

## Repayment Capacity Sensitivity Analysis Using Purdue Farm Financial Analysis Spreadsheet

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### ABSTRACT

Many agricultural producers purchased capital items the past few years and some used borrowed funds to finance the purchase. The principal payments on those term loans are paid from net farm income. This paper discusses the sensitivity of farm loan repayment capacity to changes in the gross revenue and operating expenses that determine net farm income. Sensitivity analysis is conducted using the Purdue Farm Financial Analysis Spreadsheet. The sensitivity analysis and application of the updated program are illustrated using a case study.

### Introduction

Principal payment on term debt is paid from net farm income, so it is essential that a stable or increasing level of net farm income be maintained during a scheduled loan repayment period to meet additional term debt principal payments. Increased volatility of agricultural yields and commodity prices increase repayment risk. Increased volatility of agricultural input prices also increases repayment risk. Major events such as the drought in the Midwest during the summer of 2012 significantly increase repayment risk for some producers due to the drop in net incomes that affected those respective farms. Hence, agricultural borrowers and lenders need to be aware of the impact of possible declines in gross farm revenue and/or possible increases in operating expenses on the repayment capacity of the business.



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As agricultural borrowers and lenders assess the impact of lower revenue and/or higher operating expenses on repayment capacity, they can incorporate the impact into their decision-making, along with the likelihood each scenario will become a reality. The additional information should be considered as the borrower and lender make the final decision on a loan request and decisions on practices and products to reduce repayment risk. The information is also useful for managing a farm's existing debt portfolio.

### Spreadsheet

The Financial Analysis Spreadsheet available from Purdue University (that is discussed in the previous article in this issue of the *Journal*) can be used to conduct sensitivity analysis (Barnard et al., 2013). That spreadsheet will be used to conduct an illustrative sensitivity analysis on repayment capacity in this article. Details of the spreadsheet are available in that article and will not be repeated in this article, except for the features that relate to its use to analyze repayment capacity and conduct sensitivity analysis.

Sensitivity analysis as it relates to repayment capacity measures can be due to changes in the operation that are under the control of a borrower and changes that are beyond the control of a borrower. Both types of changes are useful when assessing creditworthiness for a farm or ranch operation. Changes in the operation that are under the control of a borrower would include such things as capital purchases, increased borrowing, changes in owner withdrawals, etc. Examples of changes that are beyond the control of the operator could

include changes in total revenue due to weather and/or prices and changes in operating expenses.

The Financial Analysis Spreadsheet available from Purdue includes five different worksheets, each with a different function. Worksheet 3 is used to calculate the repayment capacity measures recommended by the FFSC (Financial Guidelines, 2008). That worksheet designation will be used in this article, Worksheet 1 is used to input data for financial analysis.

The total revenue for an operation can be changed on Worksheet 1, Line B, and the impact can then be evaluated by reviewing the impact on the term debt repayment and capital lease coverage ratio calculated on Worksheet 3. Likewise, the same procedure can be used when assessing the impact of a change in operating expenses by changing Line F on Worksheet 1. A more detailed portrayal of each of those changes can be included but for illustrative purposes only these simple adjustments are used.

### Case Study Example Farm

The same case study example farm, Frank and Frieda Farmer, is used in this analysis to illustrate how to assess the sensitivity on repayment capacity as was used in the overview article and the details are available in that article (Barnard et al., 2013). The case study example farm is used to illustrate the impact of changes in gross revenue and operating expenses on repayment capacity.

The example farm used to illustrate the spreadsheet is not intended to represent a typical Indiana farm, but is an example farm that is used to illustrate data

entry and the results that can be obtained by using the spreadsheet. Likewise, the results obtained using the example farm should not be generalized, but instead are reported to illustrate the types of analyses that can result from using the spreadsheet, including farm loan repayment sensitivity analysis.

The base case scenario numbers used to complete Worksheet 3 are transferred from Worksheet 1, except for the off-farm income, scheduled principal and interest payments on term debt, carryover operating losses, and funds needed for capital replacement, which the farm operator must input. The term debt coverage ratio (4.21 or 421%) and the capital debt repayment margin \$48,460 are calculated by the spreadsheet and serve as the base case for this analysis.

