Financing Constraints and the Family Farm: How do Families React?

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This paper explores the idea that off-farm income is used for investment in farm assets. Using Alabama farm data for the 1997-2004 period, we find that farm investment is more sensitive to off-farm than to on-farm income, and that this sensitivity is stronger for farms with sales less than $250,000.

Introduction

The proportion of off-farm income in total farm income is large especially in family farms. Studies show that off-farm income is used to manage financial risk (Mishra and Goodwin; Mishra and Sandretto). While family farms' total income is higher and assets holding are greater than those of nonfarm families, farm households' consumption expenditures are lower (Mishra et al., 2002). This suggests that perhaps farm households use off-farm income to support farming.

This study tests the hypothesis that Alabama farmers use off-farm income to invest in farming. It also asks whether off-farm income may serve to alleviate financing constraints in smaller and presumably more credit constrained farms.

Methodology

The financing constraints approach stipulates that under conditions of asymmetric information in external credit markets, external and internal funds are no longer perfect substitutes and external funds are available at premium. Thus, investment is sensitive to availability of internal funds (Fazzari et al.). Specifically, the approach estimates a reduced-form investment equation of the form:

$$(I/K)_{i,t} = f(X/K)_{i,t} + g(CF/K)_{i,t} + u_{i,t}$$

where *I* is the investment in fixed assets for firm *i* at time *t*; *X* represent a vector of variables that have been identified as determinant of investment from a variety of theoretical perspectives; *u* is the error term and *u* is assumed to be normally distributed. The function *g*(.) depends on the firm's internal funds or cash flow; it represents the "sensitivity" of investment to available internal finance, after investment opportunities are controlled for through the variables in *X*. All variables are divided by the beginning-of-period capital stock *K*.

Cash flow is defined in the literature as current revenues minus expenses and taxes, and is used as the proxy of changes in net worth. The most appropriate measure for investment opportunity (IO) is the expectation of the present value of future profits from additional capital investment. In the neoclassical theory of the choice of capital stock, this expectation is measured by marginal *q*, the shadow value to the firm of an additional unit of physical capital (Hubbard, 1998).

To account for the fact that family farms receive income form sources other than the farm, farm income is divided into net farm income and net non farm income. This model allows testing the main hypothesis that farms may use off farms sources to fund their farm investment. Given the literature suggest that farming families spend less on consumption but are richer than the average household, it is important to find out if the off farm income is being used for farm investment.

The empirical model is constructed as follow:

$$I_{i,t} = \beta_i + \beta_1 \Delta Sales_{i,t} + \beta_2 FI_{i,t} + \beta_3 FI_{i,t-1} + \beta_4 NFI_{i,t} + \beta_5 NFI_{i,t-1} + \beta_6 AVGROA_{i,t} + \beta_7 STDROA_{i,t} + \beta_8 TA_{i,t} + \beta_9 (TA_{i,t})^2 + \beta_{10} SOLVENCY_{i,t} + \beta_{11-18} DYEAR + \beta_{19-27} DINDUSTRY + \varepsilon_{i,t} \quad (2)$$

Total farm investment in period *t* ($I_{i,t}$) is modeled as a function of the change in sales ($\Delta Sales_{i,t}$), current net farm income ($FI_{i,t}$), lagged net farm income ($FI_{i,t-1}$), current net non-farm income ($NFI_{i,t}$), lagged net non-farm income ($NFI_{i,t-1}$), return on farm assets (AVGROA, STDROA), farm size (TA, TA2), solvency measure (SOLVENCY), dummy year (D97-D04), dummy industry (D30-D100) and $\varepsilon_{i,t}$ is random error term, $\varepsilon_{i,t}$ is normally distribution with zero mean and a constant variance. For farm *i* at time *t* (measured in years):

Because sales and internal finance (farm income, non-farm income both in net values) may be highly collinear, the variable change in sales ($\Delta Sales_{i,t}$) is used as the proxy of investment opportunity. The net farm income and net non-farm income terms in equation (2) are the main focus of this study. The first variable ($\Delta Sales_{i,t}$) and the rest of the variables are selected based on what the literature suggest may also influence farm investment. Equation (2) allows testing the importance of internal finance after controlling for the accelerator (sales) and other possibly important controls. Given that this equation is specified in levels and there are large differences between the farms in terms of size, all the main variables used are scaled by the farm total assets to control for heteroscedasticity.

