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IMPACT OF LAND VALUE APPRECIATION ON FARM EXPANSION

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Introduction

Since World War II, commercial agriculture has undergone considerable structural change. One of the most notable trends is that of decreasing numbers and increasing size of farm units which is not expected to cease in the future. Farm size expansion is financed primarily through (1) retained earnings, (2) asset appreciation and (3) borrowed funds. The major source of asset appreciation has been farm real estate which has exhibited rapid price appreciation in recent years.

Land value appreciation does not necessarily increase opportunities for firm expansion. Land value appreciation enhances opportunities for growth because the farmer's equity increases, but it also makes expansion more costly. In addition, land value appreciation may influence the optimal amount of leverage used to finance expansion; in particular, the rate of land value appreciation may affect the returns and variability from use of debt in the farm business. Due to the recent acceleration in land value appreciation it is important to evaluate if historical degrees of leverage are still optimal in terms of financing expansion. This paper develops a model of firm expansion to analyze the interaction between land value appreciation and degree of leverage and presents an empirical application for Georgia.

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Past research on farm firm growth has not directly considered the interaction between land value appreciation and leverage. Several researchers have incorporated land price trends in their analyses of farm growth. Martin's results indicated that land appreciation helped satisfy specified growth objectives. But increasing land values raised minimum starting equity requirements to achieve comparable annual consumption levels over time [7]. Flaskerud analyzed the effect on farm growth of such variables as method of land acquisition and beginning equity in land. He stated that regardless of the land acquisition method and production plan, the extent to which a firm can be expected to grow depends on the initial level of equity in the firm. With rather low levels of beginning equity in land, firm growth was possible under the rent and rent-purchase methods of land acquisition but not under the purchase method [2]. Results of the Hutton and Hinman study indicated that the pay-off for reducing equity-asset ratios below present conventional levels during farm expansion is quite high in most situations. However, they considered only renting as a method to acquire more land. They also indicated that appreciation of owned land had a stabilizing effect on net worth. The farms with low equity benefited the most from land appreciation [3]. Other investigations have considered the role of leverage in various methods of land acquisition. Lyman indicated that adequate beginning size of both acreage and percentage equity was the most influential factor in the growth process [6]. Van Hoozer's results indicated that growth was positively related to initial net worth and negatively related to financial leverage [9].

A General Analytical Framework of Firm Expansion

The process of farm firm expansion encompasses both an increase in physical assets controlled by the firm and in equity to finance these assets. 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 and the associated incremental nonland resources to optimally organize the expanded farm.

For an expansion associated with acquisition of a particular amount of land, the growth process can be analyzed in terms of accumulation of equity and the equity required to finance the expansion. The equity required to finance expansion is equal to the equity necessary to finance the larger farm and is identified as the minimum equity to expand (MEE) while the accumulated equity for the existing farm (E) is simply value of present assets minus present liabilities. The dynamics of a firm expansion process is illustrated in Figure 1. In this case, the firm can expand at time t^e where $E^t = MEE^t$. For a particular planning horizon, the expansion process is influenced by three factors: (1) $MEE^{to} - E^{to}$, the additional equity required for expansion at the beginning of the planning horizon, (2) $\dot{E}$, the average annual increase in E, and (3) $\dot{MEE}$, the average annual increase in MEE. Time required for expansion is specified as follows:

$$(1) \qquad t^e = \frac{MEE^{to} - E^{to}}{\dot{E}^t - \dot{MEE}^t}$$

Necessary conditions for a meaningful expansion problem are (1) minimum equity to expand is initially greater than equity, and (2) the average annual

