The impact of rising interest rates on farm profitability and debt management strategies

by

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ABSTRACT

The agricultural sector depends on external financing, making it vulnerable to interest rate changes. This study examines the impact of rising interest rates on capital debt repayment capacity (CDRC) and default probability using Kansas Farm Management Association (KFMA) data. Sensitivity analysis reveals that while higher rates increase repayment costs, default risk is primarily driven by owner equity (OE) and working capital (WC). Farms with OE below 60% faced default probabilities exceeding 0.50%, while those above 80% had near-zero risk. A 50% reduction in WC significantly increased default probability, highlighting liquidity's role in financial stability.

Beyond financial metrics, lender-borrower relationships, risk management tools, and refinancing options influence farm financial resilience. Findings suggest that equity accumulation, liquidity preservation, and revenue diversification mitigate financial risk more effectively than focusing on interest rates alone. Policy interventions supporting credit access and debt restructuring may enhance financial stability. Future research should explore long-term refinancing risks, farm profitability under prolonged high-interest environments, and the effectiveness of financial education programs in improving borrower resilience. Additionally, the role of technological adoption in cost management and its potential to offset rising borrowing costs warrants further analysis. Understanding these dynamics can help lenders and policymakers implement targeted financial support mechanisms, ensuring the sustainability of agricultural operations in fluctuating economic conditions.

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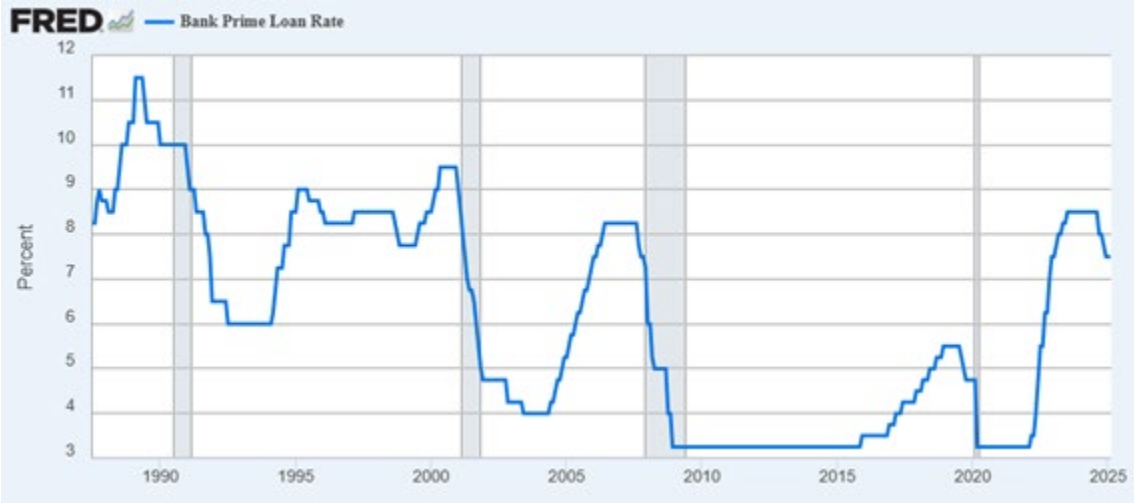
CHAPTER I: INTRODUCTION

1.1 Background

The agricultural sector relies on external financing to support operations, acquire inputs, and invest in capital assets. Given its capital-intensive nature, farms frequently utilize debt to finance land, equipment, and infrastructure necessary for maintaining production efficiency. However, dependence on borrowed capital introduces financial risk, particularly as economic conditions shift. Changes in interest rates influence debt repayment capacity and overall farm profitability, making interest rate variability a key factor in farm financial management.

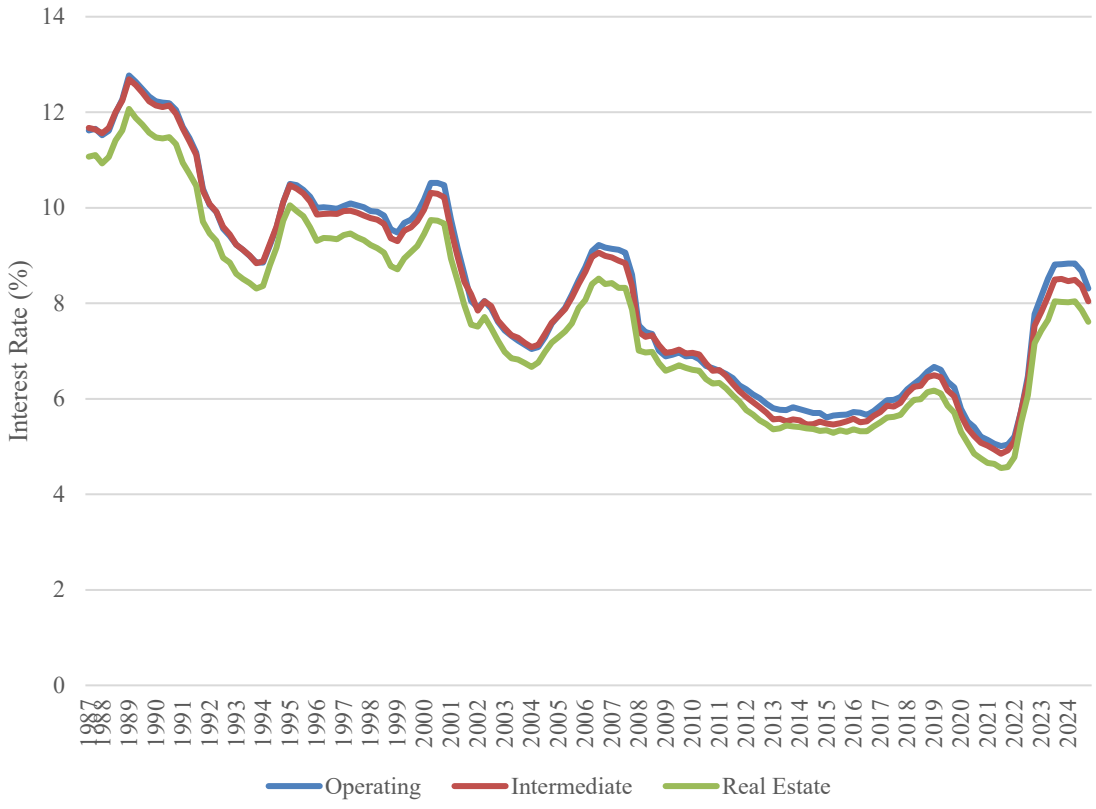
In the past decades, interest rates have experienced periods of both decline and increase, driven by economic policies, inflation rates, and global financial market trends. Figures 1.1. and 1.2 provide the past 40-year history of change in prime lending rate and estimated agricultural lending rates, respectively. Recently, a trend toward rising interest rates has emerged, influenced by central banks' efforts to curb inflation and stabilize economies. For farmers and agribusinesses, this shift translates to increased borrowing costs, which may reduce net income, strain cash flow, and raise the likelihood of default on existing debt. As farms often operate with slim profit margins, even small increases in interest rates can have outsized effects on financial health, jeopardizing their ability to service debt and maintain financial sustainability.

