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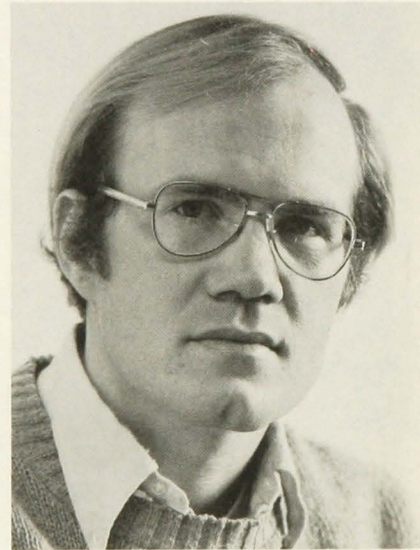
No. 613
NOVEMBER 1979



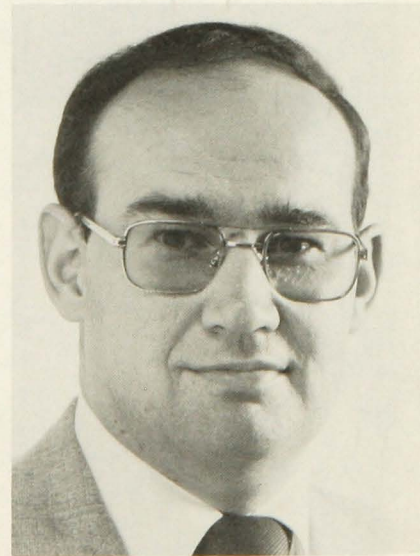
MINNESOTA AGRICULTURAL ECONOMIST

Agricultural Extension Service
University of Minnesota

Greg Hanson



Jerry Thompson



Greg Hanson, research assistant, and Jerry Thompson, assistant professor, are in the Department of Agricultural and Applied Economics, University of Minnesota.

Debt Capacity by Farm Type

Greg Hanson and Jerry Thompson

How much debt can a farm handle? This is a frequent question, but a difficult one to answer. The difficulty stems in large part from farm prices and yields fluctuating greatly. This causes farm income to climb and dip like a roller coaster. Table 1 illustrates the wide range (over time) of cash incomes and income variability rankings.

Of course, the more unpredictable the future income, the more difficult it is to assume substantial debt repayment commitments. Debt capacity is also affected by what is called "financial" and "operating" characteristics of the farm.

This issue of the Minnesota Agricultural Economist examines the effects on maximum debt capacity of variations in three financial factors: debt deferral capability, interest rates, loan maturity lengths; and three operating factors: farm size, enterprise diversification, and management ability. While the individual farmer cannot influence or control trends in farm prices, he/she can increase debt capacity to some extent by exercising control over the financial and operating factors just list-

ed (with the exception of interest rates). While the importance of "operating" factors has long been recognized, this article suggests that "financial" factors can also be surprisingly important to debt handling capacity.

To analyze how financial and operating factors influence debt carrying ability, maximum debt capacity for specific farm types was calculated from 1966-1975 records of full-time farms in southern Minnesota. This was done by increasing debt burdens to the point where debt servicing commitments just exhausted available cash flow. These calculations were made for the years of low income for each farm type, and are called *maximum debt ratios*: the ratio of maximum "safe" farm debt to farm assets (farm debt ÷ farm assets). A maximum debt ratio of .5 for a dairy farm indicates that this farm could have maintained debt equal to one-half of its assets during its low income year. If this farm had \$300,000 in assets, then it could have safely carried \$150,000 debt (since $\$150,000 \div \$300,000 = .5$).

If the maximum debt ratio for this dairy farm was .25 (instead of .5) then its maximum "safe" debt would have been only \$75,000 ($\$75,000 \div \$300,000 = .25$). Remember total assets include land valued at current prices, as well as livestock, buildings, machinery, and feed. (Use of current land values, rather than the typically much lower purchase price, enables results to apply more fully to young or beginning farmers, and also to farmers who borrow against the rapidly rising market value of their farm land.)

The maximum debt ratio is used instead of the absolute amount of maximum debt to allow comparison of farms of different sizes. Not all farms with identical enterprises and size will have the same maximum debt ratio. Usually the best managed farm or the one least committed to family consumption will be able to service more debt (have a higher maximum debt ratio).

