Impact of Lower, More Volatile Net Farm Incomes, and Higher Interest Rates on Repayment Risk

By Freddie L. Barnard & Elizabeth A. Yeager

ABSTRACT

Real returns to farm operators have been at the highest level since 1973. However, indications from the USDA and Federal Open Market Committee are that returns are not projected to remain at those levels and interest rates will rise in the next decade. This paper evaluates the potential impact on repayment risk of three interest rates, three levels of leverage, and eight deviations from a base situation. Results indicate as the level of leverage and interest rate increased, the business became more susceptible to repayment risk, but even at moderate interest rates, increasing levels of leverage should be viewed with caution.

Introduction

During the initial stages of previous periods of high net farm incomes, farm debt accumulation slowed as farmers used rising net farm incomes to pay debts and finance capital investments. However, those initial periods of high net farm incomes were then followed by the leveraging of U.S. agriculture during the 1910's and 1970's. If history repeats and farmers use debt instead of retained earnings to finance capital purchases during the next decade, another period of leveraging could occur (Henderson & Kauffman, 2013).

This period could coincide with a period characterized by higher interest rates and lower net farm incomes than have been experienced since the fall of 2006. Furthermore, the volatility of net farm income has increased for the more recent 2007 to 2013 period, compared to the 2000 to 2006 period. Such a lending environment could lead to increased levels of repayment risk than experienced during the 2006 to 2013 period.

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A major challenge for those involved in financing the purchase of capital assets in agriculture, particularly real estate, will be to first determine the potential impact on repayment risk of possible operating situations and interest rate scenarios. Second, an effort to assess the likelihood of those possible operating situations and interest rate scenarios occurring will be an essential part of future credit analyses. Finally, taking measures to mitigate the potential risk will be a key component of future loan portfolio management programs.

Agricultural Lending Environment Projections for the Future

The Federal Reserve suggests interest rates could rise during the next decade, with that rise starting during the next two years. Some Federal Open Market Committee (FOMC) members have indicated fed funds rates should rise from the current target of 0 to 0.25 percent to three percent by 2015 (Henderson & Kauffman, 2013). The Livingston Survey (2013) supports both short-and long-term interest rates remaining low through 2013, but with unemployment rates expected to fall through 2014, there is some indication interest rates will rise in the next few years.

Since 2006, U.S. agriculture exports and strong demand for biofuels has increased annual real returns to farm operators to more than $45,000 per farm, the highest level since 1973. However, returns are not projected to remain at those levels during the next decade. The USDA projects net farm returns above variable costs for corn production to decline from the previous two-year average of $580 per acre to below $350 per acre by 2014 (Westcott & Trostle, 2013). Declines for other crops are also projected. As a result, USDA projects net farm income in the U.S. to fall 20 to 25 percent below 2013 levels and to remain there over the next decade (Henderson & Kauffman, 2013).

In addition, net farm incomes have become more volatile since the fall of 2006 than during the previous period. The standard deviation of net farm income from 2000 to 2006 is $15.8 billion compared to $20.3 billion for 2007 to 2013F (USDA 2013). That volatility is due not only to higher, and more volatile, commodity prices; but also to production expenses that have increased every year since 2006, except 2009. Gross farm income levels and total production expenses for the agriculture sector for the 2007-2013F period are presented in Table 1. There is substantial variation across the years for gross farm income, with one year, 2009, experiencing a 9.9 percent decline from the previous year.

On the other side of the net income calculation, total operating expenses continued to increase, with three years during the 2007 to 2013 period experiencing an increase in excess of 5 percent. The result is net farm income variability that can be even more pronounced at the individual farm level than for the sector as a whole.

Since principal payments for term debt are paid from net farm income, sensitivity analysis is needed on loan repayment capacity for a comprehensive loan analysis. Increased repayment risk arises because repayment schedules typically span multiple years when borrowing funds to purchase capital assets (i.e., machinery, equipment, real estate, etc.).

When evaluating repayment risk for funds borrowed from a financial institution, the analysis should include possible operating situations and interest rate scenarios for the upcoming period(s) and the impact of each on farm profitability and repayment capacity. Such an analysis enables lenders for financial institutions to not only be aware of the potential for increased repayment risk but also enables them to be proactive by requiring risk-reducing measures.

Methodology

The term debt and capital lease coverage ratio recommended by the FFSC will be used in this study to represent repayment risk because of the comprehensive features of the measure and its wide use across the lending industry. To assess the impact of possible operating situations and interest rate scenarios, eight potential operating situations and three possible interest rate scenarios will be evaluated. The results will enable agricultural lenders to identify operating situations and interest rate scenarios that could result in a deterioration of the measure and the extent to which that deterioration could occur.

Spreadsheet

The Purdue Financial Analysis Spreadsheet is used in this analysis. It is discussed in detail in *Farm Business Management for the 21st Century: Measuring and Analyzing Farm Financial Performance* (Miller et al., 2012), so only a general overview will be presented in this paper. Guidelines provided by the Farm Financial Standards Council (Financial Guidelines, 2008) are used in the spreadsheet to prepare the financial statements and calculate financial measures.

Accrual-adjusted Income Statement

Accrual-adjusted net farm income is used in the spreadsheet because the benefits from using data reported on an accrual-adjusted versus a cash basis income statement have been studied and the difference has been judged by many to be unacceptable. The magnitude of the difference was reported in a 2010 article using University of Illinois Farm Business and Farm Management (FBFM) data (Barnard et al., 2010).