### Agricultural Economic Environment

The agricultural economic environment has become more profitable, but also more volatile, due to higher but more volatile grain prices since the fall of 2006. In addition, increasing input costs, particularly cash rents for farm land, have added to increased repayment risk. The drought of 2012 in the U.S. has magnified the repayment risk for farm operations that are in drought afflicted areas. Clearly, the repayment risk for agricultural term loans has increased for some farm or ranch businesses.

Gross farm income for the agricultural sector and total production expenses for the period 2007-2011 are reported in Table 1. That period was selected because the introduction of the ethanol subsidy has changed the agricultural economic environment

dramatically. As can be seen by reviewing Table 1, only one year during the period experienced a decline in gross farm income (2009) and that decline was 9.3 percent. One year experienced an increase in total production expenses in excess of 10 percent, 12.5 percent (2011F).

Hence, eight scenarios were selected for the sensitivity analysis. A five, and ten, percent decrease in gross farm revenue from the previous year; a five, and ten, percent increase in total operating expenses from the previous year; and four scenarios in which gross farm revenue decreased by five, or ten, percent during the same year that total operating expenses increased by five, or ten, percent. The data in Table 1 support routinely evaluating the sensitivity of farm businesses to changes of these magnitudes. Farm operators in drought affected areas should evaluate the sensitivity of their businesses to even larger farm revenue declines.

### Sensitivity Analysis

The case study farm example had \$95,460 in net farm income from operations for 20X2 and a term debt and capital lease coverage ratio of 4.21, so both the borrower and the lender would likely feel comfortable with the financial performance and repayment capacity for 20X2. However, how would the situation change if gross farm revenue decreased by 10 percent? Alternatively, how would these measures change if total farm operating expenses increased by 10 percent? Or, what would be the effect if both changes occurred? Such analysis is sensitivity analysis, or “stress testing”, which is required by examining authorities who examine financial institutions. In those situations

the sensitivity analysis is often conducted for possible changes in interest rates and other cost and revenue items that impact profitability. However, sensitivity analysis should also be conducted by the agricultural businesses that borrow from those institutions.

If total gross farm revenue decreased by five and ten percent while total operating expenses remained constant (Scenarios 1 and 2), net farm income from operations and the repayment capacity measures for the business would deteriorate from the base case situation. Net farm income from operations would decrease to \$73,143 and \$50,825 (Worksheet 1), respectively; whereas, the term debt and capital lease coverage ratio would decrease to 2.73 and 1.25 (Worksheet 3), respectively (see Table 2). The measure would remain above or close to 1.50 in both instances, which is an acceptable benchmark used by some analysts. However, the replacement margin coverage ratio would drop to 0.63 when gross farm revenue dropped by 10 percent.

A term debt coverage ratio of 1.25 indicates that the case farm would have sufficient income to repay term debts if revenues dropped 10 percent. But, the 0.63 replacement margin coverage ratio indicates that the farm or ranch would be unable to both repay the scheduled principal and interest payments on term debt and replace capital at the desired level. Looking only at the term debt and capital lease coverage ratio and the replacement margin coverage ratio, the deterioration may not be to a level that would greatly concern the borrower or the lender in terms of repayment of a farm's existing debt. However, the drop in gross revenues

would impact the capacity to service additional term debt as discussed in the following paragraphs.

With a five percent drop in revenues from \$446,350 to \$424,033, the farm's replacement margin coverage ratio of 1.37, or 137 percent, corresponds to a replacement margin of \$11,143. Line 16 of Worksheet 3 indicates the Farmers would like to maintain a cash reserve safety margin equal to five percent of gross revenues. With a five percent drop in revenues, Line 17 of Worksheet 3 would report the desired cash reserve safety margin as a dollar amount of \$21,202 ( $\$424,033 \times 0.05$ ). The farm's replacement margin must be above this amount before the farm will have any funds available for servicing additional term debt. Only the funds in excess of this amount would be considered available for servicing additional term debt. Because the replacement margin of \$11,143 is less than \$21,202, Line 19 of Worksheet 3 will report that the farm has "no available capacity" to service additional term debt. Net income must increase by more than \$10,059 ( $\$21,202 - \$11,143$ ) before Line 19 will start reporting capacity to service additional term debt.