The aim of estimating this model is to see whether the internal finance of a farm has an effect on farm investment in general and the particular interest is the role of off-farm income as a source of funds used for on-farm investment. Another goal of this analysis is to see whether there is difference in the investment of small and large farms. In particular, it is important to find out if only small farms (with less than $250,000 in sales as defined by USDA) use their off farm income to invest in farming or if this is also true for large commercial farms. For that purpose, equation (2) is estimated for two sub-samples – small farms (farms with sales less than $250,000) and large farms with annual sales more than $250,000.

Data

Data come from Alabama Farm Analysis Database. The database contains 8 consecutive years of data. The observations which have missing values on the key variables used in the regressions were deleted. The panel is unbalanced, consists of 1060 observations and covers the period 1997-2004. The CPI (consumer price index) is used to convert the data into constant 2004 dollars. Since farms in the sample of Alabama Farm Analysis Database are likely to be different than the average farm in Alabama, this section begins with a comparison of the characteristics of the sample with the characteristics of the average farm in Alabama and proceeds to describe the variables used in the empirical model.

The number of farms in the sample is small compared to the large number of farms in the state of Alabama. With about 130 observations for each year during the period 1997-2004, the farms analysis account for only 0.3% of the total number of farms in state of Alabama. Compared to the average total assets of about $300-400,000 for the average farm in Alabama, the average farm in the sample is larger, with average total assets of $1.1 million. The sales volume of farms in the sample is about 4-5 times bigger than the average volume of sales of farms in Alabama, suggesting that the farms in the sample depend more on agricultural activity than do farms not included in the analysis. Net farm income for Alabama's farms has increased gradually during the period without big fluctuation compared to a lot of fluctuations in this variable in the Alabama Farm Analysis Database. Farms in the sample are also much more leveraged than the average farm in the state - the ratio of farm's total debt to total assets from farm analysis is much higher than Alabama's farms as a whole. The proportions of total farm liabilities to total farm assets of farms from the sample is more than 30% compared to 12% for Alabama's farms. This means farms in the sample use greater external finance source to invest in farms and for those farms which do not have access to external funds, then their investment may be dependent on internally available cash flows. The rate of return on asset is almost the same for farm analysis and for Alabama's farms as a whole.

Graph 1 plots average net farm and off-farm incomes for the study period and graph 2 plots off farm income and wages. Average total assets, net worth and farm investment are plotted on figure 3.

The dependent variable is investment in farm fixed and intermediate asset (I_t) and includes investment on farm real estate, bare land & building, machinery and equipment, and breeding livestock. It is defined as the change in farm capital or $I_t = K_t - K_{t-1}$.

Change in sales ($\Delta Sales$) is calculates by subtracting last period sales from sales in the current period where sales is the sum of total crop, market livestock, and breeding livestock sales and the value of consumed livestock products, i.e., milk and eggs. Net Farm Income *(FI)* comes directly from the accrual income statement and is calculated by subtracting expenses from revenues, plus the gain or loss on the sale of farm capital assets; lagged net farm income ($lag\,FI_{i,t-1}$) is this variable for the previous year. Net non-farm income ($NFI_{i,t}$) also comes directly from the income statement and is defined as sum of net income from all non-farm businesses. This variable is also used with one period lag $lagNFI_{i,t-1}$.

ROA measures the return to all farm assets and is used as a proxy of farm profitability. The ratio of borrowed funds to total assets is used as a solvency measure to control for farm's ability to withstand risk, with the higher ratio indicating greater risk exposure. Dummy variables for farm type (cotton, peanuts, contract broiler, cow calf, catfish, dairy, feeding livestock, and corn and soybean) are included to control for farming activity area farming; total assets control for farm size. Internal finance and fixed investment are annual data scaled by farm's total asset.