The study found the median annual difference between cash net farm income reported on a Schedule F in a Form 1040, U.S. Individual Income Tax Return, and net farm income reported on an accrual-adjusted basis ranged from 52 percent to 63 percent for the period 2002-2006. When a three-year average was used, the smallest difference for any of the three-year periods evaluated was 52 percent. Therefore, averaging net cash farm incomes over a three-year period does not improve the accuracy of the net farm income measured using a cash basis income statement compared to using an accrual-adjusted income statement.

Repayment Capacity Analysis

The spreadsheet is used to calculate the repayment capacity measures recommended by the FFSC. Gross farm revenue and total operating expenses for an operation can be changed in the spreadsheet and the impact on the term debt repayment and capital lease coverage ratio evaluated. Likewise, the same procedure can be used when assessing the impact of a change in interest rates. Changes in gross farm revenues, operating expenses and interest rates will be used to simulate possible changes in the upcoming macroeconomic environment.

As the ratio increases, the ability of the farm or ranch to satisfy term debt and capital lease payments increases. The ratio can be calculated using historical data as well as on a projected basis. A common benchmark used for the term debt and capital lease ratio and a minimum for a business that is expanding or making major capital adjustments is 1.5 (Kohl and Wilson 2004). Of course, a ratio below 1.0 indicates the payments on term debts and capital leases could not be met from the sources used to calculate the ratio.

Base Case Farm

The base case farm selected for this analysis is intended to represent a full-time, family farm that would be large enough to provide the withdrawal for family living for the owner-operator. According to the United States Department of Agriculture (USDA), "a farm is defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold during the year" (Glossary, 2013). Such a designation for the state of Indiana in 2011 resulted in an average size farm of only 237 acres (Indiana Agricultural Statistics, 2011-2012).

Hence, an actual farm was selected that was large enough to support a farm family and had a debt-to-asset ratio somewhat characteristic of farms participating in the Illinois and Minnesota Farm Records Programs. The average annual withdrawal for family living for 2012 for the Illinois and Minnesota Farm Records Programs were $85,012 and $63,000, respectively. For the base case farm selected, the withdrawal for family living was $80,000, which is slightly above the average for the two records programs, $74,006. The four-year average debt-to-asset ratio for all farms in the Illinois FBFM records program for 2012 was 20.4 percent (Farm Income and Production Costs for 2012, 2013) and 42 percent for the Minnesota farms (2012 FINBIN, 2013), which would be an average of 31.2 percent. Hence, $80,000 withdrawn for family living and the 30 percent debt-to-asset would appear to be somewhat characteristic of the farms included in the two records programs.

Consequently, the base case farm was selected to represent a family farm in the Midwest, with about average debt-to-asset ratio for a full-time farming operation. The base case farm is used to illustrate the sensitivity of the repayment capacity for a family farm, and serves to increase the awareness of owners and operators of such farms of repayment sensitivity and the need to conduct sensitivity analysis for their individual operations. The need for an individual producer to conduct sensitivity analysis specific to his/her own operation is essential, since farms and ranches have different enterprises, debt-to-asset levels, debt structures, interest rates and operating efficiencies.

The case farm is used to assess and evaluate the impact possible operating situations and interest rate scenarios would have on repayment capacity for three levels of leverage. The base case farm is used to represent the financial condition and performance of a farm or ranch operator that is considering the purchase of farm real estate that would increase the leverage of the operation. The case farm is used to conduct the analysis, but is not intended to represent a typical U.S. farm. Instead, it

is used to illustrate the impact of changes in gross farm revenue, operating expenses and interest rates on repayment capacity for three levels of leverage. The abbreviated balance sheet, Schedule F of the form 1040, accrual-adjusted income statement and additional input data needed for the base farm are presented in attachment 1, along with the financial measures and ratios for the base case situation. The interest rate charged in the base case situation is five percent on all debt.

Furthermore, it is assumed the capital asset considered for purchase is farm real estate, which the operator currently cash rents from the seller at $250 per acre. Consequently, the size of the farming operation for the operator remains the same after the purchase as the base case, so additional debt must be paid from existing revenue-generating capacity.

Characteristics of the base case farm are:

- total farm assets of $2,132,523,
- total farm debt of $639,757,
- debt-to-asset percentage of 30.0 percent,
- net farm income of $270,369
- current scheduled total annual principal payment is $71,028,
- withdrawals for family living and taxes is $115,648, with $80,000 for family living and $35,648 for taxes,
- depreciation allowance of $110,000,
- annual operating loan of $674,183 is paid at the end of the year and does not show up on the balance sheet,
- zero non-farm income, and
- term debt and capital lease coverage ratio of 2.93.

Hence, both the borrower and an institutional lender would likely feel comfortable with the initial financial condition, profitability and repayment capacity for the base case farm.

