huffman's seminal work and work by e.g. Skoufias (1996); Ahituv and Kimhi (2002), the empirical model in this study presupposes that the farm household maximizes lifetime income derived from farm and off-farm sources, given a time constraint. Farm production is a function of various characteristics including farm work, intrinsic ability, farm-specific human capital, physical capital, and fixed inputs. This modeling framework suggests that the time-allocation between off- and farm work and capital investment is interrelated. Moreover, a time dependence in off-farm work is suggested so that a farm household that had off-farm income in the past is more likely to persist in that state.

The empirical model developed in this section follows a reduced form methodology that uses general predictions from the economic models outlined above to guide the empirical

work. Our model specification follows the general specification in Maddala (1983) for a simultaneous equations model stated in continuous dependent variables before censoring. Our model includes one off-farm labor supply model that is estimated jointly with a farm capital accumulation model. Our goal is to estimate the likelihood of farm household reliance on off-farm income and to address the issue of interrelation between off-farm income reliance and farm capital accumulation. In addition, because not every farm household has off-farm income, a censoring issue underlies the empirical model. A central issue here is whether farm capital is endogenous to off-farm income reliance. As a preliminary test of our approach we estimated the system

$$y_1^* = tobit = \boldsymbol{\beta}' \mathbf{x}_1 + \gamma\, y_2 + \varepsilon_1 \quad \text{(off-farm income)}$$

$$y_2 = \boldsymbol{\pi}'_{\mathbf{2}}\, \mathbf{x}_{\mathbf{2}} + \varepsilon_2 \quad \text{(farm capital)}$$

where exogeneity of y_2 is tested by a *t*-test of the hypothesis that $\Psi = \sigma_{12} / \sigma_2^2$ eqals zero (Greene, 2002). Our data clearly rejects exogeneity (*p*-value = 0.0153).

In order to allow for endogeneity of off-farm income in the formation of farm capital as well as endogeneity of farm capital in the off-farm income model we apply a two step maximum likelihood procedure following Blundell and Smith (1986); Greene (2002, section E21.6.2). Formally, the model structure is

$$\begin{aligned} y_{i1} &= \gamma_1 y_{i2} + \mathbf{x_{i1}} \boldsymbol{\beta_1} + \varepsilon_1 \quad (\text{off - farm income}) \\ y_{i2} &= \gamma_2 y_{i1} + \mathbf{x_{i2}} \boldsymbol{\beta_2} + \varepsilon_2 \quad (\text{farm capital}) \end{aligned} \tag{1}$$

where $[\varepsilon_1, \varepsilon_2]$ is $BVN[(0,0),(\sigma_{11}, \sigma_{22}),\sigma_{12}]$. The dependent variable in the off-farm income model is censored at lower limit $(L_i) = 0$ but the dependent variable in the farm capital equation is observed without censoring.

The two step procedure is done in two joint parts. In the first part the focus in on estimating $(\gamma_1, \boldsymbol{\beta_1})$. In the first step here, $\pi_2 = \mathbf{x_{i2}}\boldsymbol{\beta_2}$ is estimated by ordinary least square regression on y_2. The second step then estimates $\gamma_1, \boldsymbol{\beta_1}, \sigma_{11}$ by maximum likelihood in the censored regression model in the off-farm income equation while correcting for the asymptotic covariance matrix (Murphy and Topel, 1985). Analogously, in the second part, to estimate $(\gamma_2, \boldsymbol{\beta_2})$ we first estimate $\pi_1 = \mathbf{x_{i1}}\boldsymbol{\beta_1}$ by maximum likelihood using the censored off-farm income equation, and then apply predicted values together with $\mathbf{x_{i2}}$ in an ordinary least square regression of y_2 while correcting for the asymptotic covariance matrix (Murphy and Topel, 1985).

The dependent variable in the off-farm income model is the annual share of off-farm wages, salaries and business income (ofwsbi) to the total of ofwsbi and net cash farm income to the farm household. This measure is believed to represent the degree of reliance of off-farm income sources in a more direct way than hours worked off-farm and work status which are the typical dependent variables used in the off-farm work-choice literature (e.g. Mishra and Goodwin, 1997). Moreover, as this share is a continuous variable, this makes our dependent variable different from binary choice models typical in off-farm labor estimations. This, choice of dependent variable, however implies that data has to be considered as cross-section as dynamic tobit models allowing for endogeneity of explanatory variables, to our knowledge, do not exist in the present literature. Thus, we will, by the chosen procedure, not be able to disentangle the state dependence of off-farm income into a true state component and a component related to a persistence due to individual heterogeneity.