The defined of the National Commission on Small Farms is used to separate farms (based on farm's gross sales) into small and large farms. Gross sales of $250,000 is the cutoff between small and large farms. Farms with less than $250,000 of gross sales (in 2004 dollars) are placed into the small farm size class.

Results

Table 2 reports the results from estimating several specifications for farm investment using the whole sample. The best model (Column 3, in Table 2) was chosen using F-test for joint restriction exclusions. Since heteroskedasticity was detected with Breusch-Pagan/Cook-Weisberg test, results presented are corrected for heteroskedasticity using robust (Huber-White) standard errors. The specifications contain industry and year dummy variables to see the effect of individual farm's sector and individual year on investment. In this model the dummies for year 2004 (D2004) and for corn and soybeans sector (D100) serve as a base and were excluded.

The results indicate that the estimated coefficients for the current sales growth are positive and statistically significant, indicating an accelerator effect. The effect of change in sales on farm investment is 0.548 points for one point increase in the change of sales variable.

Internal finance is found to be important in the investment equation. Farm income has a positive and significant effect on farm investment. On average, a single annual increase of one unit in the ratio of farm income to farm's total assets will lead to an increase of 0.35 units in the ratio of fixed investment to total farm's assets. The effect of lagged net farm income on farm investment is 0.4 points, but this effect is not statistically significant.

The estimated coefficient for the non-farm income is also positive and significant. The effect of current non-farm income on farm investment is very strong, with the value of 0.662 points. On average, an annual increase of one unit in the ratio of non-farm income to farm's total assets will lead to an increase of 0.662 unit in the ratio of fixed investment to total farm's assets. The result shows the important role of off-farm income in farm business. Farm households in the sample use a large percentage of their income from off-farm business to invest on farms; it seems the more they earn from off-farm business the more likely they are to invest in the farm business. The finding is inconsistent with the idea that farm households reduce their investment on farm when they earn more from the off-farm business. Lagged net non-farm income is not statistically significant in the on farm investment equation.

The sample is small compared to the more than 45,000 farms in state of Alabama. Nevertheless, the findings help explain how so many small farms in Alabama continue to exist although the average operating profit margins and average rates of return on assets and equity are negative. Small-farm households and even large-farm households receive substantial off-farm income and do not rely primarily on farm income for their livelihood or as the only source of investment in the farm.

The result is consistent with the report of the U.S. Department of Agriculture that over the past fifty years, the non-farm rural economy has grown in importance as more and more farmers have become increasingly dependent on off-farm income. For the majority of U.S. farm households, the availability of off-farm income is a more significant factor for the financial well-being of the farm. Usually, the increases in off-farm income were more than sufficient to compensate for declines in farm income. Off-farm income from the spouse and/or the farm operator supports the farm. With the existence of financial constraints, market imperfection, limited availability of debt, farm operator uses off-farm income to invest on farm instead of looking for external finance from banks.

In many empirical studies, firm size has been used as an indicator of whether or not a firm is more likely to be financially constrained. For example, Carpenter *et al* use firm size in their work using US firm data, and Devereux and Schiantarelli (1990) use it in their work on financial effects and fixed investment using data on UK firms. The basic idea is that, in general, larger firms have access to a wider range of suppliers of finance than smaller firms, and as a consequence larger firms are less likely to be financially constrained than smaller firms.

To see whether only off-farm income affects only investment in financially constrained farms, we estimate the model for small, presumably more constrained and larger, presumably less constrained farms. USDA classification based on the volume of sales—more than $250,000 and less than $250,000—is used to separate the farms.

To see whether the investment equation for these two groups should be estimated jointly or together we use a Chow test. The null hypothesis is that the two groups (small farms and large farms) have the same sensitivity of investment to the dependent variables and there are no differences between large and small farms. The alternative states that one or more of the slopes differ across the groups. Results indicate that there is a difference between the groups.[1]

These results are presented in Table 3. The results in the first column relate to the sub-sample which is defined as large farm (farms with more than $250,000 of gross sales, in 2004 dollars). Larger farms, with annual sales more than $250,000 are less financially constrained than small farms, according to the estimation results Larger farms' investment in farming is less sensitive to availability of internal funds than investment in smaller farms. Size remains an important factor in access to credit for family farms and smaller farms use off-farm income to remain in farming.