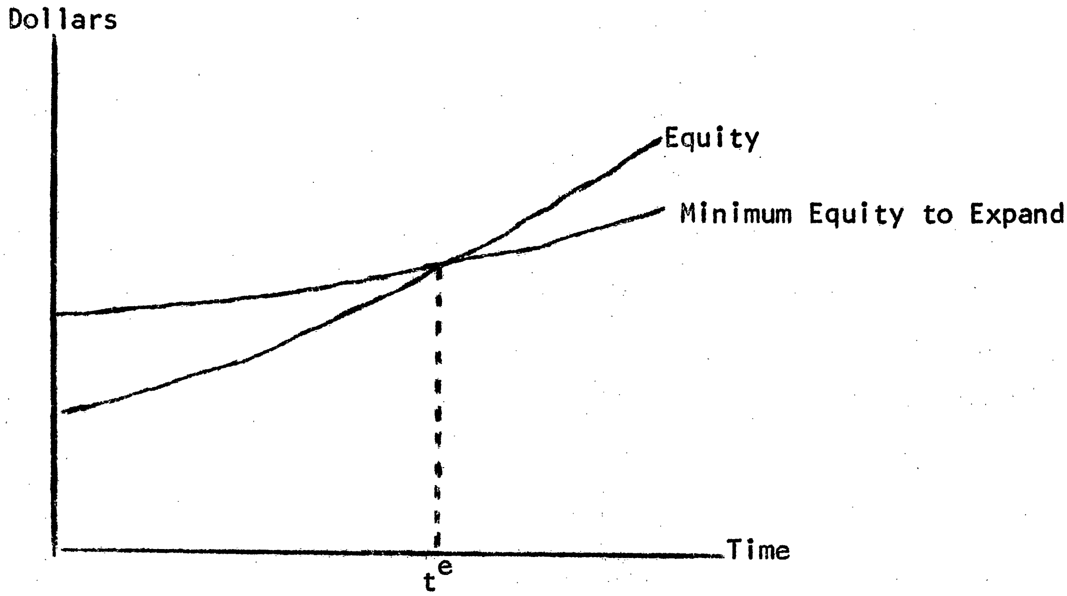

Figure 1. The Process of Firm Expansion

increase in equity is greater than the average annual increase in minimum equity to expand.

Accumulated equity in each year is the summation of the equity at the end of the previous year, change in the 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:

$$(2) \quad \dot{E}^t = NCI^t + \dot{TA}_c^t - INT^t - ITAX^t - W$$

where:

$\dot{E}^t$ is the change in the value of equity between year t and t-1,

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

$\dot{TA}_c^t$ is change in the value of noncash 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.

The minimum equity to expand for each year is estimated from the amount of required equity for the larger farm. Specifically, the minimum equity to expand in year t, MEE^t, is given by

$$(3) \quad MEE^t = r \cdot TA_g^t$$

where:

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

r is the equity-asset ratio.

Minimum equity to expand changes each year by the amount of change in value of required assets on the larger farm that must be financed by equity.

$$(4) \quad \dot{MEE}^t = r \cdot \dot{TA}_g^t$$

Equations (2) and (4) can be utilized as a framework for conventional analysis of firm growth. In terms of firm expansion, most of the studies have focused on variables that affect only equity [Equation (2)] - level of net farm income, consumption and interest levels [4, 5, 7 and 8]. However, financial leverage affects both functions; leverage affects MEE directly and the initial level of E. Another variable which directly influences both functions is asset value appreciation. This paper explores the interaction between leverage and land value appreciation in this general framework of firm expansion.

A Model of Firm Expansion With Land Value Appreciation

A change in the land value trend effects only the net rate of accumulation in equity for expansion, the denominator of Equation 1. From Equations (2) and (4), $(\dot{E}^t - \dot{MEE}^t)$ is given by

$$(5) \quad \dot{E}^t - \dot{MEE}^t = NCI^t + \dot{TA}_c^t - INT^t - ITAX^t - W - r \cdot \dot{TA}_g^t$$

In addition to a change in the value of assets, differences in land value appreciation induce changes in property taxes, income taxes, and interest on short-term loans. Since the net effect of land value appreciation on these variables is very small compared to changes in value of total assets, analysis of the effect of land value appreciation can concentrate on annual change in value of total assets. Land value appreciation affects change in value of total assets as follows:

$$(6) \quad \dot{TA}_i^t = L_i^{to}\,(1 + p)^t - L_i^{to}\,(1 + p)^{t-1} + \dot{NL}_i^t$$

where:

L_i^{to} is the initial land value on farm i,

p is the annual percentage increase in land value, and

$\dot{NL}_i^t$ is the change in value of nonland assets on farm i.

Then by substituting Equation (6) into (5) and simplifying, Equation (7) can be obtained:

$$(7) \quad \mathring{E}^t - \mathring{MEE}^t = (NCI^t - INT^t - ITAX^t - W + \mathring{NL}_c^t - r \cdot \mathring{NL}_g^t) + [(1 + p)^t - (1 + p)^{t-1}]\,(L_c^{to} - r \cdot L_g^{to})$$

In Equation (7), the effects of land value appreciation on expansion are isolated in the last term, $[(1 + p)^t - (1 + p)^{t-1}]\,(L_c^{to} - r \cdot L_g^{to})$. By considering different equity-asset ratios, three cases can be identified:

I. If $(L_c^{to} - r \cdot L_g^{to}) = 0$

or $\dfrac{L_c^{to}}{L_g^{to}} = r$

this term is zero and land value trend p has no effect on year of expansion t^e. In other words, if the value of the current farm as a percentage of the expanded farm just equals the equity-asset ratio, land value appreciation has no effect on the number of years required for expansion.