Not only should the actual size of the maximum debt ratios be of interest, but also the differences in these ratios between farm types, farm size, etc. The income year of least debt service, the "critical debt usage year," is also identified. This is the year in which maximum debt ratios (in a row) are based. Knowledge of when the problem debt servicing year occurred may aid evaluation of how much conditions have changed (for example, as farm expenses or farm program price supports have increased) since the "critical" year. Study results provide "benchmarks" from which readers can base their personal estimates of future *maximum* "safe" debt levels.

FINANCIAL FACTORS

The Debt Service Agreement

Deferral provisions in the loan agreement can be important to the debt carrying capacity of a farm. Often the loan agreement requires that all principal and interest payments be made

Table 1. Average income level and income variability by farm type, 1966-1975, medium size farms*

Income variability ranking (low to high) ¹	Farm type	Low annual cash income	High annual cash income	Average cash income	Income ranking
----- dollars -----					
Low	Dairy	20,820	56,924	34,340	5
Low	Cash grain-beef feeding	13,315	51,965	26,965	7
Moderate	Dairy-complete program hogs	18,771	83,839	39,918	2
Moderate	Beef feeding-complete program hogs	16,123	74,873	35,677	4
High	Cash grain-complete program hogs	13,519	87,844	36,784	3
High	Complete program hogs	16,327	110,753	45,497	1
High	Beef feeding	5,220	50,749	25,858	8
High	Cash grain	10,711	64,936	28,071	6
Very high	Hog finishing	-6,924	74,214	24,763	9

*Two enterprise farms derive 50 percent of total value added from each enterprise (value added consists of cash sales minus purchases plus adjustments for changes in inventory levels).

¹Income variability ranking is based on the Coefficient of Variability. Alternative farm types are of equal asset size. Income figures are based on farm records from southern Minnesota.

strictly as scheduled. Yet, deferral of loan principal payments in a year of low income (due to drought, low prices, etc.) may be allowed, e.g. by informal agreement, provided that at the end of a specified period (following the low income year of deferral) additional interest (on the deferred payments) and principal payments are made so that all originally scheduled loan servicing returns to a current basis. This means a bad year followed by two strong years will support more debt by "averaging" returns across the three years. This condition seems to be a *conservative*, yet reasonably flexible form of financial assistance.

The effects on maximum debt ratios of deferral periods of 1, 2, and 3 years compared with the strict debt service agreement (no deferral) are indicated in table 2. When all interest and principal payments were to be made strictly as scheduled (no deferral), representative beef feeding and hog finishing farms would have been unable to use any debt in the low return years. However, the mixed enterprise dairy-complete program hog operation could have successfully serviced an amount of debt approximately equal to equity (maximum debt ratio = .51). This indicates that lenders not willing to be flexible about repayment terms will not be able to extend credit to some farm types; and also that farmers with modest equity and inflexible creditors will usually not be able to invest in certain farm enterprises.

As the debt service agreement becomes more flexible (moving right across the columns of table 2), the maximum debt ratios of livestock farm types (except dairy) increase dramatically. Extending the deferral period from 2 to 3 years moderately increased the maximum debt ratios for only the farm types with the greatest income variability: beef feeding, hog finishing, and cash grain. So, for most farm types, a debt deferral length of 2 years increased maximum debt ratio levels significantly compared to the 1 year and no deferment alternatives, while the third year deferral did not. All maximum debt ratio estimates that follow will be based on an allowable 2-year debt deferral period.

Interest Rates

While small changes in interest rates were of only limited consequence to

farms with moderate amounts of debt, a change in interest rates of several percentage points significantly altered the maximum debt ratios of farms with heavy debt loads.

Table 3 shows the impact on maximum debt ratio levels of interest rate changes 1 and 2 percentage points above and below average historical levels. For the farms with maximum debt ratios greater than .65 as reported in the 2-year deferral period column of table 2, an interest rate change of 1 percentage point reduced debt ratios 2-4 percentage points. For beef feeding-complete program hogs, an interest rate increase of 4 percentage points from the actual rate minus 2 percent to the actual rate plus 2 percent) decreased the maximum debt ratio 14 percentage points, from 74 to 60 percent. These findings emphasize that farmers with very large debt ratios should carefully consider interest rate levels before undertaking further debt increases.

