THE IMPACT OF MANAGEMENT ON FARM EXPANSION AND SURVIVAL

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Commercial agriculture is undergoing a major structural change in the form of decreasing numbers and increasing sizes of farm units. This structural change results in farm firms constantly experiencing expansion and survival problems. In some cases, expansion and survival are related: growth in size is necessary to incorporate cost-reducing technological improvements to maintain income levels. In others, these problems are separated: expansion is desired to increase income-earning capacity, or survival may be a primary objective for the firm when expansion is unlikely. This paper develops an analytical framework, incorporating the dynamics of expansion and survival, and explores their interrelationships. Stochastic relationships are incorporated for use in conceptualizing simulation studies of firm growth. Its empirical relevance is demonstrated with an analysis of the interaction between managerial ability and leverage in the process of expansion and survival of a representative farm firm in South Central Georgia.

ANALYTICAL FRAMEWORK OF FIRM EXPANSION AND SURVIVAL

A Deterministic Model

The process of firm expansion and survival can be conceptualized in terms of respective levels of equity to the firm's finance assets. For survival, equity cannot fall below levels required to finance assets currently controlled, or creditors will initiate foreclosure. In expansion associated with increased acreage, acquiring additional land is a lumpy process—additional land must be purchased in discrete amounts. Thus, the expansion process can be conceived as accumulating sufficient equity to finance purchase of a particular amount of land as well as associated incremental nonland resources needed to operate the expanded farm. Required equity for expansion can be identified as the minimum equity to expand (MEE), and equity for survival as the minimum equity to survive (MES). If equity in year t is E^t, expansion is possible if $E^t \geqslant MEE^t$, and survival is guaranteed if $E^t > MES^t$.

Both MEE and MES are defined by asset values and the amount of leverage utilized by the firm. The financial concept of leverage refers to utilization of debt to finance assets. Typically, it is measured by the ratio of debt to assets. Since the ratio of equity to assets is uniquely related to the debt-asset ratio, it is utilized as a measure of leverage in this study to simplify the analytical presentation. A high (low) equity-asset ratio indicates that the firm has low (high) leverage. The specific relation between leverage and the minimum equity to expand is given by

$$(1)\quad MEE^t = r^e \cdot TA_g^t$$

where:

TA_g^t is value of total assets required on the larger farm g in year t, and

r^e is the minimum equity-asset ratio the firm owner will accept.

Similarly, the minimum equity to survive MES^t is given by

$$(2)\quad MES^t = r^s \cdot TA_c^t$$

where:

TA_c^t is value of total assets required on the current farm c in year t and

r^s is the minimum equity-asset ratio that creditors will accept.

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For dynamics considerations, the annual change in MEE^t and MES^t are of importance:

(3) $\Delta MEE^t = r^e \bullet \Delta TA_g^t$

and

(4) $\Delta MES^t = r^s \bullet \Delta TA_c^t$

where ΔMEE^t, ΔMES^t, ΔTA_g^t, ΔTA_c^t are average annual changes in previously defined variables. From equations (3) and (4) it can be noted that ΔMES^t would be less than ΔMEE^t because $TA_c^t < TA_g^t$ and $r^s \leqslant r^e$.

While MES and MEE establish the external constraints on firm growth, internal conditions affecting equity accumulation must also be considered in analyzing the process of firm expansion and survival. Accumulated equity in each year is the summation of equity at the end of the previous year; change in value of assets; and net cash operating income after deducting interest, income taxes and social security contributions; and consumption withdrawals. Thus, the annual change in equity is computed as follows:

(5) $\Delta E^t = NCI^t + \Delta TA_c^t - INT^t - ITAX^t - W$

where:

ΔE^t is the change in equity value between year t and t-1,

NCI^t is net cash operating income before interest payments in year t,

ΔTA_c^t is change in the value of assets in year t on the current farm,

INT^t is interest payment in year t,

$ITAX^t$ is income tax and social security contributions in year t, and

W is net withdrawal for consumption.

