Abstract

This paper examined the relative importance of farm size, farm type, managerial ability, capital structure, operator age, family size, and off-farm income in explaining farm growth rates. Farm type, managerial ability, and operator age were significantly related to farm growth rates. Farms that grew faster obtained a higher percent of their farm income from crops, had above average managerial ability, and had younger operators.

Factors Impacting Farm Growth

By Mario Villatoro and Michael Langemeier

Introduction

Farm structure in the United States has been changing for decades. Specifically, the number of farms has been declining and the average farm size has been increasing. Given the structural change that has been occurring, it is natural to ask why farms are growing at different rates and to explore the factors related to the differential rates in farm growth.

Numerous factors can be used to explore firm or farm growth. These factors can be categorized into two broad categories: external factors and internal factors. Firms have more control over internal factors. Examples of external factors include weather, input and output prices, farm policies, national economic growth, and off-farm job opportunities. Internal factors include farm size, farm type, managerial ability, farm organization, capital structure, and technology adoption.

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As noted in the next section, several previous studies have examined the relationship between farm growth rates, and internal and external factors. This study adds to the literature in three ways. First, many of the previous studies are quite dated. The relationship between farm growth rates, and internal and external factors using recent data may differ from results presented in previous studies. Second, most of the previous research has focused on farms that are fairly homogeneous in terms of the enterprises engaged in. This study examines growth rates for a relatively diverse set of farms. Some of the sample farms specialize in crop production while others specialize in livestock. Many of the farms have both crop and livestock enterprises. By examining this diverse set of farms, the relative growth rates of crop and livestock farms can be computed and compared. Third, many of the previous studies have not examined the relationship between farm growth and managerial ability. Above average managers earn higher profits. These profits can be used to expand the farm operation or for off-farm investments. Below average managers often do not have enough cash flow left after covering their family living expenses to expand their farm operation. This study will quantify the relationship between farm growth rates and managerial ability.

The objective of this paper was to examine the relative importance of farm size, farm type, managerial ability, capital structure, operator age, family size, and off-farm income in explaining farm growth rates. Farm growth rates were computed using nominal total farm assets.

Methods

To explore differences in farm growth rates, comparisons of the characteristics of farms with negative and positive growth rates and regression analysis were conducted. The following variables were compared for farms with negative and positive growth rates in total farm assets: farm size, percent of farm income from crops, managerial ability, debt to asset ratio, inverted current ratio, age of operator, number of family members, and off-farm income.

Regression analysis involved an exploration of the relationship between the growth rate of total farm assets on individual farms and several independent variables. Two separate regressions were used. The first regression used the mathematical growth rate of total farm assets as the dependent variable. The second regression used the geometric growth rate of total farm assets as the dependent variable. Unlike the mathematical growth rate which focuses on average growth rates over time, the geometric growth rate focuses on the difference in total farm assets between the first and last years analyzed. More information pertaining to geometric growth rates can be found in Mansfield, et al. (2002).

Independent variables used in this study included farm size, percent of farm income derived from crop production, managerial ability, capital structure, operator age, family size, and off-farm income. The expected sign for each of these independent variables is discussed below.

Total farm assets was used as a measure of farm size. Shapiro, Bollman, and Ehrensaft (1987), Upton and Haworth (1987), and Weiss (1999) used farm size to explore differences in growth rates among farms. Upton and Haworth (1987) found farm growth rates to be independent of farm size. For the farms studied by Shapiro, Bollman, and Ehrensaft (1987) and Weiss (1999), small farms grew faster than large farms. If small farms are found to grow faster than larger farms in this study, the regression coefficient on total farm assets will be negative. If larger farms are found to grow relatively faster, the regression coefficient will be positive. An insignificant coefficient on total farm assets would indicate that farm growth rates are statistically independent of farm size.

Percent of farm income derived from crop production was used to examine the importance of farm type in explaining farm growth rates. This variable was measured in decimal form in the regression. The regression coefficient on this variable will be positive if crop farms grew relatively faster than livestock farms over the study period. If livestock farms grew relatively faster than crop farms over the study period, the regression coefficient on this variable will be negative. If crop and livestock farms grew at similar rates over the study period, the regression coefficient on the percent of income derived from crops variable will be insignificant.

The positive relationship between farm performance and managerial ability is the primary impetus for including managerial ability in farm growth studies. Studies that have

examined the relationship between farm growth rates and managerial ability include Patrick and Eisgruber (1969), Eginton (1980), Summer and Lieby (1987), Upton and Haworth (1987), and Weiss (1999). Managerial ability was measured using the economic total expense ratio in this study. The economic total expense ratio for each farm was computed by dividing total economic cost (cash cost, depreciation, and opportunity charges on unpaid labor and assets) by value of farm production. Farms with above average managerial ability have a lower economic total expense ratio and are expected to grow faster so the relationship between farm growth rates and the economic total expense ratio is expected to be negative.