Loan Maturity Length

The effect of loan maturity length on farm debt capacity should not be overlooked. Extending the maturity on real estate debt from 20 to 40 years increased maximum debt ratios usually by 5-7 percentage points (column 4 vs. column 2, table 4). Farms with a cash grain enterprise, for which real estate accounted for an especially large share of total assets, particularly benefited from real estate mortgage extension (their debt ratios tended to increase 7 to 10 percentage points). However, increasing the maturity of term debt from 5 to 7 years (column 5 vs. column 2, table 4) most improved maximum debt ratios for farms with dairy enterprises, which tended to have a larger than average investment in intermediate term assets. The adverse impact on the debt capacity of dairy operations, resulting from an increase in interest rates of 4 percentage points (again, from the historical rates minus 2 percent to the historical rates plus 2 percent), would have

Table 2. Maximum debt ratios for alternative principal payments deferral period—medium size farms*

Farm type	Critical debt usage year	No deferral	Deferral length (years)		
			1	2	3
Cash grain	1967	.23	.26	.28	.35
Dairy	1975	.41	.49	.55	.56
Beef feeding	1974	0.0	.23	.36	.44
Complete program hogs	1967	.47	.57	.77	.77
Hog finishing	1974	0.0	.05	.22	.31
Cash grain-beef feeding	1967	.35	.42	.44	.45
Cash grain-complete program hogs	1967	.36	.44	.54	.55
Dairy-complete program hogs	1967	.51	.57	.65	.65
Beef feeding-complete program hogs	1974	.40	.58	.67	.69

*Two enterprise farms derive 50 percent of total value added from each enterprise (value added consists of cash sales minus purchases plus adjustments for changes in inventory levels).

Table 3. Maximum debt ratios for alternative interest rates: medium size farms—2-year deferral of loan payments allowed*

Farm type	Critical debt usage year	Interest rate levels				
		-2%	-1%	historical	+1%	+2%
Cash grain	1967	.31	.30	.28	.27	.26
Dairy	1975	.59	.57	.55	.54	.52
Beef feeding	1974	.41	.39	.36	.34	.32
Complete program hogs	1967	.81	.80	.77	.74	.70
Hog finishing	1974	.25	.24	.22	.21	.20
Cash grain-beef feeding	1967	.49	.46	.44	.41	.39
Cash grain-complete program hogs	1967	.60	.57	.54	.52	.49
Dairy-complete program hogs	1967	.71	.68	.65	.63	.61
Beef feeding-complete program hogs	1974	.74	.70	.67	.63	.60

*Two enterprise farms derive 50 percent of total value-added from each enterprise.

Table 4. Maximum debt ratios for alternative loan maturities: medium size farms*—2 year deferral of loan payments allowed

Farm type	Critical debt usage year (1)	Real estate mortgage length (years) ¹			7 year term	7 year term
		20	30	40	20 year R.E. ²	40 year R.E. ³
		(2)	(3)	(4)	(5)	(6)
Cash grain	1967	.28	.33	.35	.31	.39
Dairy	1974	.55	.59	.61	.64	.70
Beef feeding	1974	.36	.39	.41	.39	.45
Complete program hogs	1974	.77	.82	.83	.82	.85
Hog finishing	1974	.22	.24	.25	.25	.28
Cash grain-beef feeding	1967	.44	.49	.52	.48	.58
Cash grain-complete program hogs	1967	.54	.61	.64	.60	.71
Dairy-complete program hogs	1967	.65	.71	.74	.77	.88
Beef feeding-complete program hogs	1974	.67	.73	.74	.73	.78

*Two enterprise farms derive 50 percent of total value-added from each enterprise.

¹Intermediate term debt = 5 years.

²Real estate mortgage term = 20 years; intermediate term = 7 years.

³Real estate mortgage maturity = 40 years; intermediate term maturity = 7 years.

been more than offset by an increase in term debt maturity from 5 to 7 years. Similarly, a 20-year increase in mortgage length would have neutralized a 3-4 percentage point increase in average interest rates for cash grain farmers. So, it appears that farmers can increase their debt carrying capacity by judiciously trading off increases in loan maturity lengths versus increases in interest rates. The far right column of table 4 indicates maximum debt ratios when both real estate and term debt maturities are extended to 40 and 7 years, respectively. In this column, the average maximum debt ratio for farms with a labor-intensive enterprise (excluding cash grain, beef feeding, hog finishing, and cash grain-beef feeding) was quite large, about .75, or 3 parts debt to 1 part equity. Extending both real estate and term maturities increased the average base conditions maximum debt ratios by about 13 percentage points (a major "average" increase).

