Farm Survival and Performance under Alternative Financial Conditions and Credit Policies*

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The impact of beginning equity, credit limits imposed by lenders, and changes in land values on farm survival, changes in equity position and farm success (measured by the probability of a positive net present value of returns) are evaluated. Wholefarm, Monte Carlo simulations for Texas part-owner and tenant rice-soybean operations were completed over the period 1984 through 1988. Results indicate that extending additional credit to part-owner and tenant operators in a high debt position (over 50%) will allow continued operation, but continued operation significantly increases the likelihood of a loss of farm equity and loan losses to agricultural lenders. Deterioration in land values increases the need for a higher equity base.

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Financial conditions in agriculture have moved from optimistic expansion in the 1970s to financial stress and contraction in the 1980s. Growth in foreign demand, favorable income, high rates of inflation with land values rising faster than inflation, and low real interest rates in the 1970s encouraged aggressive agricultural investment. Land prices were bid abnormally high, capital intensive cultural practices replaced more labor intensive practices, and farmer's credit reserves were reduced. Producers were encouraged by the economic signals to expand using "cheap capital" to take advantage of economies of size. US farm debt, in 1984 dollars, increased from $118,487 million in 1970 to $200,507 million in 1980, an increase of almost 70%. Fortunately, farm asset values also increased over this period of time, and debt/asset ratios did not change significantly. Interest paid as a percent of gross income, and interest paid as a percent of nonfactor operating expenses, and hired labor increased, however, from 5.7% and 10.2% in 1970 to 11.2 and 18.4% in 1980, respectively.¹

A high leverage position was attractive to agricultural producers as long as their return on assets was greater than their cost of debt. Declines in farm income and high real rates of interest in the 1980s, however, have put a squeeze on farm profits and cash flows. Agricultural exports and land values peaked and began to decline in the early 1980s. Real interest rates which have averaged from 1 to 2% over the 1970s abruptly rose to approximately 8%. Although interest rates moderated slightly in early 1985, continued pressure exists for interest rates to remain high for several years.²

Farm income has not been sufficient in the 1980s for many producers to service debt obligations contracted in the 1970s. Debt for these producers continues to increase as operating debt is rolled over. This was not a serious problem in the 1970s when land value could be used as a collateral base to rollover debt obligations. In the 1980s, however, the increase in debt coupled with a decrease in equity due to operating losses and declines in farm real estate values, caused a deterioration in farmers' financial position.

Producers who currently find themselves deep in debt and in a stressed cash flow position face a dilemma. Should they continue to operate in anticipation that conditions will improve, or should they liquidate their farm assets immediately and use their remaining equity to enter some other occupation? The former is tainted by the risk of further equity depletion. The latter decision closes the door on many years of experience and may require relinquishing land held by the family for generations.

Agricultural lenders also play an important role in many producers' decision on whether to liquidate their agricultural assets or to continue farming. Without sufficient operating funds, the farmer is forced to liquidate. Often it is in the lender's best interest to help the farm continue as a viable business entity, thereby retaining the farmer as a revenue generating client, and avoiding any bad publicity associated with foreclosure. Continued extension of credit, however, can also result in potentially greater losses in the future and bad publicity when credit is finally terminated.

Given the inherent risks in agriculture, a producer's decision to liquidate or continue operating cannot be easily evaluated. Pro forma financial statements prepared for representative states of nature (e.g., optimistic, most likely, and pessimistic) and over an appropriate planning horizon can provide information useful when evaluating this decision. A projected cash flow statement gives some
information on the firm’s ability to meet all cash obligations, given a credit limit imposed by lenders. The pro forma income statement gives information on the firm’s expected profitability over time; the pro forma balance sheet indicates what may happen to the firm’s equity position.

Pro forma analysis is essential for agricultural producers and their lenders when making financial decisions. In addition, lenders may find a similar technique useful when setting credit policy guidelines for their institution. Pro forma analysis facilitates quantifying relationships between farm survival, changes in equity position (equity/total assets), profitability, credit limits imposed by lenders, initial equity position, and changes in asset values. Quantification of these relationships allows lenders to set credit limits more in line with the best interest of their institution.