Empirical studies that have examined the relationship between farm growth and capital structure include Patrick and Eisgruber (1969), Weiss (1999), and Escalante and Barry (2002). Capital structure could involve liquidity and/or solvency. The debt to asset ratio and the inverted current ratio were used to explore the relationship between farm growth rates and capital structure in this study. The debt to asset ratio was used as a solvency measure. The debt to asset ratio was computed by dividing total farm debt by total farm assets. The inverted current ratio was used as a liquidity measure and was computed by dividing current liabilities by current assets. Current liabilities included accounts payable and liabilities due within the next year. Current assets included cash, accounts receivable, feed and supply inventories, and crop and livestock inventories. A high debt to asset ratio and/or a high inverted current ratio could constrain growth. Thus, the expected relationship between farm growth and the two capital structure variables is negative.

Farm and family characteristics that have been used to examine farm growth include firm and operator age, family size, off-farm employment, educational levels, and risk attitudes. Information on operator age, family size, and off-farm income was available in this study.

Empirical results reported by Weiss (1999) suggest that farm growth increases until the operator is in his or her mid-thirties and then declines. Because the relationship between farm growth and operator age has been found to be non-linear in previous studies, both operator age and operator age squared were included in the farm growth regressions used in this study. Using the regression coefficients on age and age squared, farm growth rates will be compared for farms operated by farmers of various ages.

The relationship between farm growth and family size could be positive or negative. A positive relationship could result if additional family members work on the farm. Under this scenario, a farm with a larger family could handle more acres or livestock units. A negative relationship could result if farms with more family members have higher family living expenses. If this was the case, less money would be available for farm growth.

Upton and Haworth (1987) and Weiss (1999) found a significant relationship between farm growth and off-farm income. The relationship between farm growth and off-farm income could be positive or negative. A positive relationship could result if money earned off the farm is used to expand the farm. A negative relationship could result if time spent off the farm puts major constraints on the time spent farming. Weiss (1999) indicated that off-farm employment typically signals that a farm is not going make the farm its major source of income. Under this scenario, there would be a negative relationship between farm growth and off-farm income.

Data

Whole-farm data for 353 farms in Kansas for the 1983-2002 period were used in this paper. All of the sample farms were members of the Kansas Farm Management Association and had continuous data for the entire 20-year period. Summary information for the dependent and independent variables are presented in Table 1. To obtain the information in Table 1, 20-year averages of all of the variables were first computed for each farm. These 20-year averages were then used to compute the sample average and standard deviation for each variable presented in Table 1. Total farm assets and off-farm income are expressed in nominal dollars in Table 1.

The average annual growth rate in total farm assets was 2.08 percent using the geometric average and 3.01 percent using the mathematical average. The geometric average relies only on the level of assets in the first and last year of the sample. The mathematical average is not as dependent on these values. Using the mathematical growth rate, approximately 20 percent of the farms had a negative growth rate in total farm assets.

Using the geometric growth rate, approximately 24 percent of the farms had a negative growth rate indicating that 24 percent of the farms actually had fewer assets in 2002 than they did in 1983.

On average, total farm assets for the sample farms was $660,590. The sample farms received, on average, approximately 64 percent of their farm income from crops. The sample farms were more heavily concentrated in eastern Kansas than in central and western Kansas.

The economic total expense ratio for each farm was computed by dividing total economic cost by value of farm production. Total economic cost was computed by summing cash costs, depreciation, an opportunity charge on unpaid labor, and an opportunity charge on assets. Unpaid labor included operator and family labor. The opportunity charge on assets included opportunity charges for purchased inputs, current crop and livestock inventories, breeding livestock, machinery and equipment, buildings, and land. As indicated by the economic total expense ratio of 1.16 in Table 1, the farms on average were not covering all of their economic costs.

The average debt to asset ratio was 0.31. The inverted current ratio was computed by dividing current liabilities by current assets. Due to the fact that numerous farms had zero current liabilities, the inverted current ratio was used in this study rather than the current ratio (current assets divided by current liabilities). The average inverted current ratio was 0.70.

Average operator age was 52 and the average number of family members was 3.1. The average operator age implies that the average farmer was 42 at the beginning of the study period and 62 at the end of the study period. Off-farm income averaged $7,899.