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[1] The F-test statistic is calculated as follows:
F-test= [SSR (full model) - (SSR1+SSR2)]/ (SSR1+SSR2) * [n-2(k+1)]/ (k+1);
SSR1: the sum of squared residuals obtained from estimating for the large farms; this involves 354 observations. SSR2: the sum of squared residuals obtained from estimating the model using the small farms (269 observations); n= number of observations.
Then F-test = [49.84 – (14.26+18.27)/ (14.26+18.27) * [623- 2(7+1)]/ (7+1)= 39.68
and the critical F (7, 623) = 2.64; F-value > critical F, therefore the null hypothesis is rejected.

There are indeed big differences between the estimates of two sub-samples. The effect of change in sales is much stronger for the farms classified as small farms, 0.601 percent points compared to 0.08 points effect for large farms. This implies that the accelerator effect is very important for investment of small farms. The main differences between the analyses for two groups, which are also the main focus of this paper, are the coefficients on net farm income and on net non-farm income. Among the farms defined as unconstrained, the coefficient on current net farm income variable is positive and significant, and the magnitude of net farm income on farm investment for large farms is 0.134 points, compared to a significantly larger magnitude of for small farms of 0.205 points. The effect of lagged net farm income on investment of small farms is also stronger with the level of 0.631 points compares to the level of 0.211 points for large farms. The coefficients on lagged net farm income variable are significant and positive for the two sub-samples. Net non-farm income also has strong effect on investment of both large farms and small farms. The effect of current net non-farm income on farm investment of the large farms accounts for only 0.384 points, smaller than that of small farms which accounts for 0.741 points. The effect of lagged net non-farm income is 0.214 points for large farms and 0.109 points for small farms.

These findings are consistent with many empirical works on firms' financial constraint. They found that although the effect of internal finance on fixed investment was concentrated among firms defined as financially constrained by their financial policy, internal finance still had a positive effect on the fixed investment of unconstrained firms. The results suggest that the investment of financially constrained farms is more sensitive to the availability of internal finance than that of financially unconstrained farms. Net farm income and net non-farm income both have significantly larger effect on farm investment among smaller farms than among larger farms. This is consistent with what Carpenter *et al* and Gertler and Gilchrist (1994) report for the United States. They both found that the investment in smaller firms was more sensitive to current cash flow than investment in larger firms. The conclusion is that large farms have easier access to external finance than small farms.

Overall, results show that internal finance affects farm investment. Both farm and off-farm income have a positive and statistically significant effect on farm investment. However, farm investment is more sensitive to off-farm than to farm income.

Conclusions

This paper studies the role of internal finance farm investment for a sample of 150 farms in Alabama during the period of 1997-2004. Using annual data, the paper has examines the relationship between farm investment and internal finance, the effect of net farm income and net non-farm income on farm investment, and in particular whether the effect of cash flow on farm investment is concentrated among farms that are more likely to be financially constrained.

We find that the effect of internal finance on farm investment is positive and significant for the whole sample; net farm income has a positive and significant effect on farm investment. Secondly, in contrast to studies of other businesses, farm households used a large percentage of their income from off-farm sources to invest in the farming business. The finding shows that the more income a farm household earns from off-farm source the more likely it is to invest in the farm business. Thirdly, the results suggest that farm investment in small presumably more financially constrained farms is more sensitive to the availability of internal finance than that of financially unconstrained larger farms, consistent with other findings for US firms (Carpenter *et al* and Gertler and Gilchrist, 1994).