With a 10 percent drop in farm gross revenues to \$401,715, the Farmer's replacement margin would be negative \$11,175. The cash reserve margin at five percent of gross revenues would equal \$20,086. Line 19 of Worksheet 3 will again report "no additional capacity" for servicing additional term debt. With a 10 percent drop in revenue, net income would need to increase by more than the sum of the replacement margin shortfall and the desired cash reserve safety margin before the farm would

start regaining any capacity for servicing additional term debt. Thus, net income must increase by more than \$31,261 (\$11,175 + \$20,086) before Line 19 on Worksheet 3 starts reporting a dollar amount for additional term debt the available replacement margin could service. If the additional net income is the result of increasing revenues, the amount required to regain the capacity to service additional debt will be a little more than \$31,261 because the cash reserve safety margin dollar amount reported in the Worksheet will increase as revenues increase.

Alternatively, if total operating expenses increased by five and ten percent while gross farm revenue remained constant (Scenarios 3 and 4), net farm income from operations and the repayment capacity measures for the business would again deteriorate. However, the degree of the deterioration would probably not cause great concern for the borrower and the lender. Even with a 10 percent increase in total operating expenses, net farm income from operations would only decrease from \$95,460 to \$65,270 and the term debt and capital lease coverage ratio would decrease from 4.21 to 2.21, which is still above the 1.50 used by some analysts. The replacement margin coverage ratio would decrease from 2.11 to 1.11, but is still above 1.0 which would indicate the minimum level at which the borrower could satisfy all the loan obligations, pay family living expense, and replace capital at the desired amount. However, with a five percent gross income safety margin, there is no capacity to service additional term debt if total operating expenses increased by five or ten percent.

In any given production period, it is not unusual for both gross farm revenue to decrease and total

operating expenses to increase. As can be seen from Table 3, the only combination of decreases in gross farm revenue and increases in total operating expenses that would result in an acceptable term debt coverage ratio would be a five percent decrease in gross farm revenue combined with a five percent increase in total operating expenses (Scenario 5). In that scenario, the replacement margin coverage ratio would drop below 1.0, but the term debt coverage ratio would still be 1.73. Again, the five percent safety margin of gross farm income would result in no capacity for servicing additional term debt.

The next two combinations of a decrease in gross farm revenue of five percent and ten percent, and an increase in total operating expenses of ten percent and five percent, respectively (Scenarios 6 and 7), would yield a term debt coverage ratio less than 1.0 and a replacement margin coverage ratio less than 0.5, which would be unacceptable to many lenders. After adding back depreciation expense in Worksheet 3, the net farm income from operations for both Scenarios 6 and 7 would just be sufficient to cover family living expenses. Depreciation expense is routinely added back to net farm income from operations, when computing capital debt repayment capacity, because it is a non-cash expense. The term debt coverage ratio would drop from the 4.21 in the base case to below 1.0, so the principal payments on term debt could not be fully paid from net farm income. In the case of the 10 percent drop in revenue and 5 percent increase in operating expenses, part of the interest payment on term debt could not be made.



If gross farm revenue decreased by 10 percent and total operating expenses increased by 10 percent in the same year (Scenario 8), the repayment capacity would deteriorate to the point the lender would probably have serious reservations about financing the operation. The net farm income from operations would decrease to \$20,635, which would be insufficient to meet the withdrawal for family living expenses, even when the depreciation allowance is added back to net farm income from operations. The term debt and capital lease coverage ratio would drop to 0.75. In this situation there is no net income left to pay either the interest or principal on term debt.

The purpose for examining the eight scenarios discussed here is to illustrate how sensitive repayment capacity can be for farm and ranch businesses that borrow term debt to finance capital purchases during a time of volatile commodity prices and increasing operating expenses. A 10 percent decrease in gross farm revenue is in the realm of possibilities when considering potential changes in a volatile price environment. A 9.3 percent decrease occurred in 2009. Whereas, a 10 percent increase in operating expenses is a distinct possibility in the current environment. In 2011, forecasted total operating expenses increased 12.5 percent from 2010. Hence, both borrowers and lenders should use financial analysis spreadsheets that are available to conduct sensitivity analyses to be better prepared with contingency plans should the unexpected become a reality.