Figure 1.1 Prime Interest Rate



(Source: FRED, St. Louis Federal Reserve)

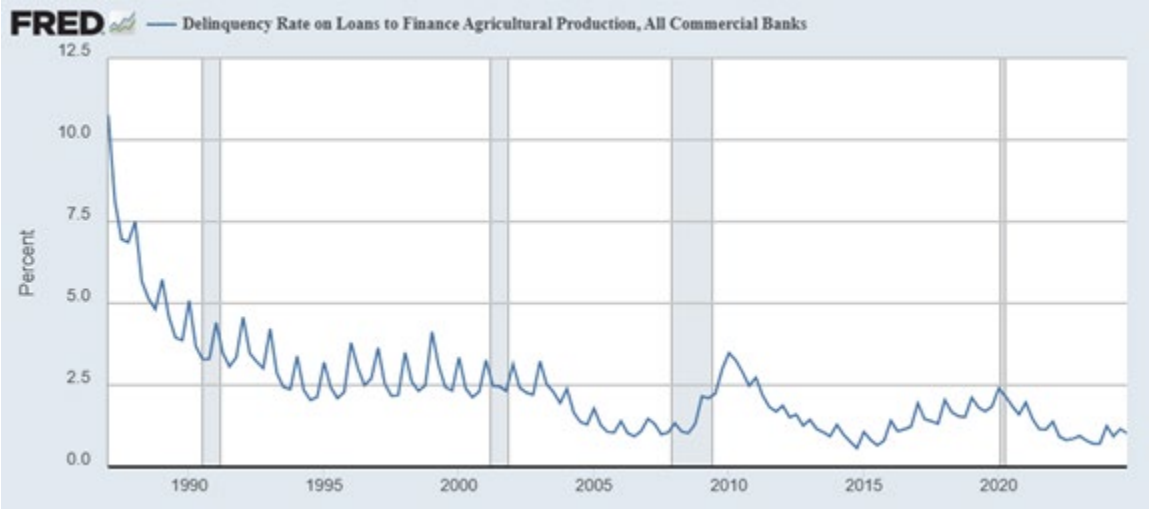
Figure 1.2 Estimated 10th Federal Reserve Agricultural Fixed Interest Rates



(Source: Kansas City Federal Reserve survey of agricultural credit)

Understanding how farm business financial conditions respond to a change in interest rate is important for understanding the change in financial stress on agricultural producers as result of central monetary policy decisions. Farm financial well-being has a direct impact on the ability of the farm business to meet debt obligations. Figure 1.3 highlights the change in US agricultural production loan delinquency rate across all commercial banks. Commercial banks and the Farm Credit system account for approximately 80% of agricultural lending by regulated financial institutions (Economic Research Service, 2025).

Figure 1.3 U.S. commercial bank quarterly delinquency rates on loans to finance agricultural production



(Source: FRED, St. Louis Federal Reserve)

Capital debt repayment capacity (CDRC) is a critical measure in assessing a farm's financial health and its ability to meet debt obligations. Featherstone, Roessler, and Barry (2006) found that the CDRC ratio, owner equity, and working capital are the strongest determinants of approximating the probability a farm business might default on agricultural loans. The CDRC measure captures multiple components of farm income and

expenses, including income from operations, non-farm income, taxes, interest paid on term debt, depreciation, and family living expenses. The CDRC ratio standardizes the CRDC (numerator) by term principal payments and interest on debt (both in the denominator). By examining these components, the CDRC ratio provides a comprehensive view of a farm's capacity to repay debt from available resources relative to level of debt carried. If CDRC is sensitive to a change in interest rates, an analysis of CDRC becomes especially relevant, as it can indicate whether a farm has sufficient financial flexibility to absorb increased borrowing costs without compromising essential expenditures or risking insolvency measured by a change in probability of default.

Interest rate sensitivity in agriculture is a topic of increasing concern among financial institutions, policymakers, and agricultural lenders. The agricultural sector's dependency on term loans and mortgages—often at fixed or variable interest rates—means that changes in interest rates directly affect the cost structure of farms. A rise in interest rates not only increases the cost of servicing current debts but also affects the feasibility of future investments, limiting a farm's ability to expand or adapt to changing market demands. This can create a cycle of financial pressure where farms struggle to keep up with debt repayments, leading to deteriorating credit quality and higher default probabilities. However, many longer-term loans were fixed at historically low rates during the COVID-19 years, temporarily insulating some operations from rising interest costs. As these loans mature and refinancing occurs at higher rates, the financial strain on highly leveraged farms may become more pronounced.

Furthermore, the effects of rising interest rates are compounded by additional pressures such as fluctuating commodity prices, rising input costs, and unpredictable

climate conditions. These factors contribute to financial volatility, making it difficult for farms to maintain stable profit margins. While government interventions, such as emergency economic relief, have historically been implemented in response to adverse market conditions, they do not directly mitigate the financial burden of higher borrowing costs. Unlike market risks, which can sometimes be offset through hedging strategies or policy support, debt obligations remain fixed and must be serviced regardless of revenue fluctuations. This creates a structural financial risk where farms with high leverage and variable-rate debt are particularly vulnerable to deteriorating credit conditions. Understanding how rising interest rates interact with these external pressures provides valuable insights into the financial resilience of agricultural operations and their ability to withstand prolonged economic stress.

Understanding these dynamics is essential for agricultural lenders who seek to balance the needs of their clients with the risks associated with extending credit in a volatile economic environment. Likewise, for policy makers and agricultural advisors, the insights gained from this study can guide strategies to support farm resilience, whether through improved debt management tools, interest rate hedging options, or educational programs focused on financial planning in high-interest environments. In an era where economic uncertainties are increasingly pronounced, assessing the impact of interest rate changes on debt repayment capacity is critical for preserving the long-term sustainability of the agricultural sector.