Operating Situations

To assess repayment capacity sensitivity for gross farm revenue, the base case amount, $1,164,898, is decreased by five percent, $1,106,653, and 10 percent, $1,048,408. These operating situations are labeled situations 1 and 2, respectively. To assess repayment capacity sensitivity resulting from changes in farm operating expenses. For the base case, total farm operating expenses excluding depreciation and interest expenses, $810,250, is increased by 5 percent and 10 percent, respectively, for situations 3 and 4. That results in operating expenses, excluding depreciation and interest, of $850,763 and $891,275, for situations 3 and 4, respectively. Once operating expenses have been increased by the respective percentages, depreciation and interest expenses are then added to the resulting numbers to calculate total farm operating expenses for operating situations 3 and 4, $1,023,694 and $1,064,207, respectively.

Four additional operating situations are evaluated to represent situations in which changes in gross farm revenue and operating expenses are both detrimental to the net farm income of the farm. Those operating situations are represented by a decrease in gross farm revenue of five percent combined with operating expense increases of five and 10 percent for situations 5 and 6, respectively; and a decrease in gross farm revenue of 10 percent is combined with operating expense increases of five and 10 percent for situations 7 and 8, respectively.

Interest Rate Scenarios

In addition, the possibility of rising interest rates during the next decade would also have a detrimental impact on a farming operation that is highly leveraged. To represent this increase, the interest rate charged on borrowed funds would increase from the base case scenario of 5.0 percent to a mid-level interest rate scenario of 7.5 percent. This interest rate scenario is used to represent an increase in interest rates alluded to in the article by Henderson and Kauffman (2013).

The 10 percent interest rate scenario is used to represent a more dramatic increase in interest rates, similar to the increase that occurred in the early 1980s. A measure used to represent yields on nominal Treasury securities at "constant maturity" is the constant-maturities Treasury note. The measure is interpolated by the U.S. Treasury from the daily yield curve for non-inflation indexed Treasury securities. The 20-year constant-maturities Treasury note increased from 9.89 in June 1980 to 15.13 percent in October 1981, an increase of 524 basis points (Board of Governors, 2013).

To represent a more dramatic increase in interest rates, a high-level scenario was evaluated that charged 10 percent on all borrowed funds.

Results

Interest Rate of Five Percent

This base case interest rate scenario assumes the interest rate charged on all existing and additional debt is 5 percent. The repayment schedule for the purchase of real estate would be equal, annual principal payments over 20 years, plus interest. Since the amount of the funds borrowed will impact financial condition and repayment capacity, two additional levels of leverage are evaluated, borrowing $319,878 and $639,757.

Base Case, Debt-to-Asset of 30 Percent. The base case for the example farm has an initial debt-to asset percent of 30.0. As can be seen in Table 2, the coverage ratio exceeds 1.5 for all operating situations, except situations 7 and 8, with situation 8 falling below 1.0. In that operating situation, gross farm revenue would decrease by 10 percent and operating expenses would increase by 10 percent. Consequently, the base case, with an interest rate of 5 percent, could withstand the adverse effects that could result from all but one of the nine operating situations evaluated and satisfactorily meet term debt and capital lease repayment obligations.

Borrowing $319,878 or Increasing Debt-to-Asset to 39 Percent. The second level of leverage evaluated represents the purchase of farm real estate and the purchase is financed by borrowing funds from a financial institution. The additional borrowing needed to finance the purchase is assumed to be $319,878, which represents a 50 percent increase in total liabilities from the base case. The purchase could represent the purchase of about 50 acres the operator is currently cash renting. The selling price is assumed to be $6,398 per acre, with the total purchase amount borrowed and the farmer pledging other assets as collateral to arrive at an acceptable loan-to-value level. Since the purchase is for farm real estate that is already

rented from the seller for $250 per acre, there is no increase in the gross revenue from the base case. However, cash rent paid by the farmer would be reduced by $12,500 ($250 per acre times 50 acres). Consequently, the debt-to-asset percent increases to 39.1 percent, which will henceforth be referred to as 39 percent. The changes to the base case include:

- Total assets increase from $2,132,523 to $2,452,401 and all of the increase is in non-current assets;
- Current liabilities increase from $126,333 to $142,327, which reflects the principal payment on the additional debt;
- Non-current liabilities increase from $584,452 to $888,336, or the additional term debt added to the non-current liabilities for the base case, less the first principal payment on the additional debt;
- Annual principal payments on term debts increase from $71,028 to $87,022, which reflects the amount of the additional annual principal payment;
- Cash operating expenses, excluding interest and depreciation, decrease from $810,250 to $797,750 due to lower cash rent (50 acres rented at $250 per acre);
- Operating loan amount decreases from $674,183 to $661,683 due to elimination of cash rent on 50 acres;
- Interest on term debt increases from $29,223 to $45,217 due to additional term debt; and
- Interest on the operating loan decreases from $33,709 to $33,084 due to a lower operating loan as a result of the elimination of cash rent on 50 acres.

As presented in Table 2, the coverage ratio remains above 1.5 for five of the nine operating situations, below 1.5 but above 1.0 for three situations (2, 6, and 7) and below 1.0 for situation 8. Hence, the purchase and additional borrowing increases repayment risk for the farm borrower, but would still likely be viewed as feasible.