OPERATING FACTORS

Farm Size

Farm size also has a significant impact on debt carrying capacity. To analyze farm size effects on debt, representative "small," "medium," and "large" size farm units were developed from the farm record data. Table 5 lists

Table 5. Total asset values by farm size*

Year	Farm size (\$000)		
	Small	Medium	Large
1966	102	137	181
1967	109	148	206
1968	119	165	230
1969	131	188	253
1970	139	200	277
1971	147	210	285
1972	167	237	326
1973	209	294	417
1974	278	400	598
1975	325	478	681

*Based on southern Minnesota farm records. Small, medium, and large size farms are defined, respectively, as farms with assets equal to the assets of the 25th, 50th, and 75th percentiles of the farm record sample. Land revalued annually to reflect current market values.

Table 6. Maximum debt ratios for alternative farm sizes*—2 year deferral of loan payments allowed

Farm type	Critical debt usage year	Farm size		
		Small	Medium	Large
Cash grain	1967	.15	.28	.38
Dairy	1974	.48	.55	.57
Beef feeding	1974	.28	.36	.40
Complete program hogs	1967	.65	.77	.80
Hog finishing	1974	.15	.22	.26
Cash grain-beef feeding	1967	.30	.44	.53
Beef feeding-complete program hogs	1974	.57	.67	.71
Cash grain-complete program hogs	1967	.42	.54	.63
Dairy-complete program hogs	1967	.56	.65	.72

*Small, medium, and large size farms are based on information in farm records and annual surveys of land values.

asset values (in thousands of dollars) by farm size and year. The more than 3-fold increase in farm asset values during 1966-1975 was primarily due to outstanding increases in land values. Table 6 gives maximum debt ratios (for the farm sizes indicated in table 5). Comparison by farm size reveals that medium size operations sustained maximum debt ratios substantially higher (by an average of about 10 percentage points) than small size operations. However, the increase in maximum debt ratios accompanying an increase in farm size from medium to large, was less (about 7 percentage points). Note that three of the medium size farm types were able to service debt burdens approximately twice the size of their equity base (that is, maximum debt ratio \cong .67). Analysis (not shown) also revealed that a small farm with 2-year permissible debt deferral could typically sustain proportionally as much debt as a large farm with no debt deferral permitted.

Other studies have found that dairy and complete program hog farms typically have a smaller capital base than cash crop or livestock feeding operations. The strong showing of *small* dairy and complete program hog farms in this study reinforces the idea that low equity farmers may best start with these enterprises.

Enterprise Diversification

The importance of enterprise selection to maximum debt usage levels is illustrated in table 7 by the wide range in maximum debt ratios that occurred for many of the farm types. The left hand percent in each column heading of table 7 indicates the sales share of

Table 7. Maximum debt ratios for alternative levels of enterprises: medium size farms*—2 year deferral of loan payments allowed

Farm type	Critical debt usage year	Enterprise mix (%)				
		100/0	75/25	50/50	25/75	0/100
Cash grain-dairy	1967	.28	.38	.45	.51	.55
Cash grain-beef feeding	1967	.28	.36	.44	.45	.36
Cash grain-complete program hogs	1967	.28	.42	.54	.66	.77
Cash grain-hog finishing	1967	.28	.32	.36	.33	.22
Dairy-beef feeding	1974	.55	.51	.48	.43	.36
Dairy-complete program hogs	1967	.55	.61	.66	.71	.77
Dairy-hog finishing	1974	.55	.45	.42	.32	.22
Beef feeding-complete program hogs	1974	.36	.52	.67	.73	.77
Beef feeding-hog finishing	1974	.36	.32	.29	.25	.22

*Percent of value added from the two enterprises composing the representative farm type. The percentage listed first is the value added percent derived from the first enterprise listed.

the first farm enterprise listed in the far left “farm type” column. For example, a farm type with 75 percent of its value added from cash grain production and 25 percent from dairy production has a maximum debt ratio of .38, etc.

Perhaps the most interesting trend in the maximum debt ratios presented is that while the largest debt ratios in each farm type row tend to occur in the one enterprise columns (enterprise shares of 100%/0% or 0%/100%), in seven of the nine farm types, the maximum debt ratios for evenly diversified farm types are in the upper half of the row range. For example, for beef feeding-complete program hogs, the 50/50 maximum debt ratio of .67 is markedly closer to the row’s highest debt ratio of .77 (for 100 percent complete program hogs - 0 percent beef feeding) than to the lowest of .36 (for a 0 percent complete program hogs - 100 percent beef feeding operation). It can be argued that if diversification is undertaken to increase the feasibility of debt leverage, and there is a large degree of uncertainty as to which of the selected enterprises may be most profitable, diversification may best be accomplished by dividing resources *equally* among enterprises. (This is a basic finding, but one that needs mentioning.)