II. If $\dfrac{L_c^{to}}{L_g^{to}} < r$,

the term in parenthesis is negative and t^e varies indirectly with rate of land value appreciation.

III. If $\dfrac{L_c^{to}}{L_g^{to}} > r$,

then the term in parenthesis is positive and land value trends have a positive effect on t^e.

These conditions can be interpreted as follows. For a given expansion situation in which a farmer wishes to expand his farm by a specified percentage increase, he must select an equity-asset ratio r less than L_c^{to}/L_g^{to} for land value appreciation to have a positive effect on t^e. The empirical application in this paper is based on this interpretation.

Application

A representative farm situation for the South Central Georgia area provided a basis for the analysis. The base farm was a general crop and livestock operation containing 200 acres. It was assumed that the farm was owner-operated with an above average level manager.[1/] Farming operations were simulated over the 10-year period 1971-1980. Random prices and yields were generated in order to measure variation in the farming operations.

The empirical distribution of the equities from 20 replications appeared to be normally distributed for each year. Although both the mean and variability increased over time, variability of equity increased relative to its mean (Table 1). This finding emphasizes the recursive nature of the growth process in which preceding events are important determinants of events during the successive time periods.

The farm would expand to 400 acres as soon as accumulated equity was sufficient for expansion. Since the value of assets required on the 400-acre farm increased over time, minimum equity to expand increased during the 10 year period in relation to the equity-asset ratio. To analyze the impact of leverage on expansion, situations with equity-asset ratios of 25, 50, and 70 percent were simulated with and without land price trends.

Without a Land Value Trend

With no trend in land value, net cash operating income on the 200-acre farm increased from $18,054 in 1971 to $21,424 in 1980 with a 70 percent equity-asset ratio (Table 1). With lower equity-asset ratios, net cash operating income was lower because of higher interest payments. With a 70 percent equity-asset ratio, equity increased from $58,884 in 1971 to $82,807 in 1980, an average annual increase of $2,394. Mean equity increased $1,686 per year with a 50 percent equity-asset ratio and $736 with a 25 percent equity-asset ratio. Thus the annual accumulation in equity with a 25 percent equity-asset ratio was only one-third the annual accumulation with the highest equity-asset ratio, even though annual incomes were much closer. In addition, the coefficient of variation for equity with the lowest equity-asset ratio (27.80 in 1980) was always much larger than with the highest equity-asset ratio (11.74 in 1980).

With no trend in land value, minimum equity to expand remained almost constant. Under a 70 percent equity-asset ratio, the minimum equity to

Table 1. Summary of Net Cash Operating Income, Equity, and Minimum Equity to Expand for Representative 200-Acre Farm With and Without Land Value Trend Under Different Equity-Asset Ratios

Equity-Asset Ratio	Mean Net Cash Operating Income	Mean Equity	Coefficient of Variation of Equity	Minimum Equity to Expand[a]	Probability of Expansion
	(Dollars)	(Dollars)	(Percent)	(Dollars)	(Percent)
<u>Without Land Value Trend</u>					
<u>70 Percent</u>					
1971	18,054	58,864	3.50	80,293	0.00
1980	21,424	82,807	11.74	85,529	0.10
Average annual increase	337	2,394		523	
<u>50 Percent</u>					
1971	16,792		4.59	61,336	0.00
1980	20,151		16.12	65,077	0.11
Average annual increase	336			374	
<u>25 Percent</u>					
1971	15,029		7.10	37,641	0.00
1980	18,352		27.80	39,511	0.20
Average annual increase	332			187	
<u>With Land Value Trend</u>					
<u>70 Percent</u>					
1971	17,906	62,036	3.38	84,167	0.00
1980	20,864	125,647	7.75	139,498	0.00
Average annual increase	276	6,361		5,533	
<u>50 Percent</u>					
1971	17,175	49,277	4.29	64,104	0.00
1980	19,698	105,738	9.60	103,626	0.80
Average annual increase	252	5,646		3,952	
<u>25 Percent</u>					
1971	16,073	33,323	6.44	39,025	0.00
1980	17.791	80,257	13.01	58,786	1.00
Average annual increase	192	4,693		1,976	

[a] Minimum equity to expand from 200-acre farm to 400-acre farm.

expand increased only $523 annually. The annual increase in minimum equity to expand increased $374 and $187 with 50 and 25 percent equity-asset ratios, respectively.