1.2 Problem Statement

Agricultural operations frequently rely on external financing to sustain production and expand business activities. However, as interest rates rise, farms face increased financial pressure in servicing existing debts, potentially leading to higher rates of default

and reduced credit quality. Understanding the capital debt repayment capacity and its sensitivity to interest rate fluctuations is essential for assessing the financial health of agricultural enterprises and ensuring that lending practices remain sustainable and supportive of the industry's unique financial structure. This research aims to investigate how interest rate changes influence the probability of default and creditworthiness among farms, with a focus on the factors that contribute to resilience or vulnerability within this context.

1.3 Research Objectives

The primary objective of this study is to analyze the effect of rising interest rates on the capital debt repayment capacity of farms and its implications for default probability and credit quality. The specific objectives are:

1. To assess the sensitivity of farm debt repayment capacity to interest rate changes.
2. To evaluate how rising interest rates affect the probability of farm loan default.
3. To explore the impact of financial pressures resulting from increased borrowing costs on overall farm profitability for different farm types.
4. To identify strategies for improving debt management and mitigating financial risk in the agricultural sector.

1.4 Research Questions

To fulfill these objectives, this study addresses the following research questions:

1. How does an increase in interest rates impact the capital debt repayment capacity of farms?
2. What is the relationship between rising interest rates and the probability of default within the agricultural sector?

3. What risk management strategies can farms employ to mitigate the effects of rising interest rates on debt repayment?

1.5 Significance of the Study

This study is significant for several reasons. First, it provides insights into the financial challenges faced by agricultural businesses in an environment of rising interest rates. Understanding the sensitivity of debt repayment capacity to interest rate changes is vital for lenders, policy makers, and farm managers seeking to make informed decisions that support financial resilience in agriculture. The findings could guide financial institutions in designing loan products that account for interest rate risks and help farms plan for sustainable financial management. Additionally, this research contributes to the broader literature on agricultural finance by offering empirical evidence on the intersection of interest rate risk and farm sustainability, helping shape strategies for long-term profitability and creditworthiness in agribusiness.

1.6 Conceptual Framework

This study adopts a conceptual framework that centers on the capital debt repayment capacity of farms as a measure of financial health and resilience in the face of economic changes. Using prior research linking CDRC ratio to an estimated probability of default this study conducts sensitivity analysis for different farm types for different combinations of financial measures. The capital debt repayment capacity ratio formula used in this research includes income from operations, non-farm income, income and self-employment taxes, interest expense on term debt, depreciation, and family living expenses. By analyzing the CDRC ratio in relation to interest rate fluctuations, the study provides a structured approach for assessing how different variables interact to influence farm debt repayment capabilities.

The conceptual framework allows for a detailed analysis of how each component of the CDRC formula contributes to financial stress or resilience under varying economic conditions. This framework also integrates the probability of default as a measure of credit quality, illustrating the broader implications of debt repayment capacity for the agricultural sector's sustainability.

1.7 Methodology Overview

To assess the impact of rising interest rates on the capital debt repayment capacity and default probability in agriculture, this study employs quantitative methods using farm-level financial data. Sensitivity analysis will be used to simulate the effect of various interest rate scenarios on debt repayment capacity and calculate the probability of default under these conditions. Data sources include income from operations, non-farm income, interest expenses, depreciation, and other relevant financial indicators that reflect the financial structure of agricultural operations.

The methodology is designed to model the financial outcomes of different interest rate scenarios, providing insights into the level of financial stress that farms may face as borrowing costs increase. This approach helps identify threshold levels of interest rate increases that significantly impact debt servicing abilities and, by extension, credit quality in the agricultural sector.

CHAPTER II: LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive review of the existing literature on the financial dynamics of the agricultural sector, with a focus on the impact of rising interest rates on capital debt repayment capacity (CDRC), default probability, and farm profitability. The literature explores the relationship between interest rate fluctuations, financial stress, and credit quality within agriculture. Furthermore, it highlights strategies for debt management and resilience in an increasingly volatile economic environment.

2.2 Agricultural Finance and Interest Rate Sensitivity

Agricultural operations rely on debt financing to fund land purchases, equipment, and working capital needs. The structure of farm financing typically includes term loans, operating lines of credit, and real estate mortgages, all of which are subject to changes in interest rates (U.S. Department of Agriculture Economic Research Service [USDA-ERS], 2025). The sensitivity of farm finances to interest rate fluctuations is a key concern, as higher borrowing costs can reduce net farm income and impact financial solvency.

Studies have shown that the capital structure of farms influences their ability to withstand rising interest rates. Featherstone and Langemeier (2017) found that farms with lower capital debt repayment capacity (CDRC) and owner equity (OE) were more susceptible to financial stress when borrowing costs increased. Similarly, research from the Farm Credit Administration (2022) indicates that farms with high leverage ratios face greater difficulty in servicing debt when interest rates rise, leading to higher default probabilities.

The impact of rising interest rates varies across different farm types. According to data from the Kansas Farm Management Association (KFMA), irrigated farms and beef

operations tend to have higher financial risk than non-irrigated row crop farms due to greater capital intensity and debt reliance (KFMA, 2024). Additionally, farms with lower working capital ratios experience greater financial strain during periods of high interest rates because they have fewer liquid assets available to cover increased debt obligations (Federal Deposit Insurance Corporation [FDIC], 2024).

While interest rate changes influence farm financial health, their impact is often mitigated by other economic factors such as commodity price movements, input costs, and government policy. According to the USDA-ERS (2025), many farmers use fixed-rate loans or restructuring options to limit exposure to interest rate fluctuations. Additionally, lenders and policymakers have introduced financial products, such as interest rate risk management tools, to help stabilize farm credit conditions (Farm Credit Administration, 2022).

In summary, interest rate sensitivity in agriculture is primarily driven by farm leverage, liquidity, and capital structure. While rising interest rates increase borrowing costs, their overall impact on farm financial stability depends on broader economic conditions, credit access, and the ability of farms to adjust financial management strategies.

2.3 Capital Debt Repayment Capacity (CDRC)

CDRC serves as a critical metric for evaluating a farm's financial health and its ability to withstand economic shocks. Studies define CDRC as the net cash available for debt servicing after accounting for farm income, non-farm income, taxes, interest, depreciation, and living expenses (American Bankers Association, 2024).