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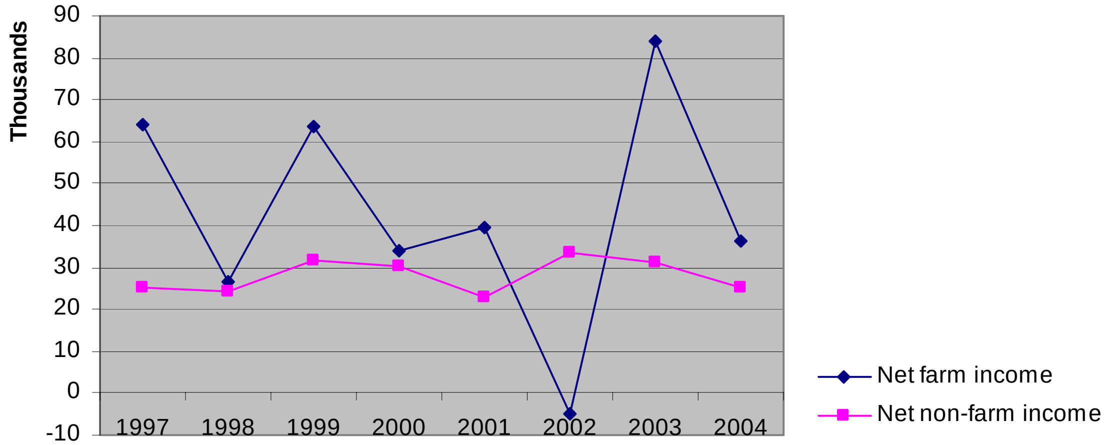
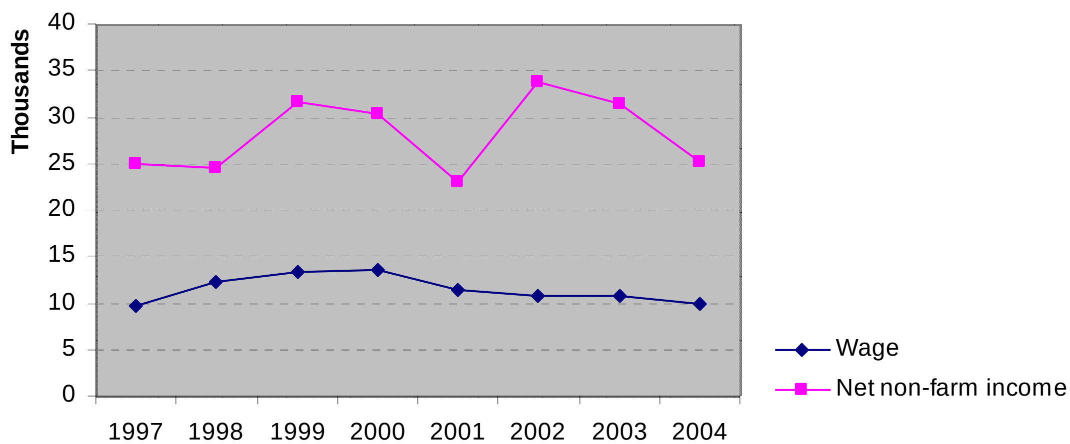
Figure 1: Average net farm income and net off-farm income.



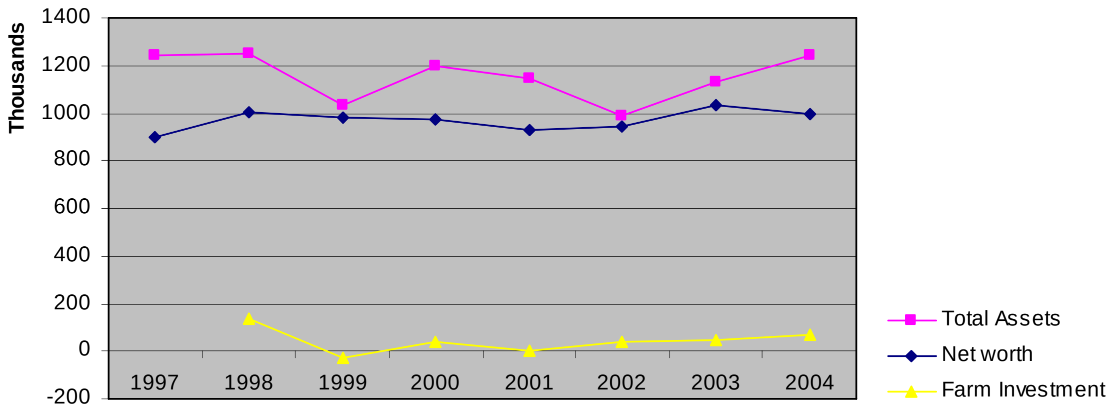
Source: Alabama Farm Analysis Database

Figure 2: Average net off-farm income and wages.