Borrowing $639,757 or Increasing Debt-to-Asset to 46 Percent. The third level of leverage assumes additional borrowing of $639,757 to purchase the farm real estate, which increases debt-to-asset percent from 30.0 to 46.2 percent, which will be henceforth referred to as 46 percent. This change represents a 100 percent increase in total liabilities from the base case, which could represent the purchase of about 100 acres at a selling price of $6,398 per acre. As with the prior situation, the total amount is borrowed with other collateral pledged to arrive at an acceptable loan-to-value. The assets are increased by that amount as well as the liabilities. Again, the entire amount is borrowed and is scheduled to be paid using 20 equal, annual principal payments, plus interest. The changes to the base case include:

- Total assets increase from $2,132,523 to $2,772,280 and all of the increase is in non-current assets;
- Current liabilities increase from $126,333 to $158,321, which includes the principal payment for the additional debt;
- Non-current liabilities increase from $584,452 to $1,192,221, which reflects the additional debt less the first annual principal payment;
- Principal payments on term debts increase from $71,028 to $103,016, which includes the amount

of the additional annual principal payment;

- Cash operating expenses, excluding interest and depreciation, decrease from $810,250 to $785,250 due to lower cash rent (100 acres at $250 per acre);
- Operating loan amount decreases from $674,183 to $649,183 due to the elimination of cash rent on 100 acres;
- Interest on term debt increases from $29,223 to $61,210 due to additional term debt; and
- Interest on the operating loan decreases from $33,709 to $32,459 due to a lower operating loan as a result of the elimination of cash rent on 100 acres.

As presented in Table 2, the coverage ratio falls below 1.5 for six of the nine operating situations. Only for the base situation, a five percent decrease in gross farm revenue and a five percent increase in operating expenses remain above 1.5. In addition, a 10 percent decrease in gross farm revenue combined with a 10 percent increase in operating expenses would result in a coverage ratio below 1.0. Hence, even in the low interest rate scenario of five percent, the repayment capacity is very sensitive to changes in gross farm revenue and operating expenses when the debt-to-asset ratio increases from 30 to 46 percent.

Interest Rate of 7.5 Percent

If interest rates increase from five to 7.5 percent, the impact on repayment capacity for the base case with a debt-to-asset of 30 percent is similar to the five percent interest rate scenario. The coverage ratio again falls below 1.0 for only situation 8. However, in this scenario, the number of operating situations in which the coverage ratio falls between 1.0 and 1.5 increases from one to three. Those situations include a 10 percent decrease in gross farm revenue and the situations with a 10 percent adverse change in one variable combined with a five percent change in the other, excluding situation 8.

Borrowing $319,878 or Debt-to-Asset of 39 Percent. However, the coverage ratio experiences a noticeable deterioration when the debt-to-asset percent increases from 30 to 39 and 46 percent. If the purchase of farm real estate increases the debt-to-asset percent from 30 to 39 percent, the coverage ratio for six of the nine operating situations falls below 1.5. Furthermore, it falls below 1.0 for all three operating situations that include a 10 percent change in one variable combined with a five or 10 percent change in the other; situations 6, 7, and 8. Also, the coverage ratio for a 10 percent decrease in gross farm income, with a constant operating expense, results in a coverage ratio of only 1.12.

Borrowing $639,757 or Debt-to-Asset of 46 Percent. If the purchase of capital assets results in an additional $639,757 in debt for the existing operation and the interest rate increases from five to 7.5 percent, there is a substantial increase in repayment risk. In this interest rate scenario, the coverage ratio is below 1.5 for all of the operating situations, except for the base case. It falls below 1.0 in four of the nine operating situations. Only situations 1, 3, 4, and 5 maintain a coverage ratio between 1.0 and 1.5. This finding illustrates the repayment risk sensitivity to an interest rate change for firms with higher levels of leverage.

Interest Rate of 10 Percent

This interest rate scenario represents a dramatic increase in interest rates that would be somewhat similar to the increase in interest rates that occurred during the early 1980s. In the 10 percent interest rate scenario, interest rates would essentially double from current levels. The same leverage levels and operating situations are evaluated as with the previous two interest rate scenarios.

Base Case, Debt-to-Asset of 30 Percent. The base case for the example farm has an initial debt-to-asset percent of 30.0. As can be seen in Table 4, the coverage ratio exceeds 1.5 for only three operating situations (base, 1, and 3). It falls between 1.0 and 1.5 for three operating situations. The coverage ratio falls below 1.0 for any operating situation that includes a 10 percent change in one variable combined with a five or 10 percent change in the other variable. Consequently, the base case, with an interest rate of 10 percent, would experience a noticeable deterioration in repayment capacity and an increase in repayment risk, if interest rates double. This would make farm operations with what would now be viewed as having acceptable levels of debt vulnerable to any change in operating conditions greater than a five percent decrease in gross farm revenue (situation 1) or a five percent increase in operating expenses.

Borrowing $319,878 or Debt-to-Asset of 39 Percent. If the debt-to-asset percent increases from 30 to 39 percent, the coverage ratio for all of the operating situations, except the base case falls below 1.5, with only three operating situations having a coverage ratio between 1.0 and 1.5 (1, 3, and 4). Furthermore, the coverage ratio falls below 1.0 for five of the operating situations; all that include a 10 percent change in one variable combined with a five or 10 percent change in the other, situations 6, 7, and 8; as well as situations 2 and 5 that include a 10 percent decrease in gross revenue and a five percent decrease in gross revenue combined with a five percent increase in operating expenses. Also, the coverage ratio for a 10 percent decrease in gross farm income, with a constant operating expense, results in a coverage ratio of only 1.09. This finding clearly illustrates the vulnerability of farm operations with what is currently considered by many analysts to be a feasible level of leverage, 39 percent, to any change in operating situation if interest rates increase to 10 percent interest.