Results

Table 2 presents a comparison of the characteristics of farms with a negative growth rate in total farm assets and a positive growth rate in total farm assets. Of the 353 farms in this study, 73 farms had a negative growth rate and 280 farms had a positive growth rate. The average annual growth rate in total farm assets for farms with a negative growth rate was -1.73 percent. In contrast, the average annual growth rate in total farm assets for farms with a positive growth rate was 4.21 percent. The farms with a positive growth rate tended to be larger, received relatively more farm income from crops, had a lower economic total expense ratio (above average managerial ability), had a lower debt to asset ratio, had a lower inverted current ratio, had younger operators, had a larger family, and a lower level of off-farm income.

Table 2 suggests a positive relationship between farm growth and family size, and a negative relationship between farm growth and off-farm income. The result with respect to off-farm income is plausible if off-farm income is related to whether an operator is a part-time or full-time operator. Full-time operators would be expected to have lower levels of off-farm income and higher growth rates. Because data on farming status (part-time versus full-time) is not available, this issue could not be further explored.

While Table 2 is useful in examining differences between groups of farms, it is not helpful in identifying significant relationships. Regression analysis was used to further explore the relationship between farm growth rates and the independent variables. The regression results are reported in table 3. The discussion of the regression results below will focus on the variables that were significant in both regressions. With the exception of the debt to asset ratio for the geometric growth rate regression, all of the regression coefficients had the expected sign.

The total farm assets variable was not significantly related to the geometric growth rate or the mathematical growth rate. Recall from the discussion of Table 2 that farms with a positive growth rate were larger than farms with a negative growth rate. The results in Table 3 indicate that there is not a statistically significant relationship between farm growth rates and farm size.

The percent of farm income from crops was significant and positively related to the growth rates of total farm assets. Crop farms thus grew at a relatively faster rate than livestock farms over the study period. Using the mathematical growth rate regression, a one standard deviation increase in the percent of farm income from crops (increasing the percent of farm income derived from crops from 63.6% to 86.7%), holding the other

independent variables constant, would result in an increase in the predicted growth rate from approximately 2.1 to 2.8 percent.

The economic total expense ratio was significant and negatively related to the growth rates in total farm assets indicating that farms with a lower economic total expense ratio had significantly higher growth rates. Using the mathematical growth rate regression, a one standard deviation increase in the economic total expense ratio (increasing the economic total expense ratio from 1.16 to 1.38) would lower the predicted growth rate from approximately 2.1 to 1.1 percent. Managerial ability obviously had a large impact on farm growth. Farm operators with above average managerial ability generated sufficient cash flow to more aggressively expand their operations.

As expected, the relationship between farm growth rates and operator age was non-linear. Operator age was significant and negatively related to farm growth rates and operator age squared was significant and positively related to farm growth rates. Using the mathematical growth rate regression, the predicted growth rates for farms operated by farmers that were 34 years old (two standard deviations below the average age) and 70 years old (two standard deviations above the average age) were 7.8 percent and 2.8 percent, respectively. It is interesting to note that the predicted farm growth rates were positive even for the older operators. Though specific information on farm succession is not available, the results with respect to operator age in this study suggest that the older operators in the sample of farms studied may be passing their farm over to younger family members to farm rather than retiring and selling their assets.

The debt to asset ratio and inverted current ratio were not significantly related to the mathematical growth rate in total farm assets. In contrast, these two variables were significantly related to the geometric growth rate. Specifically, the geometric growth rate was positively related to the debt to asset ratio and negatively related to the inverted current ratio. These results suggest that farms with relatively higher levels of total debt and relatively lower levels of current debt grew more rapidly. It is interesting to note that the relatively high total debt loads of some farms did not constrain the geometric growth rate. Conversely, as expected, lack of liquidity constrained farm growth. Lack of liquidity makes it increasingly difficult to cover farm expenses, current debt obligations, family living expenses, and new investment expenditures needed to expand the farm.

Because the highest proportion of farms were located in southeast Kansas, this region was used as the default in both regressions. This means that growth rates in other regions were measured relative to the growth rate in southeast Kansas. Results in Table 3 indicate that the farms in western Kansas had lower growth rates than the farms located in southeast Kansas. Lower growth rates in western Kansas could be due to differences in crops grown, weather, or other factors not measured in this study.

Summary

The objective of this study was to examine the impact of farm size, farm type, managerial ability, capital structure, operator age, family size, and off-farm income on farm growth rates. Farms with a higher percent of farm income derived from crops, with a lower economic total expense ratio, and with a younger operator grew at a relatively faster rate.