Source: Alabama Farm Analysis Database.

Figure 3: Average total assets, net worth and farm investment.



Source: Alabama Farm Analysis Database.

Table 1: Summary statistics of some financial indicators for farms in the sample and Alabama's farms:

Year	Number of farms in sample	Number of farms in Alabama	Net farm income (sample)	Net farm income (Alabama)	Sales (sample)	Sales (Alabama)
1997	118	49,000	64,022	22,052	309,117	65,671
1998	113	49,000	26,501	24,064	303,772	67,229
1999	121	48,000	63,689	29,449	262,418	70,875
2000	127	47,000	33,952	24,740	245,038	67,752
2001	135	46,000	39,399	36,061	234,461	75,175
2002	148	45,000	-5,081	26,086	215,861	64,892
2003	148	45,000	84,093	35,748	230,250	78,766
2004	158	44,000	36,127	46,794	237,686	92,591
Year	Total assets (sample)	Total assets (Alabama)	Debt/Assets (sample) percent	Debt/assets (Alabama) percent	ROA (sample) percent	ROA (Alabama) percent
1997	1,241,859	294,200	31	11.5	8.77	7.31
1998	1,253,471	303,224	28.1	12.1	7.53	9.40
1999	1,034,383	328,613	29.8	12.1	8.82	12.02
2000	1,197,407	351,516	29.3	12.4	7.92	7.40
2001	1,145,739	373,926	31.6	12.6	9.77	7.91
2002	991,610	398,206	37.9	12.8	7.18	5.42
2003	1,129,495	420,388	32.3	12.5	9.49	8.95
2004	1,245,321	N/A	35.1	N/A	10.34	N/A

Source: National Agricultural Statistics Service (NASS); Economic Research Service/USDA; Alabama Farm Analysis Database.

Table 2. Regression Results.

	Farm Investment	Farm Investment	Farm Investment
Constant	0.137	-0.060	-0.070
	(1.22)	(1.69)*	(1.94)*
Δ Sales	0.571	0.551	0.548
	(2.07)**	(1.98)**	(1.97)**
NFI	0.381	0.359	0.350
	(2.08)**	(1.99)**	(1.92)*
Lag NFI	-0.046	0.013	0.004
	(0.26)	(0.08)	(0.03)
NNFI	0.618	0.635	0.662
	(2.58)**	(2.56)**	(2.65)***
Lag NNFI	0.005	-0.067	-0.057
	(0.02)	(0.34)	(0.29)
TA (mln)	0.0802	0.067	0.066
	(2.37)**	(2.16)**	(2.16)**
AVROA	0.234	-0.001	
	(1.57)	(0.88)	
STDROA	-0.027	-0.000	
	(1.58)	(0.05)	
Solvency	0.040		
	(0.61)		
Year Dummies	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes
Obs	623	623	623
R squared	0.34	0.32	0.32
F-statistic	14.28	31.83	40.67

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Regression Results for Investment in Large and Small Farms.

	Investment in Large Farms[1]	Investment in Small Farms[2]
Constant	-0.079	-0.182
	(1.79)*	(4.28)***
Δ Sales	0.080	0.601
	(1.73)*	(16.84)***
NFI	0.134	0.205
	(1.84)*	(1.70)*
Lag NFI	0.211	0.631
	(4.00)***	(5.37)***
NNFI	0.384	0.741
	(2.77)***	(4.33)***
Lag NNFI	0.214	0.109
	(2.96)***	(5.76)***
TA (mln)	0.057	0.113
	(2.42)**	(4.36)***
TA^2	-3.91e-15	-1.63e-14
	(1.12)	(3.57)***
Observations	354	269
R-squared	0.15	0.31
F-value	7.40	25.07

[1]Large Farms have annual sales more than $250,000
[2] Small Farms have annual sales less than $250,000
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%