Figure 1 shows the annual relative changes in main sources of income to farm households in the sample against corresponding levels in 1993. In absolute levels, the share of ofwsbi to the total of ofwsbi and net cash farm income increased from 14.8 percent in 1993 to 22.5

percent in 2002. The Southwestern Minnesota data used in this study is in this respect similar to the National averages for large and very large farms, which in 1999 revealed a 40.4 percent and 17.7 percent off-farm income share of total farm operator household income, respectively (USDA, ARMS). We also observe that the share of farm households that do not report any ofwsbi have decreased from 28.4 percent in 1993 to 16.1 percent in 2002.

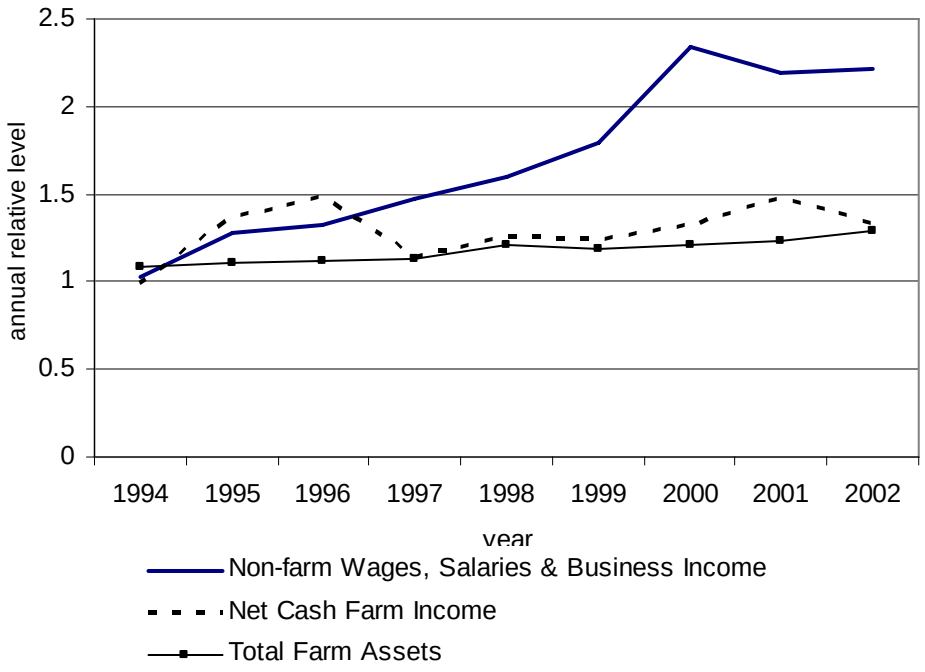

Figure 1. Relative changes in sources of farm household income and farm assets. Southwestern Minnesota Farm Business Records 1993-2002.

The dependent variable in the capital accumulation model is the log of the real value of total farm assets. Figure 1 also portrays the annual relative changes in total farm assets between 1993 and 2002. Overall, the value of real farm capital has increased with 29 percent between 1993 and 2002.

Descriptions and summary statistics for each variable used in the empirical model are reported in Table 1.

The independent variables used in the off-farm work model include operator and farm household characteristics such as operator's age; experience; farm household measures; non-farm investments; farm characteristics; government payments; state dependence in off-farm income reliance; and finally a local labor market component.

