Growth and Survival in Wheat Farming: the Impact of Land Expansion and Borrowing Restraints

Larry J. Held and Glenn A. Helmers

Simulation is used to examine impacts of land expansion strategies and self-imposed borrowing limits upon growth and survival odds of a dryland wheat farm over a 15-year period. Compared to share-rent expansion, purchasing land shows only marginally greater growth at best, with substantially higher odds of firm failure. A tradeoff of enhanced survival at the expense of reduced growth results from more conservative borrowing for land. The marginal value of liquidity (for assisting survival) is relatively high at lower levels of credit reserves.

In a whole farm context, simulation has been extensively applied in past research [Anderson; Carver & Helmers; Halter & Dean; Johnson & Rausser]. Simulation can consolidate the financial outcomes of a diverse farm system and relate these to the overall financial position of the firm. For example, simulation has been used to investigate survivorship through a large number of trials by recording the percentage of trials successfully meeting specified financial conditions. Walker and Hardin simulated firm survivorship and the feasibility of land investment in north central Oklahoma. Richardson and Condra simulated selected farm situations over a series of trials to analyze the effects of size on farm survival in the El Paso Valley. The impact of various levels of debt and loan repayment plans on firm growth and survival was considered by Patrick in a simulation framework.

In addition to income and survivorship, growth in net worth is considered an important goal to firm managers. Incentives for firm growth and expansion are varied [Harman *et al.*]. In some cases, the goal of survival may be to reach a minimum size for adequate income. In other cases, the manager may seek growth as a means to exercise his management ability or exhaust other unused resources. Potential economies of size may also be an important incentive for growth.

When higher proportions of debt capital are employed for expansion and growth, unfavorable events exert greater negative influences compared to positive influences of favorable events, consistent with the Principle of Increasing Risk. In addition to the Principle of Increasing Risk, Barry, Hopkin and Baker identify reductions in credit liquidity (from increased borrowing for expansion), as another source of financial risk [p. 192]. Liquidity in unused credit reserves is a primary defense mechanism for countering unexpected and adverse events. Unfortunately, financial theory suggests that maintaining high levels of liquidity for safety and firm survival is often in conflict with attaining rapid growth through financial leverage [Barry, Hopkin, and Baker, p. 205].

This article reports empirical results of a simulation model designed to evaluate various survival strategies with respect to selected decision criteria. Specifically, the effects of 1) alternative land expansion options and 2)

Larry J. Held is Assistant Professor in the Division of Agricultural Economics at the University of Wyoming. Glenn A. Helmers is a Professor in the Department of Agricultural Economics at the University of Nebraska.
Paper Number 5603, Journal Series, Nebraska Agricultural Experiment Station.

self-imposed borrowing limits (for purchasing expansion land) are examined with regard to firm growth and survival.

Model and Procedure

The financial simulation model reflects the operation of an average sized Nebraska Panhandle wheat farm (960 acres) over a projected 15-year period (1976-1990).[1] Executing just one 15-year trial reflects survival only in the sense that either the firm succeeds or fails financially during 15 years of operation. To depict survival in a probabilistic sense, the simulation program executes a series of 100 15-year trials, with the model farm following the same expansion and borrowing decisions during each of the 100 15-year trials.

Price-Yield Assumptions

The wheat price for year one is set at $3.30 per bushel. Wheat prices are arbitrarily assumed to increase along a 15-year trend at an annual rate of two percent (in expectation that world demand will exert increasing pressure on wheat prices), thus reaching $4.35 per bushel in year 15 (Table 1). A beginning level of $3.30 per bushel is an approximate breakeven price for covering 1976 production costs and also represents an average of wheat prices between 1973 and 1976.

Wheat yields for year one are set at 32 bushels per acre (based upon a trend estimated from 1950 through 1976). Extrapolating the trend, yields are projected to increase at an annual rate of ¼ bushel per acre, reaching an average of 35.5 bushels by year 15 (Table 2).

Two cyclical price models (Table 1) and two cyclical yield models (Table 2) are modelled with the projected price and yield trends to reflect both favorable and unfavorable returns. Cyclical patterns are employed on the basis of historical prices and yields for the study area, which have displayed cyclical movements about a trend over time. The cyclical price and yield models represent possible patterns of favorable and unfavorable price-yield conditions and are not empirical forecasts. Rather, each model reflects

[1]A detailed description of the simulation model and related assumptions is described in [Held 1977] and [Held and Helmers 1980].