A major deterrent in the use of pro forma analysis is the immense data manipulations and calculations that are required. Fortunately, computers allow data manipulations and calculations to be done quickly and inexpensively.

The purpose of this article is to demonstrate how computerized pro forma analysis can provide important information to agricultural decision makers. The article seeks to quantify relationships that can be important to lenders when formulating credit policies. Specifically, the impact of beginning equity, credit limits imposed by lenders (minimum equity required), and changes in land values on firm survival, changes in equity positions, and return to equity is emphasized. The example situation is a Texas rice and soybean farm. Comparisons are made between part-owner and tenant producers.

Several simulation studies have been conducted to evaluate the above relationships. Only the work by Perry et al. uses a wide spectrum of the three key variables: beginning equity, minimum equity required by lenders, and land capital gains. This research expands on their work by specifically addressing credit guidelines set by agricultural lenders.

**MODELING APPROACH**

The RICESIM model was used in this study. RICESIM is an updated and expanded version on FLIPSIM V' that has been altered to explicitly account for the marketing and policy situation facing Texas rice farmers. RICESIM is a firm level, Monte Carlo simulation model that simulates annual production, farm policy, marketing, management, and income tax aspects of a farm over a given planning horizon. The model recursively simulates farming operation by using the current year’s ending financial position as a beginning financial position for the following year. Pseudo-random prices and yields simulate these variables’ actual stochastic nature for each year of the planning horizon. The model generates pro forma cash flow and income and balance sheet statements over the specified planning horizon. Key performance measures can be calculated from the pro forma information.

Financial measures that capture a firm’s ability to survive, its changes in equity position, and the firm’s overall profitability are needed to evaluate the future performance of the firm. In this study, the measure used to determine a firm’s ability to survive is the probability that the farm operator will maintain the farm’s intermediate and long-term equity ratios throughout the planning horizon at greater
than minimum levels established by local financial institutions (probability of survival). In the model, the farm operator must have a positive cash balance at the end of each production year. If a negative cash balance exists at the end of a production year and intermediate and long-term equity ratios are below the minimum levels required, the farm operator is forced to liquidate farm assets.

A firm's ending equity position, as measured by the equity-to-asset ratio, was used to measure the lender's loan security. Two measures were used. First, the average ending equity position was calculated for a given scenario that included both farms that survived and those that did not. Second, the probability of the ending equity being less than zero (technically insolvent) was used to measure a lender's loan security. The first measure gives the average change in equity position. The second value measures the bank's credit risk, the likelihood of defaulted loan payments.

The net present value (NPV) of returns to equity was used in this study as the measure of profitability. Two components were involved in the NPV calculations. First, after-tax family withdrawal minus off-farm income was discounted back to the present. Second, discounted after-tax ending equity was subtracted from beginning equity. The two components were then summed. NPV is a measure of returns to equity since all debt flows are accounted for in the model. A pre-tax discount rate of 11% adjusted for taxes is used as the discount rate when calculating NPV. Probability of success is defined as the probability that NPV is greater than or equal to zero, i.e., the farm returned an 11% or greater pre-tax equivalent return on initial equity.

The simulation period for RICESIM was 1984-1988, with 50 iterations of the model performed for each scenario.* Participation in current farm programs for rice and soybeans was assumed. Target prices and loan rates for 1984 and 1985 were set at the values specified in the 1981 farm bill. Values for these variables in 1986-1988 were set at their respective 1985 levels.

Farm Situation

A representative, high level management, Upper Gulf Coast farm was analyzed in the study.† The farm, located in Liberty County, Texas, consisted of 2300 acres of farmland (95% of which was tillable) and a 10-acre farmstead. The wholly-leased tenant farm operator leased all farm acreage but owned or was purchasing the land and buildings on the 10-acre farmstead. The part-owner farm operator was leasing 1150 acres of the farm and owned or was purchasing the remaining 1160 acres. (Additional description of the representative farms is provided by Perry et al., 1985b.) Leased land was farmed on shares, the most common rental arrangement in the area.†† A soybean-soybean-rice crop rotation

*An iteration is defined as one complete simulation of the 5-year planning horizon using a unique set of random crop prices and yields. By simulating the model for 50 iterations, 50 different 5-year planning horizons were analyzed, thus providing sufficient information to estimate the parameters for probability distributions of key output variables and the firm's probability of survival.