Borrowing $639,757 or Debt-to-Asset of 46 Percent. If the purchase of capital assets results in an additional $639,757 in debt for the existing operation and the interest rate increases from five to 10 percent, there is a substantial increase in repayment risk. In this interest rate scenario, the coverage ratio is below 1.5 for all of the operating situations, including the base case. It falls below 1.0 in six of the nine operating situations and only the base case, a five percent decrease in gross farm revenue, and a five percent increase in operating expenses would result in a coverage ratio between 1.0 and 1.5. Hence, there is essentially no margin in the repayment capacity of the firm to address any adverse change in the operating situation from the base case.

Comparison of Coverage Ratios for Three Interest Rate Scenarios for 30 Percent Debt-to-Asset

The three interest rate scenarios, with a 30 percent

debt-to-asset percent, are compared in Table 5. With a 30 percent debt-to-asset percent, the repayment capacity deteriorates but remains relatively strong compared to higher levels of leverage for all three interest rate scenarios. When interest rates are increased to 7.5 percent, the coverage ratio remains above 1.5 for all of the operating situations, except for a 10 percent decrease in gross farm revenue and all of the situations in which a 10 percent decrease in one variable is combined with a five or 10 percent increase in the other. The 10 percent decrease in gross farm revenue only occurred once since 2007, which was a 9.9 percent decline in 2009. As was also the case with the five percent interest rate scenario, the ratio fell below 1.0 for only situation 8, a 10 percent adverse change in both variables.

In the 10 percent interest rate scenario, the coverage ratio remains above 1.5 for only three operating situations (base, 1, and 3). Situations 1 and 3 represent a five percent decrease in gross farm revenue and a five percent increase in operating expenses, respectively. The average for the five years since 2007 in which operating expenses increased was 4.7 percent. So, firms with a 30 percent debt-to-asset could satisfactorily meet debt obligations for most operating situations, except those in which there is both a decrease in gross farm revenue and an increase in total operating expenses.

Comparison of Coverage Ratios for Three Interest Rate Scenarios for 39 Percent Debt-to-Asset

The three interest rate scenarios, with a 39 percent debt-to-asset percent, are compared in Table 6. Under the five percent interest rate scenario, the coverage ratio is again over 1.0 for all operating situations, except situation 8. It remains above 1.5 for five of the situations and between 1.0 and 1.5 for three. Hence, a firm with 39 percent debt-to-asset could satisfactorily meet debt obligations in all operating situations, except the most extreme situation.

If interest rates rise to 7.5 percent, repayment capacity decreases and all of the operating situations in which a 10 percent adverse change in one variable is combined with a five or 10 percent adverse change in the other, situations 6, 7, and 8, fall below 1.0. The ratio falls below 1.5 but stays above 1.0 for both situations in which a 10 percent adverse change in one variable is combined with no change in the other. During the 2007-2013 period gross farm revenue only decreased 10 percent one year, 2009.

Under the 10 percent interest rate scenario, the only operating situation with a term debt and capital lease ratio above 1.5 is the base, and only three out of the eight alternative situations examined indicate payments on term debts and capital leases could continue to be met. The ratio for four of the operating situations fall below 1.0; a 10 percent decrease in gross farm revenue and all the situations with a 10 percent adverse change in one variable combined with a five or 10 percent change in the other. Hence, firms with 39 percent debt-to-asset would essentially be vulnerable in any operating situation with a deterioration in either gross farm revenue or operating expenses greater than five percent, with the other variable constant.

Comparison of Coverage Ratios for Three Interest Rate Scenarios with 46 Percent Debt-to-Asset

The three interest scenarios, with 46 percent debt-to-asset percent, are compared in Table 7. As expected, an increase in the leverage position of the farm business puts the business at greatest risk when interest rates rise. If farmers use debt instead of retained earnings to purchase capital assets, they could struggle to make payments on term debts and capital leases if there is essentially any decrease in gross farm revenue and/or increase in operating expenses combined with an increase in interest rates.

Even the more likely increase in interest rates from five to 7.5 percent, results in a coverage ratio for four of the nine operating situations falling below 1.0, with the ratio at only 1.06 for a five percent adverse change in both variables. Only the base situation has a coverage ratio above 1.5, when debt-to-asset is 46 percent and the interest rate is 7.5 percent.

When the interest rate is increased to 10 percent, the coverage ratio falls below 1.0 for all but three of the nine operating situations. Of those three situations, one represents a decrease in gross farm revenue of five percent and one represents a five percent increase in operating expenses. The coverage ratio for those situations are only 1.02 and 1.10, respectively. The coverage ratio for the base case is only 1.28.

Final Comments

Farm incomes have remained high over the last six years, but a recent USDA projection indicates net farm income in the U.S. could fall 20 to 25 percent below 2013 levels and remain there over the next decade (Henderson & Kauffman, 2013). An economic environment with lower net farm incomes and likely higher interest rates will result in increased repayment risk. If farm and ranch businesses plan to use debt rather than retained earnings to finance capital purchases, a period of leveraging similar to the 1970s could occur. It is important for both farm and ranch borrowers and institutional lenders to be more proactive in taking measures to reduce repayment risk.