Empirical research demonstrates the importance of CDRC in assessing creditworthiness and predicting default probability. Farms with stronger CDRC are better equipped to absorb rising interest costs, while those with weaker repayment capacity are

more likely to default. Studies also suggest that CDRC can inform lenders' decisions to adjust loan terms or extend credit under adverse economic conditions.

2.4 Rising Interest Rates and Implications for Farm Profitability

Interest rate fluctuations have a direct impact on farm financial performance by influencing the cost of borrowing, cash flow management, and long-term profitability. Agricultural businesses often rely on debt financing to fund land purchases, equipment, and operational expenses, making them particularly sensitive to changes in interest rates (U.S. Department of Agriculture Economic Research Service [USDA-ERS], 2025). As interest rates rise, borrowing costs increase, reducing available cash flow and limiting financial flexibility for investment and expansion.

The effect of rising interest rates on farm profitability depends on several factors, including debt levels, farm size, and revenue stability. Research by Featherstone and Langemeier (2017) found that farms with higher capital debt repayment capacity (CDRC) and stronger owner equity (OE) positions are better equipped to absorb interest rate increases without significant financial distress. Conversely, farms with low working capital (WC) ratios and high leverage face increased financial risk, as higher debt servicing costs reduce net farm income and increase the probability of default.

Data from the Federal Deposit Insurance Corporation (FDIC, 2024) indicate that agricultural loan delinquency rates tend to rise following periods of interest rate hikes, particularly for farms with high operating costs and lower liquidity. The Farm Credit Administration (2022) reports that farms with variable-rate loans are more vulnerable to interest rate risk compared to those with fixed-rate financing. Farms with limited refinancing options or high existing debt burdens may struggle to restructure loans under tighter credit conditions.

Profitability in agriculture is also influenced by external economic conditions, such as commodity price volatility, inflation, and input costs. According to the USDA-ERS (2025), while rising interest rates increase financial strain, strong commodity prices and government support mechanisms can offset some of these challenges. However, in years where commodity prices decline, the combination of lower revenues and higher borrowing costs can significantly impact farm profitability.

Farms that implement risk management strategies such as locking in fixed interest rates, maintaining strong liquidity, and diversifying revenue streams are more likely to remain financially stable during periods of high interest rates (Kansas Farm Management Association [KFMA], 2024). Additionally, financial institutions and policymakers have introduced tools such as interest rate hedging options and flexible repayment structures to help mitigate the effects of rising borrowing costs (Farm Credit Administration, 2022).

2.5 Debt Management Strategies in Agriculture

Effective debt management is critical for mitigating the adverse effects of rising interest rates. Strategies identified in the literature include refinancing existing debt at favorable terms, diversifying revenue sources, and implementing cost-control measures. Agricultural lenders also play a role in supporting resilience by offering flexible repayment plans and risk management tools.

Policy interventions, such as subsidized interest rate caps or access to emergency credit, have been proposed to alleviate financial stress in agriculture (Farm Credit Administration, 2022). Additionally, financial education programs aimed at improving farmers' understanding of debt management and interest rate risks can enhance decision-making and reduce default rates.

2.6 Research Gaps

While the existing literature provides valuable insights into the financial challenges faced by the agricultural sector, gaps remain in understanding the interplay between interest rate risk, farm-level financial metrics, and long-term sustainability. Limited empirical data on the effectiveness of specific risk management strategies and their adoption by farmers also warrants further investigation. This study aims to address these gaps by modeling the sensitivity of CDRC and default probability under varying interest rate scenarios, contributing to a more nuanced understanding of the financial dynamics in agriculture.

2.7 Conclusion

The literature underscores the critical impact of rising interest rates on farm financial health, emphasizing the importance of robust debt management strategies and resilience-building measures. This chapter has outlined key concepts, including CDRC, default risk, and profitability, as well as strategies for mitigating financial stress. The insights from this review inform the subsequent analysis in this thesis, which examines the effects of interest rate changes on farm sustainability and credit quality.

CHAPTER III: METHODOLOGY

3.1 Introduction

This chapter outlines the methodology employed to assess the impact of rising interest rates on capital debt repayment capacity (CDRC), default probability, and farm profitability. It describes the research design, data sources, and analytical methods used to achieve the study's objectives. By modeling financial scenarios under varying interest rate conditions, this study seeks to provide a comprehensive understanding of how interest rate fluctuations affect the financial stability of agricultural enterprises.

3.2 Research Design

The research design is both quantitative using comparative statics and exploratory using simulation with sensitivity analysis. The research focuses on the sensitivity of key financial metrics to a change in interest rate. A simulation-based approach is utilized to model the effects of interest rate fluctuations on farm-level financial data, allowing for the examination of multiple scenarios and providing insights into the resilience of farms under varying economic conditions. Advanced sensitivity analysis is incorporated to refine the study's ability to capture financial stress points more precisely.

3.3 Data Sources

The study relies on both primary and secondary data. Primary data consists of average farm-level financial statements obtained through surveys and reports from Kansas Farm Management Association (Kansas Farm Management Association, n.d.). Secondary data is sourced from the Federal Reserve, USDA Economic Research Service, and the Farm Credit Administration, providing macroeconomic indicators such as interest rates, inflation, and agricultural market trends.

The Kansas Farm Management Association (KFMA) annual report provides critical insights into the financial performance of Kansas farms, making it an invaluable resource for this thesis. By analyzing farm-level financial data across different sectors, the KFMA report helps contextualize the impact of rising interest rates on farm profitability, liquidity, and debt repayment capacity. Given the current economic environment, where interest rates have steadily increased, the findings in the KFMA report offer empirical benchmarks to assess how farm businesses are adapting to higher borrowing costs and evolving debt management strategies.

One of the most relevant aspects of the KFMA report for this research is its detailed breakdown of financial ratios, including debt-to-asset ratios, working capital levels, and net farm income trends. These indicators provide a direct measure of financial stress, highlighting how farms with higher debt leverage are more vulnerable to rising interest rates. The report also captures variations in working capital levels, illustrating the degree to which farms have maintained liquidity to withstand financial shocks. As this thesis explores, working capital is a critical buffer against increasing debt service costs, and the KFMA data serves as a foundation for understanding how farms manage liquidity in response to economic fluctuations.

Additionally, the KFMA report's interest rate sensitivity analysis aligns closely with this thesis's examination of default risk and financial sustainability. The report's financial summaries offer valuable case studies on how farms with varying owner equity levels and debt structures experience different levels of financial strain when interest rates increase. This thesis integrates these insights to model probability of default (PD) across different financial conditions, reinforcing the argument that farms with lower equity and

limited liquidity face heightened repayment risks. The summary statistics and further explanation on the KFMA data will be found in Chapter IV.