Again, these results are not intended to be generalized, but are instead used to illustrate how the spreadsheet can be used to assess farm loan

repayment capacity sensitivity. The sensitivity of farm loan repayment capacity can differ for farms of different sizes, levels of debt, repayment schedules enterprises, etc. Since farm loan repayment capacity sensitivity can vary from farm to farm, depending on the factors mentioned above, users need to evaluate their own businesses and not rely on general findings. Use of the Financial Analysis Spreadsheet in this article is intended to demonstrate how that can be accomplished using this particular analysis program.

### Final Comments

A financial analysis spreadsheet is available from Purdue University at no charge at [www.agecon.purdue.edu/files/EC712.xlsx](http://www.agecon.purdue.edu/files/EC712.xlsx). The spreadsheet was used to evaluate the impact on repayment capacity for a case study farm example of reducing gross farm revenue by five and ten percent, increasing total operating expenses by five and ten percent, and various combinations, including experiencing both ten percent changes in the same year.

The analysis illustrates how sensitive the repayment capacity was for an example farm and how vulnerable that business is to changes in the gross farm revenue that can result from changes in production and/or prices and to changes in operating expenses. The sensitivity analysis for the case study example farm was used to illustrate the spreadsheet and the impact of possible changes for that farm operation and should not be generalized. Instead, the impact on an individual farm or ranch business would need to be analyzed using the gross farm revenue, total operating expenses and term debt and capital lease obligations for that particular business.

## References

Barnard, F.L., E.A. Yeager and W.A. Miller. (2013). "New Features Added to the 1998 Version of the Purdue Farm Financial Analysis Spreadsheet." *Journal of the American Society of Farm Managers and rural Appraisers*: 74-87.

Farm income/balance sheet items in constant (2005=100) dollars, 1929 – 2012F, ERS, USDA. (2012). <http://www.ers.usda.gov/data/farmincome/finfidmu.htm>.

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

## 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	\$370,125
Depreciation (Schedule F, line 14)	C	\$ 27,000
Mortgage interest (Schedule F, line 21a)	D	\$ 3,990
Other interest paid (Schedule F, line 21b)	E	\$ 21,110
Total expenses (Schedule F, line 33)	F	\$350,350

  

Balance Sheet	Beginning	Ending
	12/31/20X1	12/31/20X2
Balance sheet date		
Cash	G \$ 5,000	M \$ 10,000
Total current farm assets	H \$120,000	N \$ 200,000
Total current farm liabilities	I \$ 97,000	O \$ 112,540
Prepaid expenses <sup>1</sup>	J \$ -	P \$ -
Accrued interest	K \$ 3,950	Q \$ 840
Farm accounts payable and other accrued expenses	L \$ 14,050	R \$ 17,700
Total farm assets		S \$ 638,000
Total farm liabilities		T \$ 181,540
Owner equity [S-T]		U \$ 456,460

  

Miscellaneous Data	
Breeding stock sales (Form 4797)	V \$ 1,225
Number of operators and employees (annual full-time equivalent)	W 1
Family living expenses & taxes (all families supported by the farm) <sup>2</sup>	X \$ 65,000

  

Net Farm Income	
Gross revenues [A+B+V+(N-M-P)-(H-G-J)]	Y \$446,350
Operating expenses [A+F-C-(D+E)+(R-L)+(J-P)]	Z \$301,900
EBITDA <sup>3</sup> [Y-Z]	AA \$144,450
Interest expense [D+E+(Q-K)]	AB \$ 21,990
Net farm income from operations <sup>4</sup> [AA-AB-C]	AC \$ 95,460

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> Earnings before interest, income tax, depreciation, and amortization expenses.

<sup>4</sup> 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.