In this analysis, three interest rates (5.0, 7.5, and 10.0) were examined, along with three levels of leverage (debt-to-asset percent of 30, 39, and 46) and eight potential deviations from a base situation. Not surprisingly, as the level of leverage and interest rate increased, the business became more susceptible to repayment risk. The base case situation with 30 percent debt-to-asset and five percent interest rate had a term debt and capital lease coverage ratio of 2.93.

However, even at a moderate increase in interest rates, five to 7.5 percent, and a 39 percent debt-to-asset percent, the coverage ratio for six of the nine operating situations fell below 1.5. When the debt-to-asset ratio was increased to 46 percent and the interest rate to 10 percent, the coverage ratio fell below 1.0 for six of the nine operating situations. Given the volatility of agricultural prices and the general increase in operating expenses, these are not unlikely scenarios and should cause both borrowers and lenders to view increasing levels of leverage with caution.

References

Barnard, F. L, P. N. Ellinger, and C. Wilson. (2010). "Measurement Issues in Assessing Farm Profitability through Cash Tax Returns," J*ournal of the American Society of Farm Managers and Rural Appraiser*: 218-229.

Board of Governors of the Federal Reserve System. (2013). "Economic Research and Data, Historical Data, Selected Interest Rates (Daily) – H15". Obtained July 15, 2013. http://www.federalreserve.gov/releases/H15/data.htm.

Farm Income and Production Costs for 2012: Advance Report. (2013). University of Illinois Extension Publication Number AE-4566.

Financial Guidelines for Agricultural Producers: Recommendations of the Farm Financial Council (Revised). (January 2008).

2012 FINBIN Report on Minnesota Farm Finances. (2013). Center for Farm Financial Management, University of Minnesota, www.finbin.umn.edu.

Indiana Agricultural Statistics 2011-2012. (2013). USDA, NASS. College of Agriculture, Purdue University, West Lafayette, IN.

Henderson, J. and N. Kauffman. (2013). "The Wealth Effect in U.S. Agriculture", *The Main Street Economist, Agricultural and Rural Analysis*, Federal Reserve Bank of Kansas City; Issue 1, 2013.

Farm Household Well-being: Glossary. (2013). United States Department of Agriculture. Economic Research Service.

Kohl, D. and T. Wilson. (2004). "Understanding Key Financial Ratios and Benchmarks." Farm Credit Services Business Tools, Produced by Northwest Farm Credit Services, Spokane, WA.

"The Livingston Survey," (2013). Federal Reserve Bank of Philadelphia, June. Obtained July 11, 2013, www.philadelphiafed.org/research-and-data/real-time-center/livingston-survey/2013/livjun13.pdf

Miller, A., C. Dobbins, M. Boehlje, F. Barnard and N. Olynk. (July 2012). *Farm Business Management for the 21st Century: Measuring and Analyzing Farm Financial Performance*. Department of Agricultural Economics, Purdue University Cooperative Extension Service EC-712.

USDA. (2013). "Farm income/balance sheet items in constant (2005=100) dollars, 1929-2013F." *Economic Research Service U.S. Farm Income and Wealth Statistics (includes the U.S. Farm Income Forecast, 2013*). http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx.

Westcott, P. and R. Trostle. (2013). USDA Agricultural Projections to 2022. Economic Research Service, U.S. Department of Agriculture, Outlook NO (OCE-131), February 2013, http://www.ers.usda.gov/publications/oce-usda-agricultural-projections/oce131.aspx

Table 1. U. S. Agriculture Sector, Gross Farm Income and Total Production Expenses, 2007-2013F

Year	Gross Farm Income	Percent Change	Total Production Expenses	Percent Change
		Billions of Dollars		
2007	319.6	----------	253.7	----------
2008	347.9	8.8	269.5	6.2
2009	313.5	(9.9)	255.9	(5.0)
2010	329.4	5.1	257.0	0.4
2011	377.9	14.7	273.9	6.6
2012F	388.1	2.7	290.0	5.9
2013F	412.5	6.3	302.6	4.3

Source: USDA (2013) Farm income/balance sheet items in constant (2005=100) dollars, 1929 – 2013F

Table 2. Impact of Decreasing Gross Farm Revenue and/or Increasing Total Operating Expenses on the Term Debt and Capital Lease Coverage Ratio, with Interest Rate of Five Percent

Year	Gross Farm Income	Percent Change	Total Production Expenses	Percent Change
		Billions of Dollars		
2007	319.6	----------	253.7	----------
2008	347.9	8.8	269.5	6.2
2009	313.5	(9.9)	255.9	(5.0)
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2012F	388.1	2.7	290.0	5.9
2013F	412.5	6.3	302.6	4.3

Source: USDA (2013) Farm income/balance sheet items in constant (2005=100) dollars, 1929 – 2013F

Table 3. Impact of Decreasing Gross Farm Revenue and/or Increasing Total Operating Expenses on Repayment Capacity on the Term Debt and Capital Lease Coverage Ratio, with Interest Rate of 7.5 Percent

Situation	D/A = 30 Percent	D/A = 39 Percent	D/A = 46 Percent
Base	2.41	1.88	1.56
1	1.91	1.50	1.26
2	1.40	1.12	0.96
3	2.06	1.62	1.36
4	1.71	1.36	1.16
5	1.55	1.24	1.06
6	1.20	0.99	0.86
7	1.05	0.87	0.76
8	0.69	0.61	0.56