Without a land value trend, the probability of expansion was 0.10 in 1980 with a 70 percent equity-asset ratio (Table 1).[2/] The probability of expanding in 1980 was 0.11 with a 50 percent equity-asset ratio and 0.20 with a 25 percent equity-asset ratio. Thus the farm has a slightly higher probability of expanding by 1980 with a lower equity-asset ratio, although all three probabilities are similar.

With a Land Value Trend

Next, the land value was assumed to double during the 10-year period. For all equity-asset ratios considered, the equity level increased over the 10-year period. Change in the value of assets was the same for all equity-asset ratios. The higher the equity-asset ratio, the greater the increase in cash accumulation over time (Table 1). Thus the increase in equity at the lower equity-asset ratios depends primarily upon the appreciation of land value. The difference in equity can be attributed to differences in interest payments, income taxes and social security contributions. The coefficient of variation for equity for the 25 percent equity-asset ratio was less than twice as large as with a 70 percent equity-asset ratio--13.01 compared to 7.75 in 1980. The annual increase in minimum equity to expand is larger with a higher equity-asset ratio.

The representative farm can expand to a larger size faster with a low equity-asset ratio than with a high ratio. The probability of expansion was 1.00 in 1980 with a 25 percent equity-asset ratio (Table 1). In 1974, the mean equity was sufficient to meet the minimum equity requirements for expansion. With a 50 percent equity-asset ratio, the probability of expansion was 0.80 in 1980. Mean equity was just equal to minimum equity to expand in 1979.

The order of expansion with the different equity-asset ratios is the same with and without a land value trend. The higher the equity-asset ratio, the slower the expansion of the base farm. Since initially the land value on the current farm was 57 percent of land value on the larger farm, equity-asset ratios of 25 percent and 50 percent were below this critical value.[3/] Thus, the response of t^e to rapid land value appreciation with these two ratios is hypothesized to be different than with a 70 percent equity-asset ratio.

With a low equity-asset ratio, the probability of expansion with a land value trend is higher than without a land value trend. With a 25 percent equity-asset ratio, the probability of expanding in 1980 was 0.20 without a land value trend and 1.00 with the specified land value trend. However, the 200-acre farm with a 70 percent equity-asset ratio had no chance to expand during the 10-year period with the land value trend and 0.10 probability of expanding in 1980 without a trend in land value.

The importance of expansion can be ascertained by comparing ending equity levels and income earning capacity with and without expansion. After the 200-acre farm expanded to 400 acres with a 25 percent equity-asset ratio, the ending level of mean equity was $112,463 compared with $80,257 on the current farm in 1980. With a 50 percent equity-asset ratio, the equity was $121,089 and net cash operating income was $22,249 on the larger farm. On the base farm, equity was $105,738 and net cash operating income was $19,698. Thus, farmers are likely to continue expansion of their farming operation if they are to maintain or increase their income.

Conclusions

Farmers have traditionally avoided high debt-asset positions in order to reduce risk. This financial strategy appears appropriate in periods of constant or slightly increaisng land values, because there is not a very large difference in a farm's ability to expand under various equity-asset ratios. However, in periods of rapid land value appreciation farms with low equity-asset ratios can expand very quickly, while farms with high equity-asset ratios may be unable to expand. Furthermore, land value appreciation reduces risk even under low equity-asset ratios. In fact, the coefficient of variation of equity for the 25 percent equity-asset ratio with a land value trend was the same as with the 70 percent equity-asset ratio with no land value trend. Thus in periods of rapid land value appreciation, farmers may continue to reduce equity-asset ratios in order to improve earning capacity.

Footnotes

1/ The initial asset position and enterprise organization are specified by Chang [1].

2/ Assuming that equity is normally distributed each year, the area of the probability distribution which is greater than the minimum equity to expand equals the probability of expansion from the current farm to the larger farm. The student's -t distribution was used to estimate these probabilities.

3/ The representative 200 and 400 acre farms were based on a study of optimal organization which included both agricultural and forestry enterprises. For this analysis, only the agricultural land was included; thus, the land in agricultural enterprises on the representative 200 acre farm was 57 percent of that on the 400 acre farm.

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