†It was assumed the operator had a proven record of good management ability and integrity, so credit issues relating to the person were ignored.
was assumed, as it is the predominant rotation used in the Upper Gulf Coast area.¹²

Financial Assumptions

The 10-acre farmstead consisted of three buildings with a market value of $155,000 and land valued at $1200/acre. The cropland being purchased by the part-owner was assumed to have an initial market value of $1200/acre. Intermediate-term assets were the same for both tenant and part-owner. The beginning market value of all farm machinery was $565,200. Intermediate debt was incurred only through equipment purchases. Both tenant and part-owner also had $20,000 in off-farm investments. The total beginning market value for tenant farm assets was $737,200. The overall market value of the part-owner farm was $2,117,200.

Eight different types of interest rates were used in the analysis. Annual values for these interest rates were set for each year in the five-year simulation period. Interest rates on long-term loans obtained prior to the study period were 11.75%, with interest rates on old intermediate-term loans set at 15%. New long-term, intermediate-term, and operating loan rates were calculated for the period 1984–1987 using the COMGEM econometric model.¹³ These rates ranged from 10.5 to 13.1% for long-term loans, 13.7 to 14.9% for intermediate-term loans, and 14.2 to 15.6% for operating loans. For 1988, interest rates were held constant at 1987 levels.

Annual percentage change in production costs and returns on investment were also specified in the model. In most cases, the percentage change in costs predicted by COMGEM for farm inputs was used to inflate production costs. Annual rates used were: 5.4% in 1984, 4.7% in 1985, 4.5% in 1986, 4.8% in 1987, and 5.0% in 1988. Percentage changes in the market value of used equipment were 0% for 1984–1986 and 1% in 1987–1988. The 1987–1988 rates reflected the expectation that used equipment will become more scarce and, thus, more valuable during the latter part of the 1980s.

A constant percentage change in land values of 7% per year was assumed for the base analysis. Farmland has dropped in value in many parts of the country as a result of the current agricultural recession. The representative farm’s proximity to the Houston metropolitan area, however, has resulted in land values being relatively immune to farm income variations.¹⁴ Five additional annual capital gain rates for land, (i.e., -7%, -3%, 0%, 3%, and 10%) were used to analyze the impact of changing land values on farm financial performance.

Bankers in the Liberty County area indicate a typical farm has long- and intermediate-term equity/asset ratios of about 0.60. In addition, five other beginning equity levels were also used in the study: 25%, 40%, 75%, 90%, and 100%. These five financial positions were chosen to represent the range of equity positions in the study area.

Bankers in Liberty County indicated it is not their policy to extend further credit to a farm operation with a minimum equity ratio of below 0.33 (i.e., a leverage ratio above 2). Five alternative minimum equity ratios required by lenders were used to examine the impact of both tighter and less restrictive levels of credit on farm survival and economic success: 0.50, 0.40, 0.286, 0.25, and
0.20. For each credit policy, the same required equity ratio was used for both long-term and intermediate-term debt. Farm operators were not allowed to sell cropland to avoid farm liquidation.

RESULTS AND ANALYSIS

Values for performance measures (probability of farm survival, probability of a negative equity position, and probability of success as measured by a positive net present value) were generated by RICESIM for the preselected levels of status variables, i.e., beginning equity position, minimum equity required by lenders, and land capital gain rates. The relationships between performance measures and status variables were captured statistically by econometrically fitting the data to a logit model.