TABLE 1. Structure of the 15-Year Projected Price Models.

Simulation Year	Projected Price Trend	Annual Mean Values of Cyclical Price Models	
		Model 1	Model 2
	$/bu		
1	3.30	3.30	3.30
2	3.37	3.12	3.62
3	3.43	2.94	3.94
4	3.50	2.75	4.25
5	3.57	2.57	4.57
6	3.64	3.04	4.24
7	3.72	3.52	3.92
8	3.79	3.99	3.59
9	3.87	4.47	3.27
10	3.94	4.94	2.94
11	4.02	4.62	3.42
12	4.10	4.30	3.90
13	4.19	3.99	4.39
14	4.27	3.67	4.87
15	4.35	3.35	5.35
15 Yr. Average	3.81	3.64	3.97

TABLE 2. Structure of the 15-Year Projected Yield Models.

Simulation Year	Projected Yield Trend	Annual Mean Values of Cyclical Yield Models	
		Model 1	Model 2
	bu/acre		
1	32.00	22.00	42.00
2	32.25	22.25	42.25
3	32.50	22.50	42.50
4	32.75	22.75	42.75
5	33.00	33.00	33.00
6	33.25	33.25	33.25
7	33.50	23.50	23.50
8	33.75	23.75	23.75
9	34.00	24.00	24.00
10	34.25	44.25	44.25
11	34.50	44.50	44.50
12	34.75	44.75	44.75
13	35.00	35.00	35.00
14	35.25	35.25	35.25
15	35.50	35.50	35.50
15 Yr. Average	33.75	31.08	36.42

price and yield movements which have a reasonable chance of occurring. Together, the two price and two yield models result in four 15-year price-yield combinations employed to test expansion and borrowing decision variables.

The relative favorability (with respect to returns) of each price-yield combination is obtained by multiplying the 15-year average price (Table 1) times the 15-year average yield (Table 2). Highest 15-year average gross income occurs with Price 2 — Yield 2 at $144.58 per acre. Second and third highest respectively are Price 1 — Yield 2 ($132.57 per acre) and Price 2 — Yield 1 ($123.39 per acre). Lowest average gross income occurs under Price 1 — Yield 1 at $113.13 per acre.

Normal probability distributions are incorporated about the annual mean values of the cyclical price models and cyclical yield models (Tables 1 and 2) to include elements of risk. Standard deviations of $.30 per bushel and 6 bushels per acre are employed. These standard deviations are selected on the basis of historical occurrences. The size and variation of cycles for prices and yields are selected to keep price and yield values realistic. From the normal probability distributions built around the "annual mean values" of the cyclical models one hundred "price values" and one hundred "yield values" are randomly selected for each of the 15 years. After the selection is made, the 1,500 prices for each cyclical model (100 selections for 15 years) and the 1,500 yields for each cyclical model (100 selections for 15 years) are maintained or held fixed for all subsequent experiments considering expansion and borrowing decision; i.e., the 1,500 prices randomly selected for each price model (Table 1) and the 1,500 yields randomly selected for each yield model (Table 2) are exactly the same for all trials. Therefore, each of the specified farm situations faces the same unique 15-year sequence of prices and yields for the first replication of 100 trials, the same unique 15-year sequence for the second replication of 100 trials, etc.

Financial Assumptions

The model farm starts with $391,132 of assets at 65 percent owner equity, yielding beginning net worth of $254,236. No begin-

ning short-term debt exists, but $136,896 of long-term debt (on initial 960 acres) is assumed. Machinery and operating inputs are inflated at an annual rate of 5 percent from 1976 levels. The selection of a 5 percent inflation rate for machinery and operating inputs is essentially arbitrary, assuming production costs will increase at a somewhat higher rate compared to wheat prices (at 2 percent). A starting land value of $375 per acre is used for 1976 and is assumed to appreciate at an annual rate of 4 percent. With wheat prices and yields increasing at respective annual rates of 2 percent and .25 bushels, gross returns are expected to increase approximately 3 percent annually. Coupled with non-land costs inflating at an annual rate of 5 percent, the residual return to land (and associated rate of land appreciation) is considered to inflate no more than 4 percent, assuming the residual return to land is a primary determinant of land values. The assumed annual rates of inflation are maintained over the long-term projected 15-year period for purposes of this article.[2]