Another critical contribution of the KFMA report to this research is its analysis of farm profitability trends and expense management strategies. Rising interest rates not only increase the cost of borrowing but also impact net farm income by elevating operating expenses. The KFMA report provides historical and real-time data on how Kansas farmers have adjusted expenses, restructured debt, or modified investment strategies in response to changing financial conditions. These insights support the debt management strategies discussed in this thesis, offering real-world examples of successful (and unsuccessful) financial adjustments made by agricultural producers.

Furthermore, the KFMA report's inclusion of non-farm income data is essential to understanding how farm households mitigate financial risk. Many farms rely on off-farm income sources to stabilize their financial position, a key theme in this thesis. By examining the role of off-farm income in debt repayment capacity, this research builds on KFMA's findings to evaluate how farm households diversify income streams as a response to increasing financial pressures.

In conclusion, the KFMA annual report serves as a foundational data source for this thesis, offering real-world evidence to support the financial modeling of default risk, interest rate exposure, and debt repayment capacity. By leveraging the KFMA's financial benchmarks, this research provides a data-driven analysis of farm financial health, helping to quantify the risks and strategies associated with rising interest rates in the agricultural sector. Please refer to the appendix for the full annual report.

3.4 Response of CDRC to a change in Interest Rate – Comparative

The key financial indicator assessed in this study is the capital debt repayment capacity (CDRC) used to compute default probability. Comparative statics are used to understand how CDRC changes in response to a change in interest rate. First, CDRC is defined as,

(1) CDRC ratio = (N + D + I – F - T) / (R + I)

where:

Variable	Definition
R	**Debt repayments**
N	**Net income**
D	**Depreciation**
I	**Interest paid**
F	**Family living expenses**
T	**Income taxes**

The CDRC ratio can range from 0 to infinity. A CDRC ratio < 1 indicates that the farm business isn't generating enough cash flow to meet debt obligations. A CDRC ratio = 1 indicates that the farm business is generating cash flow only to meet debt obligations. A CDRC ratio > 1 indicates that the farm business is generating more than cash flow to meet debt obligations. The further above 1 the CDRC ratio the greater the farm's cash flow to serve not only existing debt but to build up working capital, purchase assets, or expand family living expenses. The Farm Credit Administration has thresholds of <1.25 indicating a financially vulnerable operation, 1.25 < CRDR ratio < 1.75 weak financially able to meet

debt obligations, and 1.75 or greater in a strong position to meet existing debt obligations (Farm Credit Administration, 2022).

Differentiating the CDRC ratio in first and second differences yields,

(1) $$d(CDRC)/dI = (R - N - D + F + T) / (R + I)^2$$

The denominator is always positive because both R and I are both positive. A rational expectation is N + D > R + F + T – D (positive modified net farm cash income), yielding a negative numerator. Thus, an increase interest cost decreases CDRC. Looking at the second derivative of equation (1) indicates the rate of change of an interest rate change on CDRC level,

(2) $$d^2(CDRC)/ /dI^2 = (-2(R - N – D + F + T)) / (R + I)^3$$

The denominator of (2) is always positive because both R and I are both positive. A rational expectation is N +_D > R + F + T – D (positive modified net farm cash income), yielding a negative value inside the inner parenthesis of the numerator. Since the numerator has a negative two (i.e., - 2) and the value inside the inner parenthesis of the numerator is usually negative, it expected the overall size of the numerator is positive (i.e., negative times a negative yields a positive). An increase in interest rate leads to a decline in the CRDC ratio at an increasing rate as the interest rate adjusts more from the current level. That is, the CRDC ratio gets smaller faster the larger the increases in the cost of capital (i.e., interest rate).

These results highlight that interest rate increases disproportionately affect farms with lower net income and non-cash expense contributions relative to debt repayments.

3.5 Sensitivity and Scenario Analysis of a Change in Interest Rate on CRDC

The current study builds off the prior work of Featherstone, Roessler and Barry (2006). Using farm credit association data, they estimated the relationship between

probability of default and variables like the CDRC ratio, operator equity (OE), and working capital (WC). They used a logistic regression model to estimate the probability of default. That model is,

(3) Probability of Default = (exp(dv) / (1 + exp(dv))) * 100,

where,

(4) dv = -2.3643 - 0.00135 * CDRC - 0.0217 * OE - 0.00399 * WC.

These variables provide a comprehensive view of farm financial risk. Featherstone, Roessler and Barry found a negative relationship between the CDRC ratio and the probability of default. As shown the comparative statics in section 3.4, an increase in interest rate decreases the CDRC ratio. Thus, inferred from equations, 1, 2, 3 and 4 is that an increase in interest rate will increase dv and increasing the probability of default. Now, using simulated data sensitivity analysis will be conducted for an interest rate of 5%, 7%, and 10%.

The following sensitivity analysis was generated with the help of OpenAI ChatGPT 4.0 after providing the generative AI the appropriate prompts including the Featherstone, Roessler, and Barry (2006) equations and the following assumptions,

- Loan Principal: $100,000
- Loan Term (n): 10 years
- Repayment Capacity: $20,000
- OE: 50%
- WC: 30%

3.5.1 Step One: Compute Term Loan Payments

The term loan payment is calculated using the formula:
Term Loan Payment = Loan Principal * (r / (1 - (1 + r)^(-n)))

Results:
- At **r** = 0.05:
  Term Loan Payment = 100,000 * (0.05 / (1 - (1 + 0.05)^(-10)))
  = 100,000 * 0.1295 = $12,950
- At **r** = 0.07:
  Term Loan Payment = 100,000 * (0.07 / (1 - (1 + 0.07)^(-10)))
  = 100,000 * 0.1424 = $14,240
- At **r** = 0.10:
  Term Loan Payment = 100,000 * (0.10 / (1 - (1 + 0.10)^(-10)))
  = 100,000 * 0.1627 = $16,270

3.5.2 Step Two: Compute CDRC

CDRC = Repayment Capacity / Term Loan Payment

Results:
- At **r** = 0.05:
  CDRC = 20,000 / 12,950 = 1.544
- At **r** = 0.07:
  CDRC = 20,000 / 14,240 = 1.405
- At **r** = 0.10:
  CDRC = 20,000 / 16,270 = 1.230