Analyses of off-farm labor supply typically include proxies for personal and/or household characteristics to estimate structural farm household models in a reduced methodology. Several studies report that younger farmers are more likely to work off-farm (e.g. Ahituv and Kimhi, 2002; McNamara and Wiess, 2005; Ahearn, El-Osta, and Dewbre, 2006; Benjamin and Kimhi, 2006); that farm experience is negatively related to off-farm work (e.g. Mishra and Goodwin, 1997; Mishra and Holthausen, 2002). In addition, existing studies have failed to find a significant relationship between household size and off-farm work participation (e.g. Mishra and Goodwin, 1997; Ahearn et al., 2006). Mishra and Goodwin (1997), however reports that farm household with younger children are more likely to seek off-farm work. We two include variables related to the farm household as such. First, the number of total family members is included. A larger farm household might be more likely to rely on off-farm income because the family can operate the farm as well as have one or more family members working off-farm. Moreover, a larger family reasonably implies presence of children. Second, we include family living expenses as an explanatory variable. We hypothesize that higher living expenses, either as a result of a larger farm household or by seeking a higher standard of living, is positively related to off-farm reliance.

Investments in non-farm assets have grown in importance for US farm households. Mishra and Morehart (2001) report that average total financial assets increased with 51% between 1992 and 1995. At the same time average non-financial assets increased with 9.4%. Among the financial assets investment in stock, bonds, and IRA's more than doubled during 1992-1995 (Mishra and Morehart). In addition, Mishra and Morehart found that farms with

off-farm income are more likely to invest off the farm. While a growing amount of studies have analyzed determinants of off-farm investments less attention has been given to what extent off-farm investments determines decisions to work off-farm. Ahearn et al. (2006) reports that off-farm interest and dividend income is positively related to off-farm work and this might suggest that a positive relation between off-farm investment and off-farm work might be expected. To our knowledge, the relationships among off-farm labor and off-farm investment have not been examined in the literature. In this study, non-farm investment is represented with five categories as the form of the wealth portfolio of farm households with and without off-farm income is likely to be different (Mishra and Morehart, 2001). We hypothesize that farm household's that, for one or another reason, invest in an off-farm wealth portfolio might seek off-farm income as a complement to farm income to alleviate farm income risks. Figure 2 displays the development of non-farm investment for the sample used.

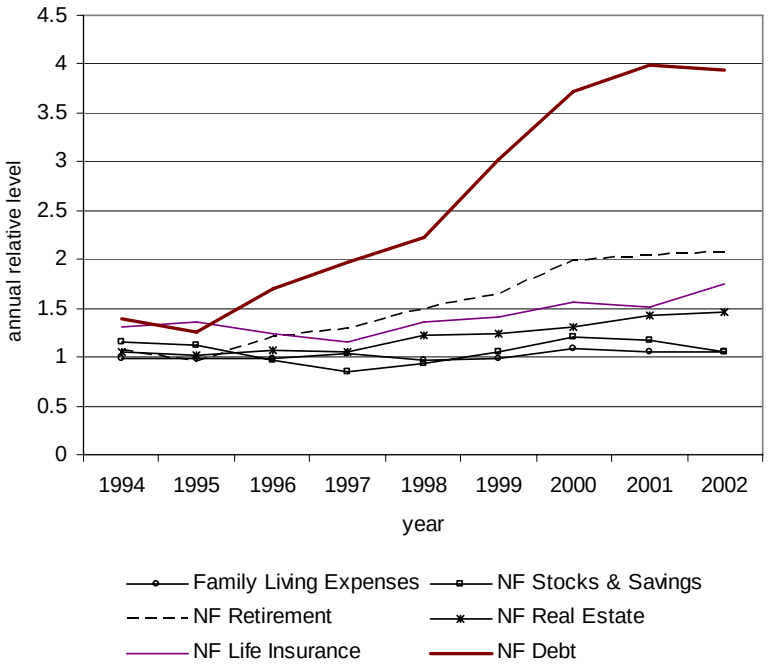

Figure 2. Annual relative changes in non-farm investment and family living expenses. Southwestern Minnesota Farm Business Records 1993-2002.