Necessary conditions for expansion and sufficient conditions for survival can be expressed in terms of ΔE^t, ΔMEE^t, and ΔMES^t. If at the beginning of the planning horizon t°, $MEE^{t^\circ} > E^{t^\circ} > MES^{t^\circ}$, the necessary condition for this expansion is

(6) $\Delta E^t > \Delta MEE^t$,

and a sufficient condition for survival is

(7) $\Delta E^t \geqslant \Delta MES^t$.

These conditions allow specification of the relationship between expansion and survival. Since $\Delta MES^t < \Delta MEE^t$, firms that are in the process of expanding also have no survival problems.

Necessary and sufficient conditions for expansion and survival within a planning horizon of n years must also consider the initial financial situation. For expansion

(8) $n\,(\Delta E^t - \Delta MEE^t) \geqslant MEE^{t^\circ} - E^{t^\circ}$,

and for survival

(9) $n\,(\Delta MES^t - \Delta E^t) < E^{t^\circ} - MES^{t^\circ}$.

Equation (8) is more restrictive than (6) in that the difference between ΔE^t and ΔMEE^t must meet a certain magnitude. However, (9) is less restrictive than (7) in that ΔE^t can be less than ΔMES^t, or negative, and still allow survival during the planning horizon.

Besides providing a taxonomic system for financial problems of firms, equations (3), (4) and (5) provide a basis for analysis of factors influencing the dynamic financial problems of a firm. This general framework is used here to explore the impact of management on expansion and survival.

Analysis of the Impact of Management

For this paper, it is assumed that lower managerial ability results in smaller profits from a particular farm unit. This viewpoint is consistent with Heady's [4] and Johnson's [6] concept of management. While this concept does abstract from much of the controversy in the production economics literature on management, it focuses analysis on a key variable in dynamic financial analysis.

For a farm unit with the same assets, the same level of leverage, and the same interest rate, managerial ability will affect NCI^t, $ITAX^t$ and W in equation (5). If managerial ability is less, NCI^t will decrease and $ITAX^t$ will therefore decrease. If the farm family consumption is consistent with typical consumption functions, W will also decrease but less than $(NCI^t - ITAX^t)$. Thus, ΔE^t will vary directly with managerial ability. From examination of (8) and (9), it can be determined that lower managerial ability could prevent the firm from meeting expansion and survival conditions.

The assumption that leverage is independent of managerial ability is inconsistent with actual financial structures of farms both r^e and r^s are probably higher for firms with lower managerial ability. The rationale for this possibility is apparent by examination of equation (5)—lower leverage will reduce interest costs to compensate for lower $(NCI^t - ITAX^t - W)$ so that ΔE^t can be raised. However, it must be noted that lower leverage does not unambiguously increase expansion possibilities, because equation (3) demonstrates that lower leverage increases ΔMEE^t. Thus, the assumption has analytical usefulness for evaluating financial strategies at lower levels of management.

Stochastic Relations in the Model

Various writings on firm growth [9] [12] have noted that one of the advantages of simulation models of farm growth is that variability of gross farm income can be incorporated in the analysis. Consideration of variability in addition to average values is especially important in reference to an analysis of survival: financial and production strategies with a high average growth in equity may also have a high probability of failure. While studies of firm growth, such as Hinman and Hutton [5], include coefficients of variation, estimates of the probability of expansion and survival under various strategies are largely absent from the literature — one exception is Flaskerud [3], who developed probability statements with a binomial distribution.

The analytical framework in this analysis can be readily adapted to yield more conventional probability statements. Expansion in a particular year is possible if $E^t \geqslant MEE^t$. Under standard research procedure of prices and yields being stochastic, E^t but not MEE^t has a probability distribution so that the probability of survival in year t equals $P(E^t \geqslant MEE^t)$. Similarly, the probability of survival in year t equals $P(E^t \geqslant MES^t)$. For the empirical analysis, gross income for each enterprise rather than price and yield was selected with a normal random number generator. Therefore, annual total gross income, annual net income, and accumulated equity are all normal variables, and the t-distribution could be utilized to estimate the probability of expansion and survival.