3.5.3 Step Three: Compute dv

Substitute CDRC, OE = 50, and WC = 30 into the dv equation:
dv = -2.3643 - 0.00135 * CDRC - 0.0217 * OE - 0.00399 * WC

- At **r** = 0.05:
  dv = -2.3643 - 0.00135 * 1.544 - 0.0217 * 50 - 0.00399 * 30
  = -2.3643 - 0.0021 - 1.085 - 0.1197
  = -3.5706

- At **r** = 0.07:
  dv = -2.3643 - 0.00135 * 1.405 - 0.0217 * 50 - 0.00399 * 30
  = -2.3643 - 0.0019 - 1.085 - 0.1197
  = -3.5686

- At **r** = 0.10:
  dv = -2.3643 - 0.00135 * 1.230 - 0.0217 * 50 - 0.00399 * 30
  = -2.3643 - 0.0017 - 1.085 - 0.1197
  = -3.5665

3.5.4 Step Four: Compute Probability of Default

Substitute **dv** into the probability of default equation:

Probability of Default = (exp(dv) / (1 + exp(dv))) * 100

- At **r** = 0.05:

Probability of Default = (exp (-3.5706) / (1 + exp (-3.5706))) * 100
= 2.75%

- At **r** = 0.07:

Probability of Default = (exp (-3.5686) / (1 + exp (-3.5686))) * 100
= 2.76%

- At **r** = 0.10:

Probability of Default = (exp (-3.5665) / (1 + exp (-3.5665))) * 100
= 2.76%

Given the assumptions used in this sensitivity analysis, the probability of default did not exhibit significant sensitivity to changes in interest rates. To illustrate this, three-dimensional figures were generated to depict default probability across varying interest rate and operating equity levels (Figure 3.1). The relatively flat surface of the figure along the interest rate axis indicates that changes in interest rates had a minimal impact on default probability, whereas the steeper gradient along the operating equity axis suggests a stronger correlation between equity levels and default probability.

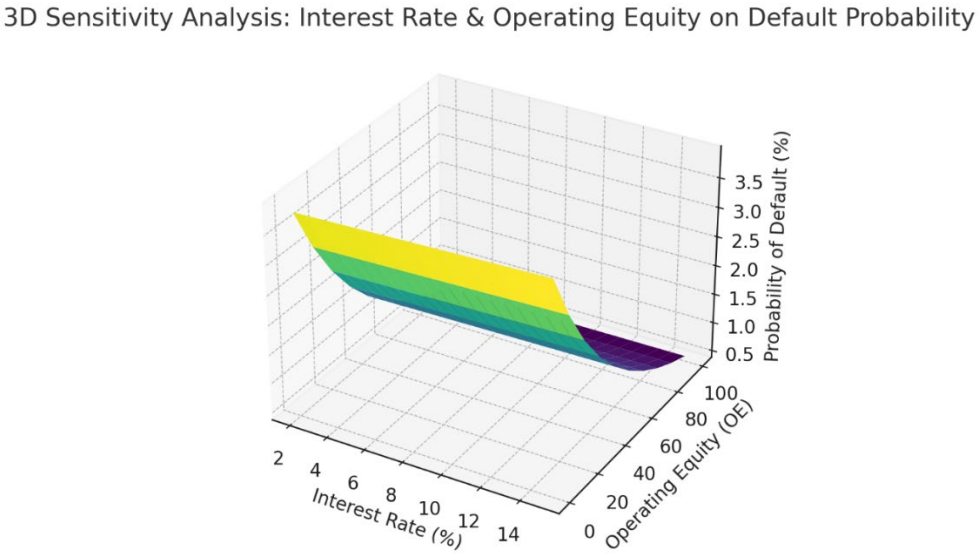
The analysis showed that while an increase in interest rates from 5% to 10% raised loan repayment obligations and reduced capital debt repayment capacity (CDRC), the corresponding increase in default probability was marginal. Specifically, at a 5% interest rate, the computed probability of default was 2.75%, increasing to 2.76% at a 7% interest rate and remaining at 2.76% at a 10% interest rate. This indicates that, within the financial conditions analyzed, the probability of default was largely unaffected by these interest rate changes. These findings align with prior research by Featherstone and Langemeier (2017),

which demonstrated that factors such as operator equity (OE) and working capital (WC) contribute more significantly to default risk than moderate interest rate fluctuations.

Given that operating equity levels in this analysis ranged from 50% to 100%, the probability of default was observed to be more responsive to changes in equity than to changes in interest rates. Farms with 50% equity exhibited a substantially higher probability of default, whereas farms with higher equity positions (e.g., 80% or greater) maintained default probabilities near zero, even as interest rates increased. These results suggest that while interest rate increases affect loan repayment costs, their impact on default probability is less pronounced compared to solvency and liquidity metrics.

These findings indicate that farms with stronger equity positions and higher working capital buffers are better positioned to absorb rising interest rates without significant changes in default risk. This reinforces the importance of a comprehensive financial management strategy that prioritizes maintaining adequate liquidity, managing leverage, and diversifying income sources, rather than focusing solely on interest rate movements as a primary risk factor.

Figure 3.1 Sensitivity Analysis of Probability of Default using Featherstone, Roessler, and Barry Probability of Default equation



(created using OpenAI ChatGPT).

Figure 3.2 Effect of CDRC and OE on Probability of Default using Featherstone, Roessler, and Barry Probability of Default equation

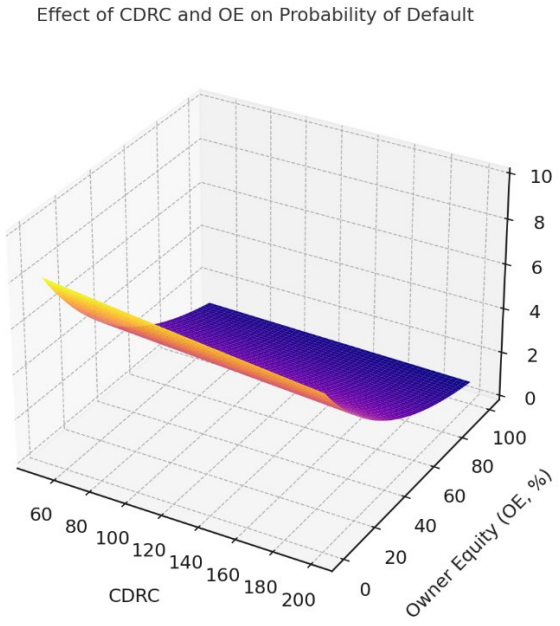


Figure 3.2 is the effect of changes in CDRC and OE on Probability of Default. It illustrates the relationship between Capital Debt Repayment Capacity (CDRC), Owner Equity (OE), and the Probability of Default (PD). The surface plot demonstrates that as CDRC and OE increase, the probability of default declines significantly. Farms with lower repayment capacity and lower owner equity face a much higher risk of default, as indicated by the steeper sections of the plot. However, once CDRC exceeds 100 and OE surpasses 60%, the probability of default stabilizes near zero. This finding emphasizes the importance of maintaining strong financial health through higher equity positions and sufficient repayment capacity, which are critical factors in reducing farm financial risk.