The logit model\textsuperscript{15} is based on the cumulative logistic probability function and is specified as

\[
P = \frac{\lambda}{1 + e^{Z}}
\]

where \(e\) represents the base of natural logarithms, \(P\) is the performance measure, \(\lambda\) is the maximum limit of \(P\), and \(Z\) is a function of the status variables. In this study,

\[
Z = \ln[(\lambda - P)/P] = b_0 + b_1BE + b_2BE^2 + b_3ME + b_4ME^2 + b_5CG + b_6CG^2 + b_7CG*ME + b_8CG*BE + b_9BE*ME + \epsilon
\]

where \(BE\) is beginning equity, \(ME\) is the minimum equity required by lenders, and \(CG\) is land capital gain rates, and \(\epsilon\) is the error term.\textsuperscript{*} Status variables are input as percentages.

Results of the logit model are presented in Tables I and II for the part-owner and tenant operator, respectively. The functional relationships contained in these equations are plotted and discussed in the following sections.

Probability of Survival

The probability of survival for a part owner operation, as a function of the status variables, is presented in Figure 1. A farm had a 100% chance of survival if beginning equity position was greater than 60% and the minimum equity required by lenders and the land capital gain rate were at the base amounts of 33 and 7%, respectively. Probability of survival declined sharply when beginning equity was less than 60%. Probability of survival dropped from 100% at 60% beginning equity to 10% when beginning equity was only 35%.

The minimum equity required by lenders had little impact on probability of survival at the base land capital gain rate of 7% when the beginning equity

\textsuperscript{*} Logit functions are commonly used and recommended for analysis of probability (or percentage) data.\textsuperscript{16} In its standard linear form, the logit exhibits a unique nonlinear relationship. Because it was not known a priori whether this standard relationship would reflect the data behavior, quadratic terms were added to allow greater flexibility in the functional form. The parsimony in parameters and internal robustness are both desirable features of the model and were important considerations when the functional form was chosen.\textsuperscript{17}
### Table I. Parameters Estimated for Selected Z Variables Using a Logit Model Eq. (2) Representative Part-Owner Rice and Soybean Farm.¹

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability of Survival</th>
<th>Ending Equity Position (Ending Equity/Total Assets)</th>
<th>Probability of Technical Insolvency</th>
<th>Probability of Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant ($b_0$)</td>
<td>10.96</td>
<td>3.96</td>
<td>-7.25</td>
<td>5.39</td>
</tr>
<tr>
<td></td>
<td>(2.18)</td>
<td>(0.198)</td>
<td>(1.88)</td>
<td>(2.032)</td>
</tr>
<tr>
<td>Beginning Equity ($BE$)</td>
<td>-0.513</td>
<td>-0.046</td>
<td>0.235</td>
<td>0.119</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.003)</td>
<td>(0.029)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Minimum Equity Required by Lenders ($ME$)</td>
<td>0.342</td>
<td>-0.035</td>
<td>0.430</td>
<td>-0.149</td>
</tr>
<tr>
<td></td>
<td>(0.107)</td>
<td>(0.0098)</td>
<td>(0.093)</td>
<td>(0.102)</td>
</tr>
<tr>
<td>Land Capital Gain ($CG$)</td>
<td>-0.505</td>
<td>-0.122</td>
<td>0.571</td>
<td>-0.520</td>
</tr>
<tr>
<td></td>
<td>(0.096)</td>
<td>(0.0088)</td>
<td>(0.088)</td>
<td>(0.096)</td>
</tr>
<tr>
<td>$BE^2$</td>
<td>0.0034</td>
<td>-0.0002</td>
<td>-0.0011</td>
<td>-0.0017</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>$ME^2$</td>
<td>0.00010</td>
<td>0.00026</td>
<td>-0.0042</td>
<td>0.00018</td>
</tr>
<tr>
<td></td>
<td>(0.0014)</td>
<td>(0.00013)</td>
<td>(0.0013)</td>
<td>(0.0014)</td>
</tr>
<tr>
<td>$CG^2$</td>
<td>0.0032</td>
<td>0.0011</td>
<td>-0.0023</td>
<td>0.00063</td>
</tr>
<tr>
<td></td>
<td>(0.0044)</td>
<td>(0.0004)</td>
<td>(0.0006)</td>
<td>(0.00062)</td>
</tr>
<tr>
<td>$BE \times ME$</td>
<td>-0.0036</td>
<td>0.00018</td>
<td>-0.0015</td>
<td>0.0015</td>
</tr>
<tr>
<td></td>
<td>(0.00055)</td>
<td>(0.00005)</td>
<td>(0.0004)</td>
<td>(0.00005)</td>
</tr>
<tr>
<td>$BE \times CG$</td>
<td>0.0033</td>
<td>0.0011</td>
<td>-0.0057</td>
<td>-0.0014</td>
</tr>
<tr>
<td></td>
<td>(0.0009)</td>
<td>(0.00008)</td>
<td>(0.0008)</td>
<td>(0.0008)</td>
</tr>
<tr>
<td>$ME \times CG$</td>
<td>0.0040</td>
<td>0.00069</td>
<td>-0.0025</td>
<td>0.0045</td>
</tr>
<tr>
<td></td>
<td>(0.0022)</td>
<td>(0.0002)</td>
<td>(0.002)</td>
<td>(0.0023)</td>
</tr>
<tr>
<td>$\tilde{R}^2$</td>
<td>0.927</td>
<td>0.991</td>
<td>0.640</td>
<td>0.805</td>
</tr>
<tr>
<td>$N$</td>
<td>180</td>
<td>216</td>
<td>144</td>
<td>144</td>
</tr>
</tbody>
</table>