Odds of survival are measured by computing the percentage of 100 trials successfully maintaining owner equity of 40 percent or more over the 15-year period. The 40 percent owner equity level (i.e., 1.5 leverage ratio) is selected in accordance with general criteria used by conventional lenders, as described by Barry, Hopkin and Baker [p. 199]. If owner equity falls below 40 percent, the simulated firm is unable to borrow additional capital for meeting annual cash flow deficits. Hence, firm failure occurs since the firm is unable to meet annual cash obligations without sale of assets.

No other control mechanism are included in the simulated model for allowing the firm to cope with adversity in meeting the 40 percent equity survival criterion. However, partial liquidation of land assets is one example of another control mechanism that could be considered. Finally, limitations are recognized in defining survival solely on maintaining an owner equity of 40 percent or more. Certainly, other factors in addition to a firm's equity position (e.g. past cash flow and repayment history) have a bearing on continued credit extension and firm survival.

Ending net worth, percent owner equity, and total acreage as of year 15 are averaged for survivors of the 100 trials. A 15-year average net farm income and corresponding coefficient of variation is also determined for survivors. Net farm income is defined as net cash income less depreciation with no wheat inventories maintained.

For cash flow purposes, a consumption allowance of $10,000 is assumed for 1976 and inflated 5 percent annually. Principal payments on real estate loans are amortized over 30 years with interest charged at 7 percent of the outstanding balance. Federal Income Tax is computed on a cash basis using 1976 tax rates.

Net cash flow is computed on an annual basis and averaged for surviving trials. Net cash flow for a given year is positive (negative) if gross income is greater (less) than cash production expenses, income taxes, land principal payments, and consumption. During years of "positive" net cash flow, excess cash is used to retire short-term carryover debt. When short-term carryover debt is totally paid, the residual is deposited in a savings account earning 5 percent interest. During years of "negative" net cash flow, savings are initially used to meet the annual deficit. If savings prove inadequate, capital is borrowed on a short-term basis at an annual rate of 8 percent. The firm can borrow short-term capital (for meeting annual cash flow deficits) as long as owner equity does not fall below 40 percent as a result of the loan. Otherwise, firm failure occurs.

[2]Increasing land appreciation from the standard rate of four percent results in both enhanced firm growth and survival odds [Held and Helmers]. Results are also expected to be sensitive to changes in inflation rates for wheat prices, yields, and production costs, although no analysis was conducted to determine the degree of sensitivity.

Decision Variables

Four land expansion options are studied: 1) purchase, 2) share-rent, 3) a combination of purchase and share-rent, and 4) no expansion. Opportunity exists to purchase six 320-acre tracts (a common sized transfer unit in the study area) in alternate years as long as the purchase does not result in owner equity falling below 40 percent. Under the share-rent alternative, 320-acre tracts can be share-rented in the same alternate years if owner equity is at least 40 percent, with the operator receiving two-thirds of the yield and paying for two-thirds of the fertilizer. The combination option allows the manager to purchase land if net cash flow (averaged from the initial year to each decision year) is positive and owner equity conditions are met. If net cash flow (averaged from the initial year to each decision year) is negative, the share-rent alternative for each decision year is engaged. Finally, an alternative of not expanding farm size beyond 960 acres is investigated.

In examining internal borrowing limits, the firm is allowed to maintain reserve borrowing capacity. The firm exhausts its external borrowing capacity and is considered illiquid at 40 percent equity from either borrowing for land or from short-term borrowing (to meet cash flow deficits).[3] This illiquid position for purposes of this study is also defined as an insolvent position. Five separate levels of self-imposed borrowing limits (45, 50, 55, 60, and 65 percent required owner equity) are placed in the purchase decision alternative, causing the firm to bypass land purchase opportunities if owner equity falls below the selected self-imposed limit as a result of the land purchase. For example, if the "self-imposed" limit is set at 45 percent required equity, the firm bypasses opportunities to purchase land over the 15-year period if a potential purchase results in owner equity falling below 45 percent. Thus, with an "external" borrowing limit of 40 percent equity, a margin of safety is established (with a "self-imposed" limit of 45 percent equity) to limit expansion and growth but increase odds of survivorship.