Three of the primary results of this study warrant further discussion. First, a positive relationship between farm growth rates and percent of farm income derived from crops was found. This implies that the farms specializing in crop production grew at a faster rate than the farms specializing in livestock production. Consolidation in the dairy and swine industries may partially explain this result. Farms that have dropped dairy or swine enterprises have had to increase their crop acres just to maintain their farm size. Farms with dairy and swine enterprises may have also sought off-farm employment to make up for the lost income associated with dropping these enterprises. Procuring off-farm employment may have made it difficult to augment their farm size. Second, farm growth rates were significantly related to the economic total expense ratio. Farms with above average managerial ability had lower economic total expense ratios and grew at a faster rate. This result is intuitive. Farms with above average managerial ability have more money available after covering family living expenses, to invest in their operations. Third, farm growth rates were found to be independent of farm size. Much of the previous literature has found the growth rate of smaller farms to

be relatively higher than the growth rate of larger farms. The relationship between farm growth rates and farm size certainly merits further study.

References

Eginton, C.W. "Impacts of Federal Tax Policies on Potential Growth in Size of Typical Farms." *American Journal of Agricultural Economics*. 62(December 1980):929-939.

Escalante, C.L. and P.J. Barry. "Business Growth Strategies of Illinois Grain Farms." *Agricultural Finance Review*. 62(Spring 2002):69-79.

Mansfield, E., W.B. Allen, N.A. Doherty, and K. Weigelt. *Managerial Economics: Theory, Applications, and Cases*, Fifth Edition. New York: Norton, 2002.

Patrick, G.F. and L.M. Eisgruber. "The Impact of Managerial Ability and Capital Structure on Growth of the Family Farm Firm." *American Journal of Agricultural Economics*. 50(August 1968):491-506.

Shapiro, D., R.D. Bollman, and P. Ehrensaft. "Farm Size and Growth in Canada." *American Journal of Agricultural Economics*. 69(May 1987):477-483.

Sumner, D. and D. Leiby. "An Econometric Analysis of the Effects of Human Capital on Size and Growth Among Dairy Farms." 69(May 1987):465-470.

Upton, M. and S. Haworth. "The Growth of Farms." *European Review of Agricultural Economics*. 14(1987):351-366.

Weiss, C.R. "Farm Growth and Survival: Econometric Evidence for Individual Farms in Upper Austria." *American Journal of Agricultural Economics*. 81(February 1999):106-116.

Table 1. Summary Statistics for the Dependent and Independent Variables

Variable	Average	Standard Deviation
Mathematical Growth Rate in Total Farm Assets	3.01%	4.48%
Geometric Growth Rate in Total Farm Assets	2.08%	3.37%
Total Farm Assets	660,590	466,246
Percent of Farm Income from Crops	63.63%	23.12%
Economic Total Expense Ratio	1.16	0.22
Debt to Asset Ratio	0.31	0.24
Inverted Current Ratio	0.70	1.17
Age of Operator	52	9
Number of Family Members	3.1	1.1
Off-Farm Income	7,899	10,226
Northeast Region	0.227	
Southeast Region	0.317	
North Central Region	0.136	
South Central Region	0.181	
Northwest Region	0.057	
Southwest Region	0.082	

Table 2. Summary Statistics for Farms with Negative and Positive Growth Rates in Total Farm Assets

Variable	Farms with Negative Growth Rate	Farms with Positive Growth Rate
Mathematical Growth Rate in Total Assets	-1.73%	4.21%
Total Farm Assets	597,264	676,985
Percent of Farm Income from Crops	58.14%	65.01%
Economic Total Expense Ratio	1.29	1.12
Debt to Asset Ratio	0.36	0.29
Inverted Current Ratio	1.19	0.58
Age of Operator	57	51
Number of Family Members	2.8	3.2
Off-Farm Income	9,035	7,614

Table 3. Regression Coefficients for Growth in Total Farm Asset Regressions

Variable	Mathematical Growth Rate	Geometric Growth Rate
Intercept	0.25199**	0.31065**
Total Farm Assets	5.03E-09	3.05E-09
Percent of Farm Income from Crops	0.01170**	0.02940*
Economic Total Expe nse Ratio	-0.03510**	-0.04400**
Debt to Asset Ratio	-0.02190	0.00104*
Inverted Current Ratio	-0.00356	-0.00292*
Age of Operator	-0.00659**	-0.00846**
Age of Operator Squared	0.00005**	0.00007**
Number of Family Members	0.00146	0.00319
Off-Farm Income	2.14E-07	-1.58E-07
Northeast Region	0.00027	-0.01010
North Central Region	-0.00173	-0.00685
South Central Region	0.00738	0.00203
Northwest Region	-0.02520**	-0.02760**
Southwest Region	-0.01834**	-0.02628**
Adjusted R-Square	0.246	0.223

Note: A single asterisk indicates significance at the 5% level. Two asterisks indicate significance at the 1% level.