Management Ability

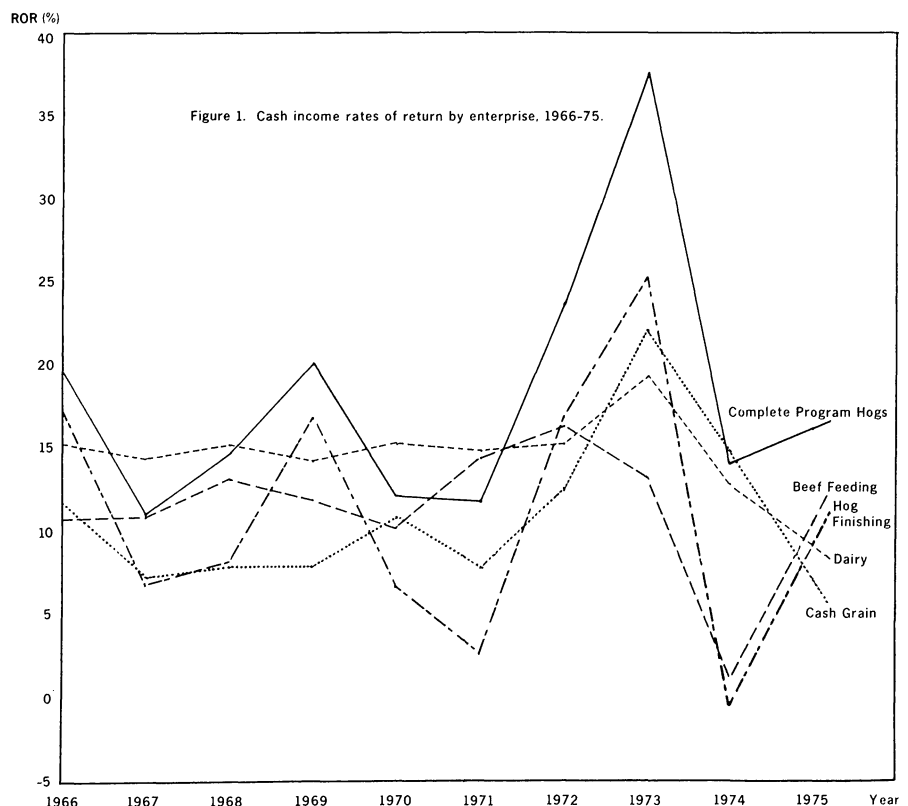
Debt financing becomes more feasible as improvements in management ability increase a farmer’s return on investment. Improvements in manage-

ment are registered through gains in technical production efficiency (for example, as the number of pigs weaned per litter increases), development of marketing skills, etc., that increase income. Accordingly, rate of return to investment will vary with the management capability of the individual farm-

er. To explore the influence of management ability on debt capacity, cash income rates of return (estimated from farm records, figure 1) were varied upward and downward from the yearly average. Note that “cash income” is cash flow adjusted for crop and livestock inventory changes but before taxes, interest, depreciation, and family living. (However, maximum debt ratios were adjusted for taxes, interest, depreciation, and family living.)

Maximum debt ratios are presented in table 8, where a 1 percent increase above the average cash income return to assets usually permits an increase in maximum debt ratios of 5 to 7 percentage points (column 5 vs. column 4). This increase is about equal to that associated with increasing farm size from medium to large (table 6). The 4 percentage point rate of return increase (column 6 vs. column 2) enables cash grain, beef feeding, hog finishing, and cash grain-beef feeding to at least double or triple debt loads. So, if a “below average” farmer were to improve management to “above average,” debt capacity would increase greatly.

Figure 1. Cash income rates of return by enterprise, 1966-1975



**Table 8. Maximum debt ratios for alternative rate of return (ROR) on assets: medium-size farms
-2 year deferral of loan payments allowed***

Farm type	Critical debt usage year (1)	For historical ROR minus 2% (2)	For historical ROR minus 1% (3)	For historical (sample average) ROR (4)	For historical ROR plus 1% (5)	For historical ROR plus 2% (6)
Cash grain	1967	.13	.21	.28	.36	.42
Dairy	1975	.467	.51	.55	.60	.64
Beef feeding	1974	.22	.29	.36	.43	.50
Complete program hogs	1967	.64	.71	.77	.81	.83
Hog finishing	1974	.01	.16	.22	.28	.34
Cash grain-beef feeding	1967	.29	.36	.44	.51	.58
Cash grain-complete program hogs	1967	.41	.47	.54	.61	.68
Beef feeding-complete program hogs	1974	.53	.60	.67	.73	.77
Dairy-complete program hogs	1967	.55	.60	.65	.71	.77

*Two enterprise farms derive 50 percent of total value added from each enterprise.

