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QUANTIFYING THE RISK OF INADEQUATE LOAN REPAYMENT CAPACITY: A CASE STUDY OF DAIRY FARMS

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The cash flow budget—a tool receiving more use in the evaluation of agricultural loans applications—does have its shortcomings. The cash flow budget analyzes the timing of cash inflows and outflows to assess repayment ability. However, it is almost invariably comprised of single-valued estimates and does not measure the possible variation in cash flows. This study estimates the extent of cash flow variability and the implications for debt repayment capacity in the case of dairy farms located in the Willamette Valley of Oregon.

The objective of this research was to estimate the probabilities of not meeting cash flow obligations under various debt servicing requirements. As lenders have observed, the risk of default increases with the size of the loan and decreases with the length of the repayment schedule. This study quantifies these relationships.

The risk of default in loan repayment faced by the lender evaluating a dairy production loan originates primarily from two sources: 1) variability of production efficiency which occurs among producers and 2) variability of product and factor prices that occur over time. Production efficiency includes such factors as milk production per cow and feed conversion ratios. This risk was estimated from cross-sectional data for 29 dairies located in the Williamette Valley of Oregon. Probability distribution for product and factor prices were derived from monthly time series data for 1968 through 1972.

SIMULATION MODEL

The study is based on a hypothetical dairy farm enterprise "typical" of those operated in the Willamette Valley of Oregon. The herd size is 81 cows with the producer raising all needed replacement heifers.[1] Twenty-four replacement heifers enter the herd each year to maintain the herd in a steady state. The enterprise has a total of 80 acres of irrigated pasture. All other roughages and all concentrates are purchased from outside sources. Labor is furnished by the operator and one full-time employee.

Description of the Model

The probabilities of inadequate debt repayment capacity were determined through computer simulation of a cash flow model of the simulated dairy farm.[2] The simulation model calculates monthly cash flows and balances over a planning period of up to 20 years. The model includes the stochastic factors which affect the monthly cash flow items. These include monthly milk production, milk prices, cow prices, feed requirements, and feed prices. The remaining cash flow elements were deterministic. Trend was removed from the time series data so as to hold the expected prices, milk sales, and cash expenses constant at the levels for the 1971 year.[3]

Operation of the Model

The monthly net cash flow is calculated as the difference between the total monthly cash inflow and total monthly cash outflow. This difference is then added to the month's beginning cash balance. A cash surplus signifies that the producer's monthly revenue plus the beginning cash balance was enough to meet cash outflow including debt service; a cash deficit indicates that the cash outflow requirements could not be met.

It was assumed any cash surplus would be invested in a short-term account earning an after-tax interest rate of 4 percent. A cash deficit means that the producer, in order to remain liquid, needs to obtain short-term funds

[1] Herd size and other general characteristics of the study farm were based on findings of [2].

[2] Data sources and estimation procedures for the model are described in [1]

[3] The time series data used in estimation of the probability distribution were detrended. Trend was not considered to be a part of the risk facing the lender because of its predictability. It is the random fluctuation in prices and milk sales which constitutes the risk in projecting cash flow. The 1971 year was chosen because of the availability of data [2].

either from his non-farm reserves or borrowed funds. The interest rate paid or his opportunity cost, depending on the source of funds, is an after-tax rate of 9 percent. The amount of interest paid or received is then added to the monthly cash balance.

At the end of each year, in the simulation run, the ending cash balance is checked. A positive balance indicates that the producer has been able to meet all his obligations by the year's end given the level of his monthly loan payments. A negative year-end cash balance would signify the producer was unable to make up any monthly deficits that may occur by the year's end. These year-end accumulated cash balances are the figures used to evaluate the probabilities of inadequate debt repayment capacity associated with given levels of monthly debt service.

Experimental Design

For each level of debt service, 522 observations were generated by the simulation model. Each observation consisted of one 20-year period with the incidence of negative cash balances at the end of each of the 20 years recorded. The 522 observations were obtained by replicating each of 29 levels of production efficiency (cross-sectional data) for eighteen 20-year periods (time series price data).

RESULTS OF THE SIMULATION ANALYSIS

The simulation model was run to generate 522 observations at each of five different levels of debt service. The levels of debt service (principle plus interest) ranged from $420 to $756 per month in $84 increments. The monthly loan payment is dependent upon three factors: 1) the amount of the loan, 2) the interest rate, and 3) the length of the loan. Collapsing this information into one figure eliminates the need to make simulation runs for different combinations of values for these factors.[4] Results were obtained for loan lengths of one to 20 years.

Illiquidity, i.e., inadequate loan repayment capacity, occurs when cash obligations are larger than the amount of cash available at the end of a given year. The producer's cash balance was set equal to zero at the beginning of each 20-year observation and the only source of cash is that generated by the dairy farm.

With a monthly loan payment of $420, the results (Figure 1) show a 3.8-percent probability that the "typical" Willamette Valley dairy farm cannot generate enough cash to have loan obligations paid-up at the end of ten years. This means that to repay a ten-year loan, with $420 monthly payments, "typical" producers would have to rely on another source of cash, outside the dairy farm, almost four percent of the time.

Holding the loan length constant at ten years and increasing the monthly loan payment to $756, the results show there is a 43.9-percent probability that producers cannot completely repay the loan by the end of the repayment period without using an additional source of cash.[5] In general, the results in Figure 1 show the increase in risk of illiquidity associated with the increase in the monthly debt service requirement when the repayment period is held constant.