Results

Land Expansion

Results of the expansion trails across the four price-yield conditions are shown in Table 3. Comparing the purchase option with no expansion shows a general trade-off between growth and survival; i.e., striving for higher growth via land puchase reduces survival odds due to leverage effects. No option (purchase, share-rent, or combination) demonstrates a consistently higher growth in net worth among the four price-yield combinations.

Under the more favorable price-yield situation (Price 1 — Yield 2 and Price 2 — Yield 2), the purchase option shows greatest growth in net worth, while the share-rent and combination options experience greater growth at lower price-yield situations (Price 1 — Yield 1 and Price 2 — Yield 1). Even when greater growth occurs through land purchase, net worth is only marginally higher compared to share-renting or the combination option. Moreover, such growth is realized at an extremely high risk of failure. In addition to low survival odds, relatively low net farm income is experienced with the purchase option, requiring substantial borrowing of short-term capital (as evidenced by large net cash flow deficits). The model farm must borrow an average of $25,475 (Price 1 — Yield 1) to $15,142 (Price 2 — Yield 2) annually to bridge cash flow deficits (Table

[3]To illustrate how the external credit limit is set over the 15-year period, if in a given year total assets = $400,000, and total liabilities = $155,000, then net worth and percent equity equal $245,000 and 61.25 percent, respectively. Borrowing capacity is evaluated as 60 percent of total assets ($240,000), minus existing debt ($155,000) = $85,000. If $85,000 is borrowed to meet annual cash flow deficits, borrowing capacity is then exhausted. Having borrowed $85,000 to pay cash obligations, total assets remain at $400,000, total liabilities increase to $240,000 and net worth decreases to $160,000, resulting in 40 percent equity (the external credit limit).

TABLE 3. Growth, Income and Survivorship of the Model Farm as Affected by Expansion Policies.

Price-Yield Combinations & Expansion Options	Rate of Survival (Yr. 15) %	Survivors Net Worth (Yr. 15) $	Survivors 15 Yr. Avg. Net Farm Income $	Survivors Coefficient of Variation Net Farm Income	Survivors 15 Yr. Avg. Net Cash Flow $	Survivors Owner Equity (Yr. 15) %	Survivors Acreage (Yr. 15) (acres)
Price 1 — Yield 1							
Purchase	1	491,511	9,899	3.099	−25.475	43.0	1,600
Share-rent	73	535,345	29,460	1.668	−11,479	69.8	2,880
Combination	68	538,592	29,112	1.681	−12,282	67.1	2,880
No expansion	37	344,646	4,586	4.886	−22,631	47.3	960
Price 2 — Yield 1							
Purchase	8	598,776	12,437	2.253	−26,030	46.7	1,800
Share-rent	99	650,506	35,363	1.155	− 1,673	83.4	2,880
Combination	95	656,572	32,874	1.242	− 6,543	75.6	2,880
No expansion	85	405,137	8,064	2.136	−18,522	55.7	960
Price 1 — Yield 2							
Purchase	23	782,235	26,762	1.711	−23,548	46.3	2,421
Share-rent	100	681,483	43,706	1.078	6,992	87.2	2,880
Combination	67	742,259	33,883	1.479	−16,111	59.7	2,880
No expansion	100	471,002	15,369	1.488	−12,081	64.7	960
Price 2 — Yield 2							
Purchase	47	949,229	37,482	1.147	−15,142	50.8	2,655
Share-rent	100	815,326	53,673	.723	21,981	93.5	2,880
Combination	66	925,029	39,748	1.095	−10,775	58.2	2,880
No expansion	100	577,798	24,252	.866	− 1,646	79.4	960

3). Ending owner equity is approximately 50 percent or less, leaving the firm in a vulnerable position for future years. High interest and taxes on purchased land (relative to returns) are major reasons for low income under the purchase option. The coefficient of variation reflects income variability to be relatively high under the purchase option, due to higher financial leverage.