Finally, observe that medium size farms with 2 percent superior earnings (column 6, table 8) have higher debt ratios than large size farms with average earnings (table 6, far right column). These findings clearly demonstrate the crucial importance of farm management skills to successful debt leverage.

Summary and Implications

This study attempted to measure the effects of interest rates, debt deferral, loan maturity lengths, farm size, enterprise mix, and production management ability on maximum debt capacity. Decisions made and arrangements negotiated by a farmer on these key financial and operating factors can significantly affect the size of the debt burden that may be "safely" assumed. While it would be difficult to comment on what would be an equally likely change in one specific factor versus another, a number of implications and conclusions may be drawn.

Within the framework of this study, a flexible repayment agreement was essential for heavy reliance on debt financing (table 2). With a flexible repayment agreement and with land valued at current prices, very substantial debt use was feasible for many farm types in 1966-1975 (for example, an average maximum debt ratio of nearly .60 for the four medium size dual enterprise farms, table 2). Management ability can have a greater influence on successful debt usage than farm size. For example, small farms with above average rates of return experienced maximum

debt ratios comparable to those of large farms with average rates of return. Debt servicing ability was improved more by becoming a good manager than simply a large operator.

While increasing returns to management proved to be an important factor affecting debt capacity, such increases may not be easy to obtain. It may be less difficult to raise debt capacity through extending real estate and intermediate term debt maturities than by attempting to focus scarce resources on long term management development. Dairy-complete program hogs provided the outstanding example of this. An improvement in the dairy-complete program hogs rate of return to assets from 2 percentage points below to 2 percentage points above the actual average (a very large increase) raised the maximum debt ratio 22 percentage points from 55 percent to 77 percent (table 8).

However, extending intermediate and long term debt maturities, respectively, by 2 and 20 years for this farm type, raised debt capacity 23 percentage points from 65 percent to 88 percent (table 4). This suggests that maximum debt usage may be significantly increased by a small investment of time focusing on the finance details of a loan agreement, followed by negotiation of favorable debt maturity lengths for the farmer. Interest rate changes of 1-2 percentage points above average historical rates did not appear to lower maximum debt ratios more than a few percentage points. However, an increase in interest rates of about four percent-

age points would appear to reduce maximum debt ratios by 10-15 percentage points for heavily leveraged farms.

Maximum debt ratios differed substantially by farm type. Farms with a labor intensive livestock component sustained the highest maximum debt ratios (generally by wide margins). This indicates that a beginning farmer may have great difficulty financing a cash grain operation, while a labor-intensive dairy-complete program hog operation may prove to be an especially attractive entry-level farm type. Some farm lenders (while agreeing that debt usage differences by farm type exist) have been quite reluctant to clearly differentiate maximum "safe" debt usage on the basis of the enterprise mix. Results of this study indicate, however, that farm type may be the major predictor of maximum debt ratio levels.

The study suggests the following policy implications. Agricultural lenders may spur farm community growth by promoting investment through use of flexible loan repayment conditions. Extension of mortgage and/or intermediate term debt maturities appears to be a potentially effective strategy to neutralize even large increases in (market determined) interest rates. Should interest rates continue to fluctuate widely, while the trend to heavy reliance on debt financing continues, farm extension agents may discover that the impact of credit terms on maximum debt usage will become even more important in the future than this study indicates. Finally, agricultural policy may significantly affect farm survival and success not only by limiting downward price movements, but by promoting favorable credit terms for farmers. If government policies selectively encouraged flexible loan repayment agreements or longer loan maturities this may help establish young farmers, maintain small and medium size farms, and stabilize growth in an American agriculture that increasingly sows and harvests with borrowed capital.

For a much more detailed description of the study model, write for Hanson and Thompson, Staff Paper P78-9, available from the Department of Agricultural and Applied Economics, 1994 Buford Avenue, University of Minnesota, St. Paul, Minnesota 55108, Attn.: Publications.

Please send all address changes for Minnesota Agricultural Economist to Nancy Van Hemert, 231 Classroom Office Building, 1994 Buford Ave., University of Minnesota, St. Paul, MN 55108.

Jerome W. Hammond, Editor
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