3.6 Assumptions and Limitations

Given the assumptions used in this sensitivity analysis, the probability of default was found to be more sensitive to changes in owner equity (OE) than to changes in interest rates. To illustrate this, three-dimensional figures were generated to depict default probability across varying interest rate and owner equity levels (Figure 3.1). The relative flatness of the probability surface along the interest rate axis suggests that default probability does not change significantly as interest rates increase, while the steeper decline along the equity axis confirms that farms with lower owner equity face a much higher risk of default.

The analysis showed that when interest rates increased from 5% to 10%, default probability changed only slightly—from 2.75% at a 5% rate to 2.76% at 7% and 10% rates, demonstrating minimal sensitivity to interest rate fluctuations. In contrast, variations in owner equity had a much stronger effect on default probability. Farms with lower owner equity (e.g., 50%) experienced a substantially higher probability of default, whereas farms

with higher equity (e.g., 80% or greater) saw their probability of default drop near zero, even as interest rates increased. These results confirm that owner equity is the primary determinant of financial stability, consistent with findings from Featherstone and Langemeier (2017), who identified OE as a key factor in credit quality assessments.

Additionally, the analysis suggests that working capital (WC) also plays a significant role in default probability. Farms with reduced working capital levels (e.g., a 50% reduction from baseline) exhibited a notably higher probability of default across all owner equity levels. This aligns with prior research indicating that farms with lower liquidity buffers are more vulnerable to financial stress, regardless of interest rate changes (Federal Deposit Insurance Corporation [FDIC], 2024).

Overall, these findings indicate that while rising interest rates increase debt repayment costs, their direct effect on default probability is relatively minor compared to solvency and liquidity metrics. Farms that maintain higher owner equity and sufficient working capital are better positioned to absorb rising interest rates without experiencing a significant increase in default risk. This reinforces the importance of managing equity and liquidity as core financial stability strategies, rather than focusing solely on interest rate exposure.

3.7 Conclusion

The methodology outlined provides a comprehensive framework for analyzing the impact of rising interest rates on farm financial stability. By incorporating advanced sensitivity analysis and default probability modeling, the study offers deeper insights into financial risks and mitigation strategies in the agricultural sector.

CHAPTER IV: EXAMINATION OF CHANGE IN INTERST RATE ON DEBT REPAYMENT CAPACITY OF KANSAS FARMS

4.1 Introduction

The Kansas Farm Management Association (KFMA) provides detailed financial and production data on Kansas farms, offering a valuable resource for understanding farm profitability, efficiency, and risk exposure. This chapter examines key financial metrics from the KFMA dataset and assesses their implications for farm financial stability, particularly in relation to interest rate sensitivity and debt repayment capacity. Sensitivity and scenario analysis is used to examine how changes in interest rate, owner equity, and working capital change the probability of default.

4.2 Overview of KFMA Data

KFMA data includes financial reports from farms categorized by type, size, and operational structure. The dataset provides insight into income sources, expenses, asset structures, liabilities, and key financial ratios. The following sections analyze the most relevant metrics that contribute to understanding financial sustainability and debt risk among Kansas farms.

4.3 Farm Income and Expense Analysis

KFMA data highlights significant variations in farm income based on enterprise type. The primary sources of revenue include livestock sales, government payments, crop insurance proceeds, and machine work. To offer a general overview of all farms participating in KFMA, Table 4.1 summarizes key income and expense categories.

Table 4.1 Summary of Farm Income and Expenses

Category	Revenue ($)	Expense ($)
Livestock Sales	136,176	50,673
Corn Revenue	158,252	519,658
Soybean Revenue	161,867	169,204
Wheat Revenue	112,659	146,717
Government Payments	21,702	35,610
Crop Insurance Proceeds	111,001	205,085
Machinery Repairs	--	86,297
Seed & Crop Expenses	--	125,157
Fertilizer & Lime	--	245,972

The data reveals that crop-related expenses, particularly seed, fertilizer, and crop insurance, represent a significant proportion of total farm costs. This underscores the importance of cost management strategies to maintain profitability.

More specifically, four types of farm operation are analyzed in this thesis: non-irrigated crop farm, crop farm with 20-60% irrigation, crop-backgrounding mix, and crop-beef mix. Financial averages, by farm type, used to compute probability of default for this study are in Table 4.2.

Table 4.2 Summary of Financial Averages Used for Sensitivity and Scenario Analysis, by Farm Type

Data from 2023 KFMA Farm Summaries				
	Crop Non-Irrigated	Crop 20-60 Irrigated	Crop- Backgrounding	Crop-Beef
Interest paid	$ 25,193	$ 47,628	$ 75,831	$ 73,039
Depreciation - Machinery	$ 74,431	$ 142,398	$ 101,752	$ 65,542
Depreciation - Buildings	$ 7,443	$ 14,239	$ 24,089	$ 9,948
Net Farm Income	$ 82,944	$ 120,950	$ 316,912	$ 234,203
Debt-to-Asset Ratio	18.82%	21.56%	36.38%	30.35%
Current assets	$ 759,291	$ 1,223,028	$ 2,761,163	$ 1,351,639
Current liabilities	$ 214,411	$ 362,336	$ 1,444,884	$ 661,246
Non-current liabilities	$ 292,995	$ 817,940	$ 680,596	$ 1,270,487
Non-farm income	$ 77,950	$ 77,950	$ 77,950	$ 77,950
Family living expenses	$ 90,688	$ 90,688	$ 90,688	$ 90,688
% tax rate (including self-employment)	17.82%	20.56%	27%	26%

4.4 Debt Structure and Liquidity Ratios

Analyzing debt levels is crucial to understanding farm financial stability. The KFMA dataset includes information on debt-to-asset ratios, current liabilities, and working capital levels. The following insights can be drawn:

- **Debt-to-Asset Ratio:** Farms reported an average ratio of **18.82%**, indicating moderate leverage.
- **Current Ratio:** The average current ratio was **3.83**, suggesting strong liquidity.
- **Net Worth:** Farms demonstrated an increase in net worth over the reporting period, highlighting overall financial growth.