Four farm characteristics are included in the off-farm labor model. First, farm size is included as it has been found to be negatively related to off-farm labor decisions (Ahituv and Kimhi, 2002; Benjamin and Kimhi, 2006). As noted by Goodwin and Bruer (2003) farm households operating larger farm might be less likely to seek off-farm income as the on-farm effort required to operate a larger farm is influenced by the size of the operation. Second, we include the tenure share as farm households might have different objectives and face different economic constraint in off-farm work participation given the ownership status of the farm operated. Work by Tavernier, Temel and Li (1997); Mishra and Holthausen (2002) found that off-farm work participation was negatively related to the degree of farm ownership. Third, it is standard in off-farm work participation model to include a dummy variable for whether or not the farm operation specializes in dairy. The idea is that more labor demanding types of farm operations will have a lower off-farm participation rate. Ahearn et al. (2006), using an extended set of five specialization categories, indeed found that specialization in dairy was negatively related to the operator off-farm participation while specialization into cash crops; beef and hog; and other livestock were positively related to off-farm labor participation. In this study, we include four specialization dummies defined in accordance with the Farm Business records from which data is provided on the basis of the farm having 60 percent or more of sales from a given category. Fourth, government payments are included. Recent work by Ahearn et al. (2006) focusing on individual participation in off-farm labor market based on ARMS data and work by Shrestha and Findeis (2005) focusing on the off-farm employment rate based on county-level data have found evidences of a negative relation between government payments and off-farm employment for U.S. overall, and a mixed relationship when examining this relationship by type of payment on a regional basis. Fifth, the leverage position was found by Mishra and Goodwin (1997) to be a determinant of off-farm labor supply. In the present study we maintain the hypothesis that farm households with farm

financial difficulties might be more likely to seek off-farm work in order to sustain them selves. A variant of Altman's (1968) original ZPROB specification is included as a predictor of financial distress in the farm operation as the leverage position by itself is not a direct measure of to what extent the farm family might seek off-farm income to alleviate financial problems. For two observations our predictive measure turned up to be negative. Farmers with negative values of this measure are most likely to experience financial difficulties. Since the predictive measure is constructed so that higher values imply lower profitability, negative values would introduce a bias in the results and therefore these observations were excluded from the final sample.

To address the issue of state dependence in off-farm income reliance we include the lagged share of ofwsbi to total household income as an explanatory variable. Work by Corsi and Findeis (2000); Ahituv and Kimhi (2002) suggest that previous off-farm labor state is relevant in off-farm labor participation choices.

Finally, county population density is included as a proxy for local labor market characteristic. We hypothesize that this density is positively related to off-farm work accessibility and negatively related to various transaction costs related to seeking off-farm work. Previous studies have recognized the importance of various local economic effects such as the structure of local labor market (Hearn, McNamara, and Gunter, 1996; Ahearn et al., 2006) and county differences in volatility in off-farm wages (Goodwin and Bauer, 2003). Results from Mishra and Goodwin (1997) support that distance to town are negatively related to off-farm labor supply. The recent study by Ahearn et al. (2006), however, found that local area variables like unemployment rate¸ employment in specific industries, and urbanization were rather unimportant in explaining off-farm labor participation likelihood.

The independent variables used in the capital model include operator characteristics such as operator's age and experience, farm size, tenure share, and government payments. Farm

specialization is represented by dummy variables for farms specialized in crop, dairy, hog, and beef production, respectively. Farm operation efficacy is represented by the operating profit margin and the asset turnover rate. The financial status of the farm operation is represented by the debt-to-asset ratio, the interest burden, and the effective interest rate on debt, and the predictive measure of financial distress, respectively.