This procedure for considering variability in net income and equity explicitly considers only objective variability. In Knight's theoretical framework [7], subjective variability of uncertainty would also be important in analysis of expansion and survival. Variability in input prices, asset values, and other factors which determine E^t, MEE^t, and MES^t exist even though methods for objective estimation of the parameters of their probability distributions have not been developed. The research in this paper could be extended to include uncertainty in two ways. Modern concepts of uncertainty which utilize farmers' subjective estimates of variability in the analysis could be used rather than objective estimates from historical data. While this concept of variability has not been incorporated in firm growth models, production economists, such as Lin, Dean, and Moore [8], have utilized similar methodology in farm organization models. An alternative method of incorporating uncertainty in the analysis would be to use alternative price and yield trends in the simulation. Results of this analysis could be evaluated to determine the impact of variability unamenable to objective probability statements on firm expansion and survival.

REPRESENTATIVE FARM SITUATION

Farm sizes used for the analysis were a 200-acre and a 400-acre unit, respectively, for the current and expanded farm. Total assets at the beginning of the analysis included land, machinery, and equipment necessary for the 200-acre farm.[1] The level of debt was determined by the equity-asset ratios specified. Specific equity-asset ratios used for the analysis were 25, 50, and 70 percent; the first is near the maximum percentage of current market value that the Federal Land Bank can loan on real estate. The third is representative of borrowers from the Farm Credit System in the Southeast [2]. Enterprise organization selected for the representative farm was adopted from Westberry's study of optimum organization [13]. Principal enterprises included tobacco, peanuts, cotton, corn, soybeans, sow-pig and market hog operations.

Gross Income: Trends and Variability

Prices used in the initial production period were averages from 1970-72 [11]. For subsequent periods, prices were adjusted using annual trends from USDA projections for 1985 [1]. Variability in gross income of each enterprise was calculated from historical crop and livestock prices and crop yields for the area from 1958 through 1972 [10]. Variability in gross incomes due to random fluctuations in demand and supply was estimated by adjusting gross income to reflect time trends. Statistically significant linear time trends in gross incomes were removed and an adjusted variance-covariance matrix was calculated for the gross income from enterprises. This matrix was incorporated in The Simulator's normal random number generator. A sample of 20 gross income patterns for the planning horizon was simulated for each situation.

Cash Expenses and Asset Value Trends

Input requirements and cash production costs for above-average management were based on Westberry's enterprise budgets [13]. Each enterprise was also charged a cash overhead cost of ten percent of enterpise cash costs. Costs were assumed to increase at an annual rate consistent with historical (1959-1972) rates of inflation for

[1] A description of the farm situation is available in Westberry [13] and Chang [1].

Georgia [1]. Land value trends, also reflecting Georgia price trends, were assumed to double during the 10-year period 1971-1980.

Management

Cash generating ability of the farming operation was assumed to be directly related to management level. With the above-average management situation, consumption withdrawals were initially $12,000 annually but increased at historical rates [1]. Average annual net cash accumulation for above-average management was $3,000-$5,000 over the period. For average and below-average management, annual net cash accumulation was assumed to be $0 and -$2,000, respectively, with the area's average equity-asset ratio (70 percent). The lower level of profit accumulation could result from lower yields, higher production costs, higher consumption, or more likely a combination of lower yields and less than proportionate reduction in consumption and production costs.

While incorporating managements into the analysis is somewhat arbitrary, it is consistent with methodology used in previous studies. Hinman and Hutton used a management efficiency level of 85 to 100 percent of above-average management in their analysis [5]. Patrick and Eisgruber adjusted crop yields to estimate management capabilities [9]. The methodology in this study appears to be no more arbitrary than in the two cited, and has the advantage of being more straight-forward.