Situation 1 = Decrease Gross Farm Revenue by 5 percent
Situation 2 = Decrease Gross Farm Revenue by 10 percent
Situation 3 = Increase Total Operating Expenses by 5 percent
Situation 4 = Increase Total Operating Expenses by 10 percent
Situation 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%
Situation 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%
Situation 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%
Situation 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%

Table 4. Impact of Decreasing Gross Farm Revenue and/or Increasing Total Operating Expenses on Repayment Capacity on the Term Debt and Capital Lease Coverage Ratio, with Interest Rate of 10.0 Percent

Situation	D/A = 30 Percent	D/A = 39 Percent	D/A = 46 Percent
Base	2.01	1.54	1.28
1	1.56	1.22	1.02
2	1.11	0.89	0.76
3	1.70	1.32	1.10
4	1.38	1.09	0.93
5	1.25	0.99	0.84
6	0.93	0.77	0.67
7	0.80	0.66	0.59
8	0.48	0.44	0.41

Situation 1 = Decrease Gross Farm Revenue by 5 percent
Situation 2 = Decrease Gross Farm Revenue by 10 percent
Situation 3 = Increase Total Operating Expenses by 5 percent
Situation 4 = Increase Total Operating Expenses by 10 percent
Situation 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%
Situation 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%
Situation 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%
Situation 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%

Table 5. Comparison of Term Debt and Capital Lease Coverage Ratios for Three Interest Rate Scenarios for 30 Percent Debt-to-Asset

Situation	5 Percent	7.5 Percent	10 Percent
Base	2.93	2.41	2.01
1	2.35	1.91	1.56
2	1.77	1.40	1.11
3	2.53	2.06	1.70
4	2.12	1.71	1.38
5	1.95	1.55	1.25
6	1.54	1.20	0.93
7	1.37	1.05	0.80
8	0.96	0.69	0.48

Situation 1 = Decrease Gross Farm Revenue by 5 percent
Situation 2 = Decrease Gross Farm Revenue by 10 percent
Situation 3 = Increase Total Operating Expenses by 5 percent
Situation 4 = Increase Total Operating Expenses by 10 percent
Situation 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%
Situation 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%
Situation 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%
Situation 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%

Table 6. Comparison of Term Debt and Capital Lease Coverage Ratios for Three Interest Rate Scenarios for 39 Percent Debt-to-Asset

Situation	5 Percent	7.5 Percent	10 Percent
Base	2.32	1.88	1.54
1	1.88	1.50	1.22
2	1.44	1.12	0.89
3	2.02	1.62	1.32
4	1.72	1.36	1.09
5	1.58	1.24	0.99
6	1.28	0.99	0.77
7	1.14	0.87	0.66
8	0.84	0.61	0.44

Situation 1 = Decrease Gross Farm Revenue by 5 percent
Situation 2 = Decrease Gross Farm Revenue by 10 percent
Situation 3 = Increase Total Operating Expenses by 5 percent
Situation 4 = Increase Total Operating Expenses by 10 percent
Situation 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%
Situation 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%
Situation 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%
Situation 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%

Table 7. Comparison Term Debt and Capital Lease Coverage Ratios for Three Interest Rate Scenarios for 46 Percent Debt-to-Asset

Situation	5 Percent	7.5 Percent	10 Percent
Base	1.95	1.56	1.28
1	1.60	1.26	1.02
2	1.24	0.96	0.76
3	1.71	1.36	1.10
4	1.47	1.16	0.93
5	1.36	1.06	0.84
6	1.12	0.86	0.67
7	1.00	0.76	0.59
8	0.76	0.56	0.41

Situation 1 = Decrease Gross Farm Revenue by 5 percent
Situation 2 = Decrease Gross Farm Revenue by 10 percent
Situation 3 = Increase Total Operating Expenses by 5 percent
Situation 4 = Increase Total Operating Expenses by 10 percent
Situation 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%
Situation 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%
Situation 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%
Situation 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%

Worksheets for Measuring & Analyzing Farm Financial Performance

Worksheet 1. Input Information

Schedule F Data				
Taxable Year:		20X2		
Cost of livestock sold (Schedule F, line 1d)	A			
Gross income (Schedule F, line 9)	B	$ 1,164,898		
Depreciation (Schedule F, line 14)	C	$ 110,000		
Mortgage interest (Schedule F, line 21a)	D	$ 29,223		
Other interest paid (Schedule F, line 21b)	E	$ 33,709		
Total expenses (Schedule F, line 33)	F	$ 983,182		
Balance Sheet		**Beginning**		**Ending**
Balance sheet date		12/31/20X1		12/31/20X2
Cash	G	$ 138,911	M	$ 228,750
Total current farm assets	H	$ 208,711	N	$ 401,150
Total current farm liabilities	I	$ 107,583	O	$ 126,333
Prepaid expenses[1]	J	$ 9,316	P	$ 7,400
Accrued interest	K	$ 3,505	Q	$ 2,255
Farm accounts payable and other accrued expenses	L	$ 33,050	R	$ 53,050
Total farm assets			S	$ 2,132,523
Total farm liabilities			T	$ 639,757
Owner equity [S-T]			U	$ 1,492,766
Miscellaneous Data				
Breeding stock sales (Form 4797)	V	$ 4,803		
Number of operators and employees (annual full-time equivalent)	W	2		
Family living expenses & taxes (all families supported by the farm)[2]	X	$ 115,648		
Net Farm Income				
Gross revenues [A+B+V+(N-M-P)-(H-G-J)]	Y	$ 1,274,217		
Operating expenses [A+F-C-(D+E)+(R-L)+(J-P)]	Z	$ 832,166		
EBITDA[3] [Y-Z]	AA	$ 442,051		
Interest expense [D+E+(Q-K)]	AB	$ 61,682		
Net farm income from operations[4] [AA-AB-C]	AC	$ 270,369		

[1] If prepaid expenses are changed as part of an analysis, total current assets must be changed by the same amount to properly reflect the changes to net farm income from operations.