¹Standard errors are in parentheses.

Position was greater than 60% or less than 30% (Figure 1). The probability of survival was 100% when beginning equity was greater than 60% and almost 0% when beginning equity was less than 30%, regardless of the minimum equity required by lenders. The minimum equity required had an important impact on survival when beginning equity was between 30 and 50%. This is illustrated further in Figure 2. Probability of survival dropped from 100 to 25% when the minimum required equity was increased from 20 to 50% (assuming a 50% beginning equity and 7% land capital gain).

The level of land capital gains had a significant impact on survival. Probability of survival dropped, for example, from 66% at a land capital gain rate of 7 to 15% at a land capital gain rate of -7% when the beginning equity was 50% and the minimum equity required was 40% (Figure 2). Land capital gains had a greater impact when a more restrictive credit policy and a lower beginning equity were assumed. This result was expected because less credit reserves were available, and, therefore, it was more difficult for the firm to survive declines in land values. On the other hand, firms that were in a strong equity position and could borrow against a larger equity base, were expected to better withstand land price declines.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability of Survival</th>
<th>Ending Equity Position (Ending Equity/Total Assets)</th>
<th>Probability of Technical Insolvency</th>
<th>Probability of Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant ($b_0$)</td>
<td>2.038</td>
<td>4.102</td>
<td>-13.08</td>
<td>2.431</td>
</tr>
<tr>
<td></td>
<td>(2.073)</td>
<td>(0.157)</td>
<td>(2.24)</td>
<td>(0.394)</td>
</tr>
<tr>
<td>Beginning Equity ($BE$)</td>
<td>-0.184</td>
<td>-0.080</td>
<td>0.322</td>
<td>-0.055</td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.0022)</td>
<td>(0.035)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Minimum Equity Required by Lenders ($ME$)</td>
<td>0.325</td>
<td>-0.010</td>
<td>0.298</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(0.102)</td>
<td>(0.008)</td>
<td>(0.111)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Land Capital Gain ($CG$)</td>
<td>-0.004</td>
<td>-0.003</td>
<td>0.018</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>(0.089)</td>
<td>(0.007)</td>
<td>(0.104)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>$BE^2$</td>
<td>0.0009</td>
<td>0.0002</td>
<td>-0.001</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.00002)</td>
<td>(0.0002)</td>
<td>(0.00004)</td>
</tr>
<tr>
<td>$ME^2$</td>
<td>0.0007</td>
<td>0.00004</td>
<td>-0.0005</td>
<td>-0.0002</td>
</tr>
<tr>
<td></td>
<td>(0.0011)</td>
<td>(0.0001)</td>
<td>(0.001)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>$CG^2$</td>
<td>-0.0006</td>
<td>0.000003</td>
<td>-0.00003</td>
<td>-0.0005</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.0005)</td>
<td>(0.007)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>$BE \times ME$</td>
<td>0.00001</td>
<td>0.0001</td>
<td>-0.003</td>
<td>0</td>
</tr>
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<td></td>
<td>(0.002)</td>
<td>(0.00004)</td>
<td>(0.0005)</td>
<td>(0.0009)</td>
</tr>
<tr>
<td>$BE \times CG$</td>
<td>0.00004</td>
<td>0.00002</td>
<td>-0.0007</td>
<td>-0.0001</td>
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<tr>
<td></td>
<td>(0.0008)</td>
<td>(0.0007)</td>
<td>(0.0009)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>$ME \times CG$</td>
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<td>0.0003</td>
<td>-0.0002</td>
<td>0.00003</td>
</tr>
<tr>
<td></td>
<td>(0.0005)</td>
<td>(0.0002)</td>
<td>(0.002)</td>
<td>(0.0004)</td>
</tr>
<tr>
<td>$\bar{R}^2$</td>
<td>0.942</td>
<td>0.995</td>
<td>0.793</td>
<td>0.909</td>
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<tr>
<td>$N$</td>
<td>108</td>
<td>144</td>
<td>144</td>
<td>144</td>
</tr>
</tbody>
</table>