RESULTS

Opportunities for Expansion With Increase in Leverage

A two-fold identification of situations in which expansion was possible at the beginning of the planning horizon is possible. First, beginning equity may be greater than minimum equity to expand for the firm's target equity-asset ratio. A more interesting analytical problem exists in the second situation, when equity is minimum for the

Table 1. EQUITY AND MINIMUM EQUITY TO EXPAND AT THE BEGINNING OF THE PLANNING HORIZON BY EQUITY-ASSET RATIO

Item	Equity-Asset Ratio (%)[a]		
	25	50	70
	(Dollars)		
Farm Assets	60,618	60,618	60,618
Equity in Noncash Assets	15,154	30,309	42,433
Cash Balance	14,966	14,966	14,966
Equity[b]	30,120	45,275	57,399
Minimum Equity to Expand			
Beginning of the Period	37,569	61,191	80,089
1980	58,786	103,626	139,498
Annual Increase	2,122	4,244	5,941

[a] Specified equity-asset ratio applies to noncash assets. It is further assumed that the firm initially has a sufficient cash balance to cover operating expenses.

[b] Equity is the summation of equity in noncash assets and cash balance.

desired equity-asset ratio and current assets so that expansion is possible only if maximum allowable leverage is increased. If either 70 or 50 percent of assets are accounted for by owner-equity, ex-

Table 2. SUMMARY OF NET CASH ACCUMULATION, EQUITY, AND MINIMUM EQUITY TO EXPAND FOR REPRESENTATIVE 200-ACRE FARM BY LEVEL OF MANAGEMENT

Equity-Asset Ratio	Mean Net Cash Accumulation	Mean Equity	Coefficient of Variation of Equity	Probability of Expansion	Probability of Survival
	(Dollars)	(Dollars)	(Percent)	(Percent)	(Percent)
Above-Average Management					
70 Percent					
1971	3,041	62,164	1.46	0	100
1980	5,063	123,983	4.23	0	100
Average annual change	222	6,869			
50 Percent					
1971	2,354	49,364	1.85	0	100
1980	3,991	103,488	5.44	56	100
Average annual change	189	6,014			
25 Percent					
1971	1,511	33,357	2.76	0	100
1980	2,534	77,143	7.60	100	100
Average annual change	117	4,865			
Average Management					
70 Percent					
1971	0	59,123	1.53	0	100
1980	0	83,479	6.91	0	100
Average annual change	0	2,706			
50 Percent					
1971	-677	46,323	1.97	0	100
1980	-1,180	62,269	9.40	0	100
Average annual change	-56	1,771			
25 Percent					
1971	-1,530	30,316	3.04	0	100
1980	-2,639	35,602	16.67	0	100
Average annual change	-129	587			
Below-Average Management					
70 Percent					
1971	-2,000	57,123	1.59	0	100
1980	-2,000	63,619	9.15	0	100
Average annual change	0	655			
50 Percent					
1971	-2,677	44,323	2.06	0	100
1980	-3,198	42,335	13.91	0	100
Average annual change	-58	-221			
25 Percent					
1971	-2,348	28,316	3.26	0	100
1980	-4,720	15,591	38.28	0	0
Average annual change	-264	-1,414			

pansion is possible at the beginning of the period by decreasing the equity-asset ratio to 25 percent (Table 1).

For the firm with a 70 percent equity-asset ratio but which is willing to allow its ratio to fall to 50 percent, expansion requires accumulation of more equity from net farm income and/or land value appreciation. Further equity accumulation is also necessary for firms which are unwilling to increase leverage. The remainder of this paper concentrates on analysis of the process of equity accumulation for expansion.