## Worksheet 2. Repayment Capacity Ratios and Measures

**Capital Debt Repayment Capacity and Margin, and Replacement Margin**

Net farm income from operations (Item AC, worksheet 1)	1	\$	95,460
Off-farm income <sup>1</sup>	2	\$	-
Interest expense on term debt <sup>2</sup> (Item AB, worksheet 1, minus operating interest)	3	\$	6,090
Depreciation (Item C, worksheet 1)	4	\$	27,000
Family expenses, income taxes, etc. <sup>3</sup>	5	\$	65,000
<b>Capital debt repayment capacity [(1+2+3+4)-5]</b>	6	\$	63,550
Principal on term debts and capital leases	7	\$	9,000
Unpaid operating debt from a prior period (carryover loss)	8	\$	-
<b>Capital debt repayment margin [6-(3+7+8)]</b>	9	\$	48,460
Cash used for capital replacement (or a replacement allowance) <sup>4</sup>	10	\$	15,000
<b>Replacement margin [9-10]</b>	11	\$	33,460

**Term Debt and Capital Lease Coverage Ratio [6÷(3+7+8)]** 12 421.1%

**Replacement Margin Coverage Ratio [6÷(3+7+8+10)]** 13 211.2%

**Estimated amount of additional term debt the replacement margin calculated above could service?<sup>5</sup>**

Estimated years to repay term debt	14		7
Estimated Interest rate available on new term debt for the term entered on line 14	15		6%
Percent of gross income to retain as a safety margin	16		5%
Cash reserve safety margin [16 X Item Y, Worksheet 1]	17	\$	22,318
Amortization factor	18		0.17914
<b>Additional term debt the margin would service [(11-17)÷18]</b>	19	\$	62,202

<sup>1</sup>Include gross off-farm income received by family members used to support family living or farming activities.

<sup>2</sup>Enter amount of interest paid on term debt if different from mortgage interest reported on the tax return.

<sup>3</sup>The amount on Line X, Worksheet 1.

<sup>4</sup>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.

<sup>5</sup>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.

Table 1. U.S. Agricultural Sector, Gross Farm Income, and Total Production Expenses

<b>Year</b>	<b>Gross Farm Income</b>	<b>Percent Change</b>	<b>Total Production Expenses</b>	<b>Percent Change</b>
Billions of Dollars				
2007	339.6	-----	269.5	-----
2008	377.9	11.3	293.2	8.8
2009	342.7	(9.3)	281.1	(4.1)
2010	364.7	6.4	285.6	1.6
2011F	419.4	15.0	321.3	12.5

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Source: Farm income/balance sheet items in constant (2005=100) dollars, 1929 – 2012F.

**Table 2. Impact of Decreasing Gross Farm Revenue or Increasing Total Operating Expenses on Repayment Capacity**

<b><u>Measure</u></b>	<b>Scenarios</b>				
	<b><u>Base</u></b>	<b><u>1</u></b>	<b><u>2</u></b>	<b><u>3</u></b>	<b><u>4</u></b>
NFI	\$95, 460	\$73,143	\$50,825	\$80,365	\$65,270
CR	4.21	2.73	1.25	3.21	2.21
RR	2.11	1.37	0.63	1.61	1.11

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NFI = Net Farm Income

CR = Term Debt and Capital Lease Coverage Ratio

RR = Replacement Margin Coverage Ratio

Scenario 1 = Decrease Gross Farm Revenue by 5 percent

Scenario 2 = Decrease Gross Farm Revenue by 10 percent

Scenario 3 = Increase Total Operating Expenses by 5 percent

Scenario 4 = Increase Total Operating Expenses by 10 percent

Table 3. Impact of Decreasing Gross Farm Revenue and Increasing Total Operating Expenses on Repayment Capacity

<u>Measure</u>	<b>Scenarios</b>				
	<u>Base</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
NFI	\$95,460	\$58,048	\$42,953	\$35,730	\$20,635
CR	4.21	1.73	0.73	0.25	(0.75)
RR	2.11	0.87	0.37	0.13	(0.38)

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NFI = Net Farm Income

CR = Term Debt and Capital Lease Coverage Ratio

RR = Replacement Margin Coverage Ratio

Scenario 5 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 5%

Scenario 6 = Decrease Gross Farm Revenue 5%/Increase Operating Expenses 10%

Scenario 7 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 5%

Scenario 8 = Decrease Gross Revenue 10%/Increase Total Operating Expenses 10%