*Standard errors are in parentheses.

Probability of survival was more tenuous for a wholly-leased farmer versus a part-owner operation (Figure 3). A beginning equity of at least 70% was required to assure the tenant operator a 95% chance of survival when the minimum equity required was 33%. The probability of survival dropped rapidly to 4% as beginning equity was decreased to 40%. Minimum equity required was important to tenant operators with beginning equities between 30 and 70%. Given a 50% beginning equity, a tenant’s probability of survival decreased from 90 to 35 and 0% as minimum required equity increased from 20 to 33 and 50%, respectively.

**Probability of Technical Insolvency**

Probability of the part-owner operation becoming technically insolvent during the 5-year period was essentially zero. Only at negative land capital gain rates, liberal minimum equity requirements, and/or low beginning equity positions did the probability of technical insolvency rise above 2%. Even at the more extreme scenarios, the probability remained at or below 20%. This information indicates that collateral was sufficient to protect the lender from loan losses. Both lender
and producer, however, would be interested in changes in equity position over the planning horizon.

The probability of a tenant farmer becoming technically insolvent was zero as long as the beginning equity was greater than 55% (Figure 4). The probability of technical insolvency was less than 5% even at lower beginning equity positions when minimum equity required was 50%. When the credit policy was relaxed and the beginning equity position was less than 55%, the probability of technical insolvency increased dramatically. At 40% beginning equity, the probability of technical insolvency increased from 0 to 14% when the minimum equity required was reduced from 50 to 20%. Similarly, the probability of technical insolvency increased from 4 to 55% at 30% beginning equity. The implication to lenders is that extending credit to the representative tenant farmer when equity is below 50% increases significantly the lender’s credit risk.

**Ending Equity**

The expected ending equity position deteriorated relative to the beginning equity position when beginning equity position was less than 45% (Figure 5). Increasing the beginning equity position from 38 to 70% improved the expected ending
Figure 2. Probability of part-owner surviving at selected minimum equity levels required by lenders and land capital gain rates, 50% beginning equity.

Figure 3. Probability of tenant surviving at selected beginning equity levels and minimum equity levels required by lenders, 7% land capital gain rate.
Figure 4. Probability of tenant being technically insolvent at selected beginning equity levels and minimum equity levels required by lenders, 7% land capital gain rate.

Figure 5. Change in part-owner equity position at selected beginning equity and minimum equity levels required by lenders, 7% land capital gain rate.
equity position. Increases in the beginning equity position from 25 to 38% and from 70 to 100% caused a deterioration in the expected ending equity position. This latter result is seemingly counterintuitive. This can be explained by noting that the distribution from which the expected ending equity measure was drawn is truncated at the low and high ranges of beginning equity. At 100% beginning equity, expected ending equity position can deteriorate significantly but cannot improve. Similarly, at low levels, deterioration in ending equity position was limited because the firm was forced out of business if the equity position did not improve.