Above-Average Management

Assuming that land values would double during the 10-year period, the representative 200-acre farm with above-average management provided positive net cash accumulation each year after allowing for expenses, taxes and social security contributions and consumption withdrawals (Table 2). Opportunities from farm expansion, however, depended on the equity-asset ratio used for expansion.

Each of the three equity-asset ratios considered with above-average management met the necessary condition for expansion, $\Delta E^t > \Delta MEE^t$. However, only the lower equity-asset ratios allowed expansion during the ten-year planning period. The probability of expansion in 1980 was 1.00 with a 25 percent equity-asset ratio and .56 with a 50 percent equity-asset ratio (Table 2). In a longer planning horizon, expansion would be possible with the largest equity-asset ratio.

As the proportion of debt in the financial structure increases, variability of equity increases. For the above-average management case, coefficient of variation increased from 4.23 to 7.60 in 1980 as equity-asset ratio decreased from 70 to 25 percent. Using the variance in equity obtained from simulated farm operations, the probability that equity in 1980 would remain above 15 percent of assets was calculated and intrepreted as a probability of survival. For all situations with above-average management, there was no probability of failure.

Average Management

With average management, mean net cash accumulation was always zero or negative. However, asset value appreciation was sufficient to more than compensate for negative cash accumulation for all three equity-asset ratios. As a result of asset appreciation, the probability of survival in all cases was 1.0 in 1980 with present trends indicating no likelihood of failure in later years. However, the necessary condition for expansion to 400 acres was not met, indicating that equity accumulation would not provide for such a large expansion even in a longer planning horizon.

Below-Average Management

Lower annual net cash accumulation made failure a much more prominent problem in below-average management situations. With a 25 percent equity-asset ratio, the probability was 0.0 that equity would remain above 15 percent of total assets by 1980 (Table 2). In addition, the 50 percent equity-asset ratio had declining mean equity levels, indicating failure at a later date. Only with a 70 percent equity-asset ratio and land value appreciation did the firm have a growth in mean equity during the ten years. Thus, survival of a farm with below-average management appears to depend on maintaining low leverage and continuation of land value appreciation.

CONCLUSIONS

The logical framework of farm expansion and survival which was developed in this paper provides a basis for analysis of dynamic problems of farm finance. Its potential was demonstrated in consideration of the impact of leverage on farm expansion and survival for a representative farm in South Central Georgia. Simulation analysis suggested that high leverage is appropriate for above-average managers. Farms with a low equity-asset ratio expanded to a larger farm in fewer years than those maintaining higher equity-asset ratios. In addition, all above-average management situations had a zero probability of failure and therefore would not need to limit debt to ensure survival. High levels of leverage did not appear to be appropriate for average and below-average managers. In several cases, the sufficient condition for survival was not met, and, in one case, the probability of failure in 10 years was 100 percent.

While these particular results are based on specific income and asset value assumptions utilized in the simulation, the theoretical structure can be utilized to generalize results. In an uncertain agricultural environment, a range of price trends for inputs, outputs, and asset values must be considered. Situations could be defined in which the sufficient condition for survival would be met for lower levels of management with high leverage. However, since ΔE^t is always greater for above-average management, the advantage of leverage demonstrated in this paper would still exist. Alternatively, situations exist in which the sufficient condition for survival would be violated for above-average managers; again, the disadvantage of high leverage for lower levels of management in the empirical analysis of this paper would still exist. Thus, higher leverage is advantageous for above-average managers in all situations in which it is advantageous for lower levels of management, and for some situations in which it is not appropriate for lower levels of management. Each particular situation can be evaluated with the theoretical and empirical framework of this paper.

While this paper only considered the impact of managerial ability and leverage on expansion and survival, the framework is general enough to analyze other factors affecting firm growth. In particular, the usefulness of this taxonomic and analytical framework in organizing meaningful research can be emphasized. Estimation of time required for achievement of a particular expansion goal and of the probability of expansion of survival of a farm in a particular year should be of more interest to farmers and creditors than conventional results of growth in equity and coefficient of variation.

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