Table 1. Definition and descriptive statistics of variables in models estimated

Variable names	Definitions	Mean	Standard deviation
sofwsbi	Share of off-farm wages, salaries and business income to the total of off-farm wages, salaries and business income and net cash farm income	0.219	1.446
log tfa	Log of real total farm assets[a]	5.85	0.294
op age	Age of senior operator	47.1	10.58
yif	Years in farming for senior operator	24.08	10.53
flivexp	Real family living expenses[b] ($)	31,709	14,627
memb	Number of family members	3.52	1.60
nfssb	Real non-farm savings, stocks, and bonds[b] ($)	17,532	63,293
nfra	Real non-farm retirement accounts[b] ($)	23,420	51,303
nfre	Real non-farm real estate[b] ($)	37,893	47,825
nfli	Real non-farm life insurance[b] ($)	10,059	16,534
nfd	Real non-farm debt[b] ($)	10,058	21,964
acres	Total acres operated	635.2	345.7
tensh	Tenure share. The share of rented land to the sum of owned and rented land).	0.626	0.307
dcrop	Dummy for specialized crop production (=1 if more than 60 percent of farm gross sales is from crop production; 0 otherwise)	0.467	0.499
ddairy	Dummy for specialized dairy production (=1 if more than 60 percent of farm gross sales is from dairy production; 0 otherwise)	0.02	0.14
dhog	Dummy for specialized hog production (=1 if more than 60 percent of farm gross sales is from hog production; 0 otherwise)	0.074	0.262
dbeef	Dummy for specialized beef production (=1 if more than 60 percent of farm gross sales is from beef production; 0 otherwise)	0.059	0.236
opm	Operating Profit Margin (return to farm assets divided by value of farm production). Value of farm production is gross farm income minus feeder livestock purchased and adjusted for inventory changes in crops, market livestock and breeding livestock.	0.195	0.219
atr	Asset Turnover Rate (value of farm production divided by average farm assets).	0.32	0.2
dar	Debt to Asset Ratio. Total Farm Liabilities divided by Total Farm Assets.	0.393	0.236
iburd	Interest burden. Interest expenses (cash) divided by gross cash farm income minus cash operating expense.	0.084	8.90
eintr	Effective interest rate on debt. Interest expense (cash) divided by average total farm liabilities.	0.063	0.03
gpts	Real government payments (all types)[b] ($)	24,942	22,973
z-1	Predictor of financial distress. Equals Total Farm Assets divided by the sum of 3.3 times net farm income before extraordinary items plus operating expenses plus 1.4 times retained earnings plus 1.2 times net working capital (i.e. total farm current assets minus total farm current liabilities).	0.54	0.282
popden	County population density. County population divided with county area (acres). Data source: Minnesota Department of Administration	0.033	0.0094

[a]Gross Domestic Product Implicit Price Deflator used for deflation (www.economagic.com)
[b]Consumer Price Index U.S. City Average used for deflation (www.economagic.com)

Results

The data used in this study are obtained from the Southwestern Minnesota Farm Business Management Association. The sample includes data from 252 sole proprietorships. Time series are collected from the period 1993 through 2002. Our working sample includes 1452 observations. An important advantage from this data set is that we observe the differences in the behavior of the farm household over a relatively long time period. 165 proprietorships are represented in the data set with 4 or more consecutive observations. We will first present the off-farm income reliance results, and then present the farm capital stock results

Off-farm income equation

Parameter estimates for the off-farm income share model are reported in Table 2. The sign of the lagged share of off-farm income is positive and highly significant. This suggests that a farm household that to a higher extent have relied on off-farm income in the past is more likely to persist in such income dependence in the future. Reasons for such state dependence might include higher off-farm wages for those with more off-farm work experience, which affect the opportunity cost of farm work. Farm size as well as farm capital has a negative impact on the off-farm income share, and the impact of farm capital is stronger than that of farm size (by acres). The latter finding is central to the question of endogeneity of capital stock to off-farm labor decisions. Our finding is consistent with the Israeli results by Ahtiuv and Kimhi (2002) for off-farm work participation, as well as with the results by Goodwin and Bauer (2003), which reported that larger firms implies less off-farm employment.

The coefficients of age of senior farm operator (opage) and age squared ($opage^2$) corroborates the familiar nonlinear effect of age reported in off-farm work participation studies. The latter finding is also supported by the negative relation found between off-farm income share and the number of years spent as a farmer.

The results for the two farm household characteristics included in the model are mixed. Family living expenses is, as expected, positively and significantly related to the off-farm income share but the household size, although estimated with a positive sign, is not significant. The latter result also suggests that off-farm income reliance is more related to standards of living than to the household size by itself.

Moreover, investments in non-farm assets are also found to have a mixed impact on off-farm income reliance. Only investment in retirement accounts is significant at the 5 percent level. The other four non-farm asset categories included are not significant at any conventional level.

In addition, a positive and significant relationship between the off-farm income share and farm tenure share is found. The positive sign for this coefficient is inconsistent with earlier studies based on national (Tavernier et al., 1997) or shorter farm household data sets (Mishra and Goodwin, 1997). One reason for the positive relationship found in the present study is that farm enterprises with a higher tenure share operates a lower value of the farm capital stock, which makes them more likely to seek off-farm work. This is further confirmed in the subsequent presentation of the estimates for the farm capital stock equation.