The results also show that, in general, the probability of illiquidity decreases as the loan length increases when the monthly loan payment is held constant. For a monthly payment of $588, a producer with the typical enterprise has a 24.0-percent probability of not generating sufficient liquidity to repay a five-year loan completely by the end of the five years, a 16.3-percent probability of not repaying a ten-year loan, and 14.0-percent probability of not repaying a 15-year loan.

If the amount of the loan is fixed, an example (Table 1) shows how the risk of inadequate loan repayment capa-

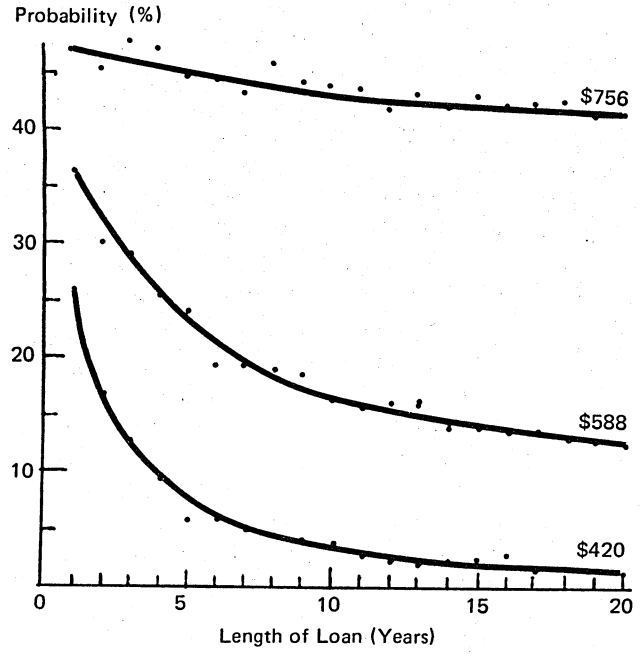
[4] This procedure does have a disadvantage. Interest paid on business loans is deductible as a business expense which reduces the income tax payment. The income tax calculated in the model does not consider this deduction. Figuring the interest rate on an after-tax basis alleviates the problem.

[5] It should be emphasized that loans not repaid on time would not necessarily be losses. This study considers the dairy farm to be the only source of cash. Sufficient funds may be generated from other sources to repay the loan on time, or it is probable that the lender needs only to extend more time to the borrower until he is able to completely repay the loan.

Table 1. Example of the effects of various loan terms on risk of illiquidity (inadequate loan repayment capacity)

Amount loaned	After-tax interest rate	Monthly debt payment	Repayment period	Risk of illiquidity
$	%	$	years	%
30,052	6.5	420	7+	5.0
30.052	6.5	504	6	11.3
30.502	6.5	588	5	24.0
30.052	6.5	672	4+	34.7
30.052	6.5	756	3+	47.9

Fig. 1. Estimated probabilities of illiquidity (inadequate loan payment capacity) by length of loan for three levels of monthly loan payments.



city is affected by an increase in the monthly loan payment with a corresponding decrease in the repayment period. For the example, the amount loaned equals $30,052 or $371 per cow for the "typical" dairy farm. The interest rate is fixed at an after-tax rate of 6.5 percent. Repaying the loan at $420 per month would take just over seven years with a five percent probability that producers would not be able to repay the loan on schedule. At $588 per month, there is a 24-percent probability that they would not generate sufficient funds to repay the loan by the end of five years. Increasing the monthly payment to $756 decreases the repayment period to three years, but increases the probability of inadequate liquidity to 48 percent.

It appears from the example in Table 1 that the lender in this case could substantially reduce his risk, i.e., the probability of producer default on a loan, by increasing the loan repayment period and reducing the monthly loan payment.

The results are not without some limitations:

1. The risk estimates were developed using a model dairy farm located in the Willamette Valley of Oregon with a herd size of 81 cows. These results should not be generalized for dairy enterprises which differ in terms of location, herd size, production systems, etc.
2. The model was based on cost and return relationships as they existed in 1971. Changes in these relationships over time would affect the risk of illiquidity.
3. The probabilities of inadequate liquidity were estimated from cross-sectional observations on production efficiency and may over estimate the risk associated with an individual producer when that specific information is known.
4. The structure of the model could also affect risk somewhat. Cash flow items which were deterministic may in fact be subject to variation; assumptions concerning the timing of some events and their cash flows could also affect the risk.
5. In the model, the mix of production inputs remains unchanged as a result of changes in input or output prices. Management is only considered in terms of production efficiency factors and not in terms of making adjustments in response to changes in prices and other factors.

CONCLUSION

The results of this research substantiate a large reduction in the probability of inadequate producer liquidity by decreasing the loan payment and increasing the length of the loan. However, it must be recognized that this is but one consideration in the formulation of agricultural lending policy.

The reduction in risk associated with smaller monthly payments is explained by the accumulation of a reserve of excess liquidity which provides a safeguard against the future possibility of insufficient cash flow to meet all commitments. Thus, any loan policy, such as longer repayment periods or deferred payments for the first months of the loan, which allows this surplus to accumulate would appear to reduce the financial risk faced by both lenders and borrowers.

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