[2] Enter $0 if all the owner-operator's compensation is included as wages in total expenses in item F above. Enter actual or estimated family living expenses and income taxes if a sole proprietorship. Enter owner withdrawals from the business for family living expenses and income taxes if a partnership or similar entity. This number is used to approximate the value of unpaid family labor and management.

[3] Earnings before interest, income tax, depreciation, and amortization expenses.

[4] Exclude large, unusual and infrequent gains or losses which are not recurring, such as the sale of land. Net farm income from operations is EBITDA - interest expenses - depreciation and is calculated on a pre-income tax basis.

Worksheets for Measuring and Analyzing Farm Financial Performance

Worksheet 2. Financial Position and Performance Ratios[1]

Profitability	Your Farm	Benchmark	Strong/Weak
Return on Assets [(AC+AB-X)÷S]*100	10.1%	11.4%	Weak
Return on Equity [(AC-X)÷U]*100	10.4%	16.6%	Weak
Operating Profit Margin Ratio [(AC+AB-X)÷Y]*100	17.0%	24.6%	Weak
Liquidity			
Current Ratio [N/O]	3.18	2.30	Strong
Working Capital/Gross Revenues Ratio [(N-O)÷Y]*100	21.6%	38.1%	Weak
Solvency			
Debt-to-Asset Ratio [T÷S]*100	30.0%	42.0%	Strong
Debt-to-Equity Ratio [T÷U]*100	42.9%	73.0%	Strong
Financial Efficiency			
Asset Turnover Ratio [Y÷S]*100	59.8%	46.4%	Strong
Revenue per Full-Time Laborer	$ 637,109	$400,000	Strong
Operating Expense Ratio [Z÷Y]*100	65.3%	67.9%	Neutral
Depreciation Expense Ratio [C÷Y]*100	8.6%	5.2%	Weak
Interest Expense Ratio [AB÷Y]*100	4.8%	3.7%	Weak
Net Farm Income Ratio [AC÷Y]*100	21.2%	23.4%	Neutral

[1] Alphabetical items in parentheses or brackets in the left-hand column refer to Worksheet 1.

Worksheets for Measuring and Analyzing Farm Financial Performance

Worksheet 3. Repayment Capacity Ratios and Measures

Capital Debt Repayment Capacity and Margin, and Replacement Margin		
Net farm income from operations (Item AC, worksheet 1)	1	$ 270,369
Off-farm income[1]	2	$ -
Interest expense on term debt[2] (Item AB, worksheet 1, minus operating interest)	3	$ 29,223
Depreciation (Item C, worksheet 1)	4	$ 110,000
Family expenses, income taxes, etc.[3]	5	$ 115,648
Capital debt repayment capacity [(1+2+3+4)-5]	6	$ 293,944
Principal on term debts and capital leases	7	$ 71,028
Unpaid operating debt from a prior period (carryover loss)	8	$ -
Capital debt repayment margin [6-(3+7+8)]	9	$ 193,693
Cash used for capital replacement (or a replacement allowance)[4]	10	$ 100,000
Replacement margin [9-10]	11	$ 93,693
Term Debt and Capital Lease Coverage Ratio [6÷(3+7+8)]	12	293.2%
Replacement Margin Coverage Ratio [6÷(3+7+8+10)]	13	146.8%
Estimated amount of additional term debt the replacement margin calculated above could service?[5]		
Estimated years to repay term debt	14	5
Estimated Interest rate available on new term debt for the term entered on line 14	15	5%
Percent of gross income to retain as a safety margin	16	0%
Cash reserve safety margin [16 X Item Y, Worksheet 1]	17	$ 20,000
Amortization factor	18	0.23097
Additional term debt the margin would service [(11-17)÷18]	19	$ 319,052

[1]Include gross off-farm income received by family members used to support family living or farming activities.

[2]Enter amount of interest paid on term debt if different from mortgage interest reported on the tax return.

[3]The amount on Line X, Worksheet 1.

[4]The amount of cash used for down payments or "boot" when making capital purchases. Do not include cash financed with loans. If the actual amount of cash used for capital replacement is zero or abnormally low use a number that reflects the average amount of cash used for capital replacement over the last five years.

[5]This assumes the calculated replacement margin will recur every year during the repayment period. The actual replacement margin available each year is likely to vary considerably. So, it would not be prudent from a risk management perspective to plan on the full amount on line 11 being available for additional debt service every year. On line 17, a portion of the farm's revenue is retained to provide a margin of safety. The minimum that would be prudent to retain for low risk operations is 5%. The amount retained in order to provide a margin of safety should be increased in more financially risky farm businesses.