Only farm specialization in crop production is significantly and positively related to the off-farm income share. Specialized dairy and hog operations are typically more labor intensive than crop enterprises and although the coefficients for these farm type specializations are negative, as expected, they are not statistically significant. Specialization in beef production is, according to the data, not related to the dependent variable.

No significant relationship between the off-farm income share and the amount of government payment or population density is revealed. The first result is inconsistent with earlier results. The sign of the coefficient for government payments is, however, positive and this is consistent with work by Shrestha and Findeis (2005) who based on county-level data

found the effect on other federal programs (OFP) on off-farm employment to be positive in the Northern Crescent and Eastern Uplands, i.e. opposite against the results for U.S. overall. To investigate to what extent the result obtained is due to the passage of the 1996 policy change the model were re-estimated over the 1993-1996 period, without any observed major changes with respect to the coefficient related to government payments.

Finally, and interestingly, the predictive measure of farm financial distress (z-1) has a positive and highly significant effect on off-farm income reliance.

Table 2. Maximum likelihood estimates (Tobit) of off-farm income share by farm households in Southwestern Minnesota, 1993-2002

Variable	**Coefficient**	**p-value**
intercept	0.352	0.347
lag-1 shofwsbi	0.08	< 0.0001
log tfa	-0.21	0.0001
opage	0.035	0.022
$opage^2$	- 0.0003	0.0782
yif	- 0.015	0.0016
flivexp	$0.3*10^{-5}$	0.041
memb	0.006	0.655
nfssb	$0.23*10^{-6}$	0.4593
nfra	$0.81*10^{-6}$	0.0362
nfre	$-0.36*10^{-6}$	0.3945
nfli	$0.19*10^{-6}$	0.8726
nfd	$-0.1*10^{-6}$	0.9059
acres	-0.00037	< 0.0001
tensh	0.21	0.0001
dcrop	0.178	< 0.0001
ddairy	-0.135	0.2941
dhog	-0.026	0.7153
dbeef	0.0004	0.9960
gpts	$0.128*10^{-5}$	0.1878
z-1	0.532	< 0.0001
popden	-1.99	0.3044
σ	0.601	0.000
Log-likelihood	-1,163.034	
No. observations	1,338	

Capital equation

Parameter estimates for the off-farm income share model are reported in Table 3. The model explains 82% of the variation in the capital stock in sampled farm operations. The variable of special interest in this study is that measuring the explanatory power of the off-farm income share to the capital stock. The results, however, suggest that off-farm income reliance do not provide any such explanation. A negative relation, implying that off-farm income do not increase farm capital accumulation, could have been expected if farm households were subject to borrowing or capital constraints (Reardon, 1997). Conversely, a positive relation would have implied that funds earned outside of the farm operation were re-invested in the farm enterprise. It is noted, however, that the predictive measure of financial distress (z-1) is positively related to the capital stocks. This suggests that larger farms (by capital) are more financially vulnerable.

The coefficient of farm size (by acres) is small but positive, implying that on average, land and capital are complements. In addition, the farm operator age characteristics reveal a nonlinear but not statistically significant relationship, while it is noted that the impact of number of years in farming is not significant as well. Tenure share has a negative and significant effect on farm capital accumulation. This is of relevance for the off-farm income model as smaller firms are more likely to be more dependent on off-farm income.

Farm specialization has a mixed effect on capital accumulation depending on farm type. The coefficient for farm specializing in crop production has a negative and significant effect on the capital stock, while specialization in dairy; hog; and beef production is found positively related to capital intensity. However, the results for dairy operation are not significant.

Table 3. Ordinary least square estimates for determinants of capital stock by farm households in Southwestern Minnesota, 1993-2002

Variable	Coefficient	p-value
intercept	5.618	< 0.0001
sofwsbi	-0.005	0.9865
opage	0.005	0.1377
$opage^2$	$- 0.35*10^{-4}$	0.2554
yif	0.001	0.3637
acres	0.0005	< 0.0001
tensh	-0.178	< 0.0001
dcrop	-0.074	< 0.0001
ddairy	0.027	0.2888
dhog	0.084	< 0.0001
dbeef	0.105	< 0.0001
opm	0.139	< 0.0001
atr	-0.624	< 0.0001
dar	-0.086	< 0.0001
iburd	0.0008	0.0276
eintr	0.296	0.0129
gpts	$0.54*10^{-5}$	0.0061
z-1	0.101	< 0.0001
R^2 (adjusted R^2)	0.824 (0.822)	
F-value (*p*-value)	358.18 (<0.0001)	
No. observations	1318	

Farm capital efficacy measures are also significant in explaining capital accumulation. The coefficient of the operating profit margin is positive while the coefficient for the asset turnover rate is negative. The positive relation between the first driving factors of return to farm assets is expected as more profitable operations are more likely to grow larger. The negative relation between the asset turnover rate and capital stocks is also reasonable as capital rationing is a known strategy to increase the turnover rate.