Compared to purchasing, expansion through share-renting results in comparable growth but higher rates of survival. Growth under the share-rent option is partially caused by appreciation on initially owned land and relatively high income. Higher income under share-renting results from more acres coupled with greater net income per acre since land costs are more in line with returns. Compared to the purchase alternative, this option avoids higher interest costs and land taxes, which combined with lower principal payments results in improved cash flow and ending owner equity.

Under the combination option, the model farm combines benefits of share-renting (not incurring large fixed obligations) with benefits or purchasing (attaining wealth from future appreciation). At higher price-yield situations (Price 1 — Yield 2 and Price 2 — Yield 2), the combination option is midway between the purchase and share-rent options with regard to survivorship, growth, and income. Under lower price-yield situations (Price 1 — Yield 1 and Price 2 — Yield 1), the combination option yields the greatest growth in net worth. Survival odds under the combination option decline under more favorable price-yield combinations compared to less favorable prices and yields. This occurs since under less favorable price-yield situations, the firm bypasses some purchase opportunities in favor of share-renting, resulting in a more stable financial position. However, greater growth in net worth occurs under higher price-yield situations reflecting some payoff for incurring a higher risk of failure.

A no-expansion option does not guarantee survival. Yet, it is only at the lowest price-yield level (Price 1 — Yield 1) that survival can be considered low (37 percent). Ending net worth is by far the lowest of all options. Inflating production costs reduce net farm income, which combined with a non-growing land base prevents significant growth.

Borrowing Limits

The effect of borrowing limits upon growth and survival is investigated from the most liberal "external" limit of 40 percent required equity to more conservative "self-imposed" limits of 45, 50, 55, 60 and 65 percent required equity. For example, at the most liberal limit, the firm can buy land if owner equity does not fall below 40 percent as a result of the purchase. Conversely, under the most conservative self-imposed limit (i.e., 65 percent required equity), the firm bypasses opportunities to purchase land if a potential purchase pushes owner equity below 65 percent. The survival definition with a self-imposed limit (e.g. 65 percent required equity) still remains at 40 percent equity. Although opportunities for growth are bypassed, a margin of safety for survival is maintained by means of unused borrowing reserves.

Results presented in Table 4 reflect the relative magnitude of trade-offs between growth (net worth in year 15) and survival as borrowing for land purchases is reduced to more conservative self-imposed limits. Consistent with financial theory, employing more conservative self-imposed borrowing limits (i.e., reserving more unused credit from 40 through 65 percent required equity) provides additional liquidity to meet unexpected cash flow deficits, thus assuring increased odds of survival but reducing growth as less capital is available for land expansion. Conversely, more liberal borrowing limits are accompanied by a higher risk of failure, greater net worth, and higher net farm income. Net farm income is reduced through more conservative borrowing limits because farm size growth is limited. However, more conservative borrowing also results in an improved cash flow and higher percent owner equity

TABLE 4. Growth, Income and Survivorship of the Model Farm Under the Purchase Option as Affected by Self-Imposed Borrowing Limits.

Price-Yield Model	Self-Imposed Borrowing Limits %	Rate of Survival (Yr. 15) %	Survivors Net Worth (Yr. 15) $	Survivors 15 Yr. Avg. Net Farm Income $	Survivors 15 Yr. Avg. Net Cash Flow $	Survivors Owner Equity (Yr. 15) %	Survivors Acreage (Yr. 15) (acres)
Price 1 — Yield 1	40	1	491,511	9,899	−25,475	43.0	1,600
	45	10	496,947	10,062	−25,566	44.1	1,568
	50	15	440,499	7,911	−24,594	46.2	1,301
	55	35	350,598	4,709	−22,962	46.6	997
	60	37	344,646	4,586	−22,631	47.3	960
	65	37	344,646	4,586	−22,631	47.3	960
Price 2 — Yield 1	40	8	598,776	12,437	−26,030	46.7	1,800
	45	51	598,094	14,294	−22,153	52.0	1,606
	50	73	526,100	11,759	−20,959	53.3	1,355
	55	83	438,273	8,715	−19,753	53.2	1,103
	60	83	410,681	8,130	−18,755	55.0	987
	65	85	405,666	8,063	−18,559	55.5	964
Price 1 — Yield 2	40	23	782,235	26,762	−23,548	46.3	2,421
	45	68	697,393	22,483	−22,763	47.3	2,094
	50	93	649,923	21,124	−19,624	50.8	1,806
	55	100	590,177	19,156	−17,139	53.6	1,536
	60	100	523,927	16,587	−15,384	56.6	1,264
	65	100	476,453	15,414	−12,720	61.2	1,040
Price 2 — Yield 2	40	47	949,229	37,482	−15,142	50.8	2,655
	45	69	884,766	33,529	−15,190	53.4	2,342
	50	97	856,320	33,187	−12,135	57.7	2,108
	55	100	797,748	32,324	− 7,894	63.0	1,789
	60	100	696,643	28,154	− 5,782	67.1	1,440
	65	100	644,369	25,648	− 5,113	69.2	1,274