The impact that minimum equity required had on changes in expected equity position was limited (Figure 5). Increases in the minimum equity required (more restrictive credit policy) resulted in an increase in the expected ending equity. The positive relationship between credit policy and changes in equity diminished as beginning equity increased. At a beginning equity of 40%, the expected change in minimum equity position increased 3.5 percentage points when the minimum equity required was increased from 20 to 50%. Given the same change in minimum equity required at a beginning equity of 60%, the change in equity only increased 1.5%. Credit policy had no effect on the change in equity position at beginning equities greater than 75%.

The impact of land capital gain rates on the expected ending equity position increased at an increasing rate as beginning equity was reduced (Figure 6). The land capital gain rate was not a significant factor when the firm started with at least 80% equity. The expected ending equity position was 15 percentage points less, however, when the land capital gain rate declined from 7 to −7% at 33% beginning equity.

**Probability of Success**

Probability of success (NPV ≥ 0) for the part-owner operation was less than 50% when beginning equity was less than 80% and land capital gains rate was 7% (Figure 7). Probability of survival tapered off and even increased slightly as beginning equity decreased below 60%. This relationship is observed because there was less chance of continued operating losses at lower beginning equity positions. At high and intermediate beginning equity positions, the firm could continue operating after a series of unprofitable years by financing the losses using equity as collateral. Firms with lower beginning equity, however, were forced to liquidate more quickly since they did not have the required equity to secure additional financing. In any event, firms with beginning equities below 70% had less than a 30% chance of obtaining their required rate of return on farm investments.

More restrictive credit policies decreased part-owner operators' probability of success when the beginning equity position was greater than 70% (Figure 7). On the other hand, restrictive credit policies improved the chance of success at beginning equity positions below 70%. An explanation for this phenomenon is that (1) restrictive credit policies force firms with higher levels of equity to liquidate prematurely and (2) low equity firms are forced to liquidate before large equity losses occur. This prevents additional losses in equity. In either case, however, the impact that minimum equity required levels had on the probability of survival was overshadowed by the importance of beginning equity.
Figure 6. Change in part-owner's equity position at selected beginning equity and capital gain rates, 33% minimum equity required by lenders.

*Change in equity position is the difference between the farm's ending equity-to-asset and the farm's beginning equity-to-asset ratio.

*Beginning equity is the farm's beginning equity-to-asset ratio stated as a percent.

*Minimum equity is the minimum equity-to-asset ratio that local financial institutions allow before they initiate farm foreclosure.

Figure 7. Probability of part-owner success at selected beginning equity levels and minimum equity levels required by lenders, 7% land capital gain rate.

*Probability of success as used is the probability of generating a positive after-tax net present value for the farm.

*Beginning equity is the farm's beginning equity-to-asset ratio stated as a percent.

*Minimum equity is the minimum equity-to-asset ratio that local financial institutions allow before they initiate farm foreclosure.
As expected, probability of success was very dependent on the land capital gain rate (Figure 8). Even when the part-owner operator had 100% equity in the operation, the probability of success dropped from 95 to nearly 0% as the land capital gain rate was decreased from 7 to -7% (assuming a minimum equity required equal to 33%).

A tenant operator's probability of success, like the part-owner, was very dependent on the beginning equity position (Figure 9). His probability of success dropped from 75 to 27% when beginning equity was decreased from 100 to 40%. The minimum equity required had little effect on the probability of success.

**SUMMARY AND CONCLUSIONS**

The purpose of this article was to demonstrate how computerized pro forma analysis, via whole-farm simulation, could provide important information to agricultural decision makers. This study focuses on the impact of beginning equity, credit limits imposed by lenders (minimum equity required), and changes in land values on firm survival, changes in equity position, and return to equity. Three performance criteria (probability of survival, probability of technical insolvency, and probability of success) were used in the analysis. The RICESIM model was used to generate performance measures by simulating a representative Texas rice/soybean farm. The performance variables were analyzed for selected ranges of status variables, i.e., beginning equity position, minimum equity required by lenders, and land capital gain rates. Relationships between performance criteria and key variables were analyzed using a logit model. Functional relationships were plotted for ease of presentation.