Financial characteristics are significant in explaining capital accumulation. First, it is noted that the coefficient of the debt-to-asset ratio is negative implying that more capital intensive farm operations have lower leverage than less capital intensive operations. Second, both the interest burden as well as the effective interest rate on farm liabilities is positively and significantly related to capital intensity. Although, this findings are mutually consistent

they are less obviously consistent with that larger farm operations would have a lower leverage.

Finally, as expected, government payments are found to be positively related to capital stocks.

Concluding remarks

Using a censored simultaneous estimation of farm level data, we evaluate the role of farm operator characteristics; farm household measures; non-farm investments; farm characteristics; farm capital efficacy; farm financial status; state dependence in off-farm income reliance; and finally a local labor market component in off-farm income reliance and capital accumulation. A novel feature of this study is that we investigate the joint decisions by farm households to work off-farm, and their farm capital accumulation. With the exception of the work by Ahituv and Kimhi (2002) the literature on off-farm labor supply seems to have overlooked the possible endogeneity of farm capital in off-farm labor decisions, and vice versa. Several important results are found.

The results strongly suggest that there is a negative relation between off-farm income reliance and farm capital accumulation. This likely implies that many part-time farmers or farm household operating smaller farm units to a larger extent relies on off-farm income compared to full-time operators or larger farm units. The association between off-farm income and farm capital has important policy implications. Agricultural policy affects both rural and urban labor markets and labor market policy tends to spill over to the farm sector. In addition, encouraging, or impeding, specific forms of agricultural production such as part-time farming necessitates understanding about the causality between off-farm income and farm capital, in particular because policies cannot be easily reversed.

Second, there is support for true state dependence in off-farm income reliance. As noted by Corsi and Findeis (2000) this implies that off-farm labor adjustments will be more rigid than without such dependence and that, although farm households might seek off-farm income to counteract farm income volatility, this dependence likely reflect that off-farm income are critical to the financial well-being of many farm households. A related result is that government payments are found to be weakly positively related to off-farm income reliance and strongly positively related to capital intensity. The relationship between government payments and off-farm income reliance supports the finding by Shrestha and Findeis (2005) that from county-level data found that the income effect of government payments is specific to region. Our results is insensitive to presence of more decoupled payments following the 1996 FAIR and this is in line with the recent results by Ahearn et al. (2006) showing that the observed nationwide increase in off-farm labor participation was not the results of the changes of government subsidies following the 1996 reform of agricultural policy. We conclude that it is not unlikely that a farm household that is allowed to plan the production organization more flexible, while still receiving support, will accommodate into seeking more off-farm work as many farm households to a large extent depend on off-farm income as a source for their cash income. Yet another related result is that farm households predicted to be in farm financial distress are more likely to rely on off-farm income.

Third, while an emerging literature has provided result on determinants of off-farm investment little attention has been given to the role of off-farm investment in explaining off-farm work participation or off-farm income reliance. While including five non-farm asset categories typically held by farm household we found that only investments in non-farm retirement accounts is related to off-farm reliance at conventional significance levels. The latter result is reasonably as pension plans might be included in off-farm employment contracts. This, however, further accentuates the rigidity in off-farm work adjustments.

Fourth, and finally, the estimation of the capital accumulation model suggests that farm financial such as leverage; interest burden; effective interest rate on farm debt; and financial distress, as well as farm capital efficacy factors such as operating profit margin and asset turnover rate contributes in explaining farm capital growth and therefore indirectly has effect on off-farm income reliance.

Taken together, the results obtained in this study is of use in understanding: who will be likely to rely on off-farm income? And: will income from off-farm work be used to expand the farm operation?

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