(year 15), promoting greater financial safety for upcoming years.

The relationship of enhanced survival at the expense of reduced growth in net worth is shown in Figure 1, given borrowing ranges from 40 percent required equity to more conservative self-imposed limits of 45, 50, 55, 60 and 65 percent equity. Survival payoffs for marginal reductions in borrowing are generally higher within a more liberal range of borrowing (40 to 50 percent required equity). That is, odds of survival are enhanced substantially with only moderate reductions in growth, as shown by flatter slopes between 40 and 50 percent required equity (Figure 1). This essentially reflects the marginal value of liquidity (for assisting survival) as being quite high with relatively low amounts of credit reserves. This phenomenon is consistent with observations by Barry, Hopkin and Baker [p. 220]: "As a credit reserve is reduced by borrowing, it is logical to expect the remaining units of unused credit to become increasingly valuable." Within more conservative ranges of borrowing (50 to 65 percent required equity), the risk of failure is reduced very little, if any, with substantial sacrifices in growth. This essentially reflects the marginal value of liquidity (for assisting survival) as being quite low with relatively high amounts of credit reserves. In fact, under stronger price-yield situations (Price 2 — Yield 2 and Price 1 — Yield 2), the marginal value of liquidity essentially reaches zero. Reduced borrowing serves only to reduce growth further, with small, if any, corresponding gains in survivorship odds. It would seem that any farmer choosing a firm organization with relatively high credit reserves likely exhibits a high liquidity premium on the maintained credit reserve.

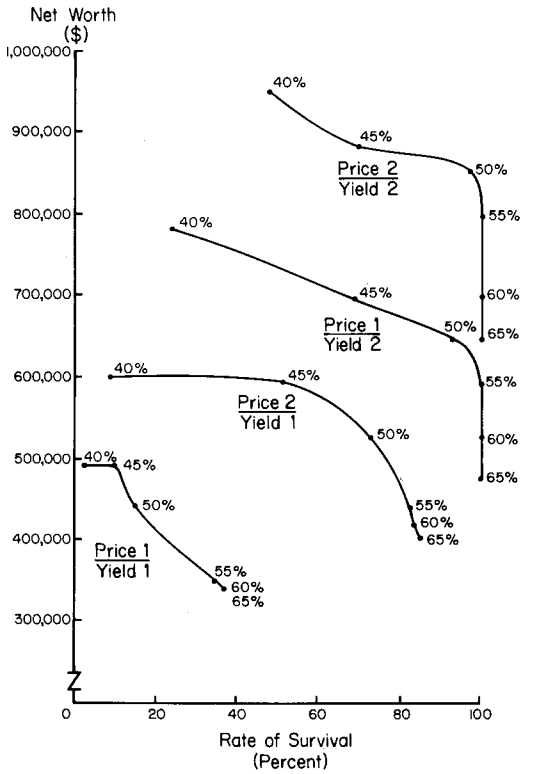

Figure 1. Growth in Net Worth and Survival Relationships from Liberal to More Conservative Self-Imposed Borrowing Limits.

Conclusions

Expected wealth from future land appreciation and increased income often serve as major incentives for producers to expand by large scale purchases of land. Results, however, indicate pursuit of such ends must essentially be tempered by the firm's current financial strength, alternative sources of income (e.g. off-farm income), and expanded financial risk. A substantial risk of failure exists when purchasing large quantities of land.