Beginning equity position was the most important key variable examined in the study. At the base level of land capital gain (7%) and minimum equity required (33%), the part-owner's probability of survival fell from 100% to less than 5% when beginning equity was decreased from 60 to 35%. Similarly, the tenant's probability of survival dropped from 100% to less than 5% when beginning equity was decreased from 80 to 40%. Low beginning equity position for the part-owner operator did not result in a significant chance of technical insolvency unless coupled with negative land capital gain rates (-7%) and restrictive credit policies. The ending equity position deteriorated, however, relative to the beginning equity position when beginning equity position was less than 50%. The tenant operator faced a high probability of technical insolvency when beginning equity was less than 50%. The part-owner operator's chance of achieving an 11% return on equity (probability of success) dropped sharply from almost 100% to less than 20% when beginning equity was decreased from 100% to 60%. Beginning equity had less impact on the tenant operator. The tenant's probability of success was reduced 35 percentage points when beginning equity was reduced from 100 to 50% whereas part-owner's probability of success was reduced 85 percentage points over the same reduction of beginning equity.

Less restrictive credit policies (reduction in the minimum equity required) significantly increased the part-owner and tenant operator's chance of survival at intermediate levels of beginning equity. At the base level of land capital gains (7%), the part-owner operator had a high chance of survival with a credit reserve of 15% (i.e., a beginning equity position 15 percentage points higher than the minimum required equity). The tenant operator did not have the increased value
of land to use as a source of liquidity. The tenant operator would need twice the credit reserve (30%), to insure at least a 90% chance of survival.

Less restrictive credit policies did not significantly affect the part-owner’s probability of technical insolvency or ending equity position. Credit policies did significantly affect the tenant’s probability of technical insolvency, however, when the beginning equity position was less than 55%. At a beginning equity position of 30%, for example, a tenant operator had a 12% probability of technical insolvency if his lender required a 33% minimum equity but allowed the tenant one more year of operation. At the same time, if the lender relaxed the minimum equity required to 20%, the tenant operator’s probability of technical insolvency jumped to 55%.

Credit policy had little impact on the part-owner or tenant operator’s probability of success. Part-owner operators with beginning equity positions greater than 70% were prematurely forced out of business, decreasing their probability of success when restrictive credit policies were used. Farmers with beginning equity positions of less than 70%, however, actually benefitted by restrictive credit policies which improved their chance of success. In both cases, the impact that minimum equity required had on the probability of success was overshadowed by the beginning equity position.

The level of land capital gains had a significant impact on the part-owner’s probability of survival, ending equity position, and probability of success. The probability of survival, ending equity position, and probability of success, for example, were reduced 50, 12, and 12 percentage points, respectively, when land capital gains were reduced from 7 to −7%.

Decision rules have not been explored in this study. General statements can be inferred from the results, however. To insure a 90% probability of survival, lenders should set minimum equity requirements to 15% credit reserve for part-owner operators and a 30% reserve for tenant operators. If land values follow the trend in other parts of the country (i.e., decreasing land values), more restrictive credit policies may be needed. The probability of success is low and equity positions may deteriorate at beginning equity positions below 50%. Relaxing credit policy will likely not improve the profitability or change financial position at the low levels of equity positions. It can be concluded from these data that extending additional credit to operators in high debt positions may allow for continued operation. However, the continued operation will probably result in a significant loss in equity for the part-owner operator. The tenant’s continued operation may result in technical insolvency, thereby increasing the lender’s risk of loan default.

REFERENCES


13. J. B. Penson, Jr., D. W. Hughes and R. F. J. Romain, An Overview of COMGEM: A Macroeconomic Model Emphasizing Agriculture, DIR 84-1, DP-12, Department of Agricultural Economics, Texas A&M University, College Station, TX, December 1984.