Substantial growth over time from highly leveraged purchases of land might appear superior to remaining more conservative. However, it must be recognized that an inherent cost (i.e., a high risk of failure) can be incurred when pursuing large scale expansion.

Providing some financial reserves through unused borrowing capacity improves odds of survival while sacrificing growth and income potential. The choice between ends of survival versus growth and income can be made by firm decision makers, perhaps in consultation with financial lenders. Producers plan-

ning to rely upon unused borrowing reserves for meeting emergency cash flow deficits must work closely with lenders to accurately assess the magnitude of their borrowing capacity.

It is recognized that conditions constituting firm survival become quite complicated in the real world. The definition of survivorship used in this study is limited in this respect. Lenders in many instances may have reason to continue extension of credit when owner equity is below the 40 percent survival limit as depicted in the current model. Conversely, continually allowing short-term borrowing as long as owner equity is above 40 percent raises questions of how regularly lenders will continue to cover short-term deficits in the face of persistent cash flow deficits. The dependence on collateral as the only factor in determining borrowing capacity is critical to the definition of survivorship.

Finally, assumptions relating to the need to provide realistic financial flexibility when the model firm encounters financial stress are not implicitly included in the model. Such flexibility could include provision for postponement in machinery replacement and consumption expenditures and asset liquidation under severe financial stress. Without such flexibility, survival rates of the firm are likely to be underestimated. Thus, the specific conditions under which financial insolvency is defined are most important to this and other firm financial simulation models.

References

Anderson, J. R., "Simulation: Methodology and Applications in Agricultural Economics." *Review of Marketing and Agricultural Economics*. 43 (1974): 3-55.

Barry, P. J., J. A. Hopkin, and C. B. Baker. *Financial Management in Agriculture*. The Interstate Printers and Publishers, Inc., Danville, Illinois, 1979.

Carver, R. D. and G. A. Helmers. *Growth Potential of Sandhills Ranches Through Irrigation*. Nebr. Agr. Exp. Sta. Res. Bul. 266, 1975.

Halter, A. N. and G. W. Dean. "Use of Simulation in Evaluating Management Policies Under Uncertainty: Application to a Large Scale Ranch." *American Journal of Agricultural Economics*. 47 (1965): 557-73.

Harman, W., R. E. Hatch, V. R. Eidman, and P. L. Claypool. *An Evaluation of Factors Affecting the Hierarchy of Multiple Goals*. Okla Agr. Exp. Sta. Tech. Bul. T-134, 1972.

Held, L. J. "Growth and Survival of a Wheat Farm Under Selected Financial Conditions: A Simulation Analysis." Ph.D. Dissertation. University of Nebraska, Lincoln, 1977.

Held, L. J. and G. A. Helmers. *Growth and Survival of Nebraska Panhandle Wheat Farms Under Selected Financial Conditions*. Nebr. Agri. Exp. Sta. Res. Bul. 295, 1980.

Hutton, R. E. *A Simulation Technique for Making Management Decisions in Dairy Farming*. U.S.D.A. Agr. Econ. Rep. 87, 1966.

Johnson, S. R. and G. C. Rausser. "Systems Analysis and Simulation: A Survey of Applications in Agricultural and Resource Economics." *A Survey of Agricultural Economics Literature*. Vol. 2, University of Minnesota Press, 1977.

Patrick, G. F. "Effects of Debt Levels and Loan Arrangements on Farm Firm Survival and Growth." Proceedings of a seminar sponsored by Western Regional Project W-149, San Francisco, CA, 1979, AE-4492, Illinois Agricultural Experiment Station, pp. 83-96.

Richardson, J. W. and G. D. Condra. "Farm Size Evaluation in the El Paso Valley: A Survival/Success Approach." *American Journal of Agricultural Economics*. 63 (1981): 430-37.

Walker, O. L. and M. L. Hardin. "Risk and Risk Control in Firm Growth: A Simulation Analysis." Proceedings of a seminar sponsored by Western Regional Project W-149, San Francisco, CA, 1979, AE-4492, Illinois Agricultural Experiment Station, pp. 97-117.