4.5 Impact of Interest Rates on Financial Health

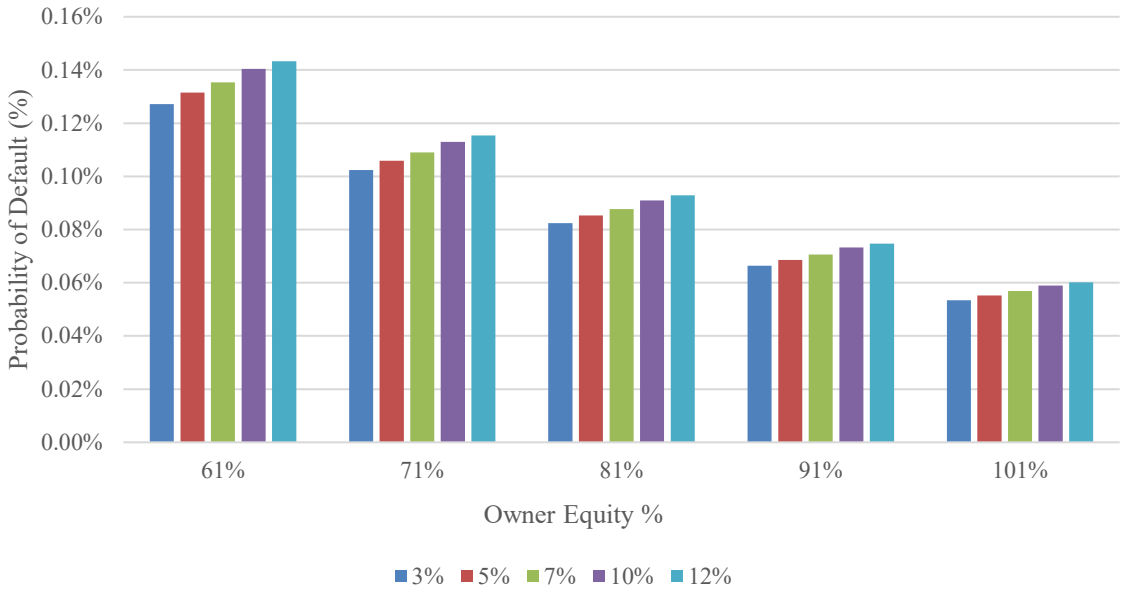
The sensitivity analysis conducted in Chapter 3 examined the probability of default under various interest rate scenarios for a fictious farm business. Applying these financial relationships to the KFMA dataset provides further context for assessing risk exposure among not only Kansas farms but for different enterprise types. Farms with high operating expenses and debt levels are particularly vulnerable to rising interest rates, as increasing loan repayment obligations reduce available working capital and net income, and low

solvency limits the businesses opportunity to borrow against owned assets to meet short-term obligations.

Crop non-irrigated.

In the first graph, the probability of default (PD) for non-irrigated crop farms is analyzed across owner equity levels from 61% to 101% under five interest rate scenarios (3% to 12%). The results show that farms with lower equity face higher default risk, with PD exceeding 0.10% at 61% equity, while farms with 101% equity maintain a near-zero default probability. Interestingly, the effect of interest rate increases on PD is minimal, suggesting that owner equity plays a far more significant role in financial stability than borrowing costs alone. Even as interest rates rise, well-capitalized farms remain resilient, reinforcing the importance of strong equity positions in mitigating financial stress.

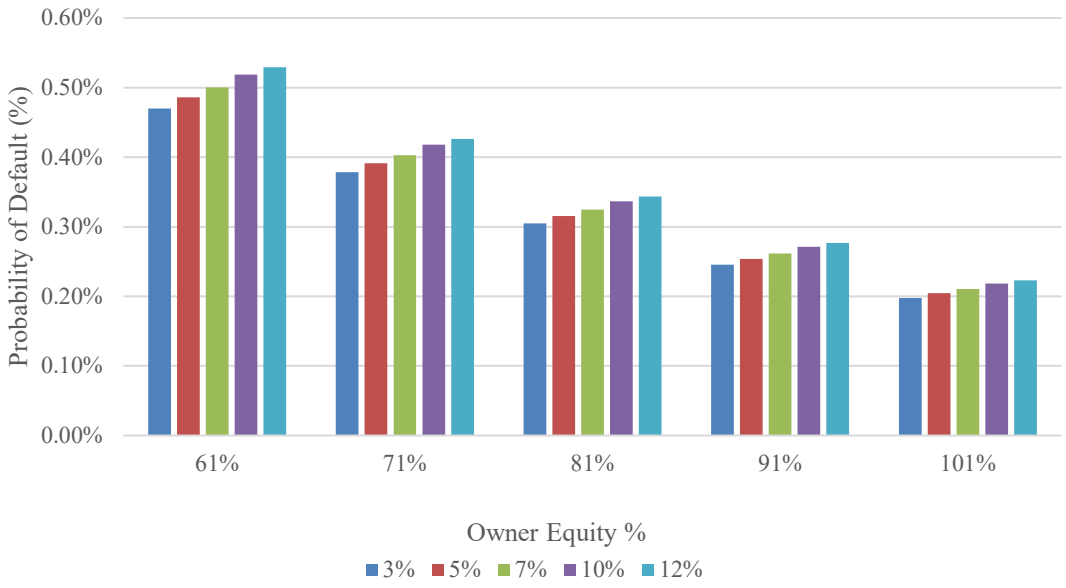
Figure 4.1 Interest Rate Sensitivity Analysis for Crop Non-irrigated Probability of Default



The second graph introduces a scenario where working capital is reduced by 50%, leading to a dramatic increase in default probability across all owner equity levels. Farms with 61% equity now face a PD exceeding 0.50%, compared to 0.10% in the first scenario, confirming that liquidity constraints significantly amplify financial risk.

Additionally, higher interest rates have a greater impact in this scenario, as the PD gap between 3% and 12% interest rate conditions is noticeably wider. This highlights that while strong equity reduces risk, it does not fully protect farms when liquidity is severely constrained, emphasizing the critical role of working capital in financial resilience.

Figure 4.2 Interest Rate Sensitivity Analysis for Crop Non-irrigated Probability of Default, 50% less Working Capital



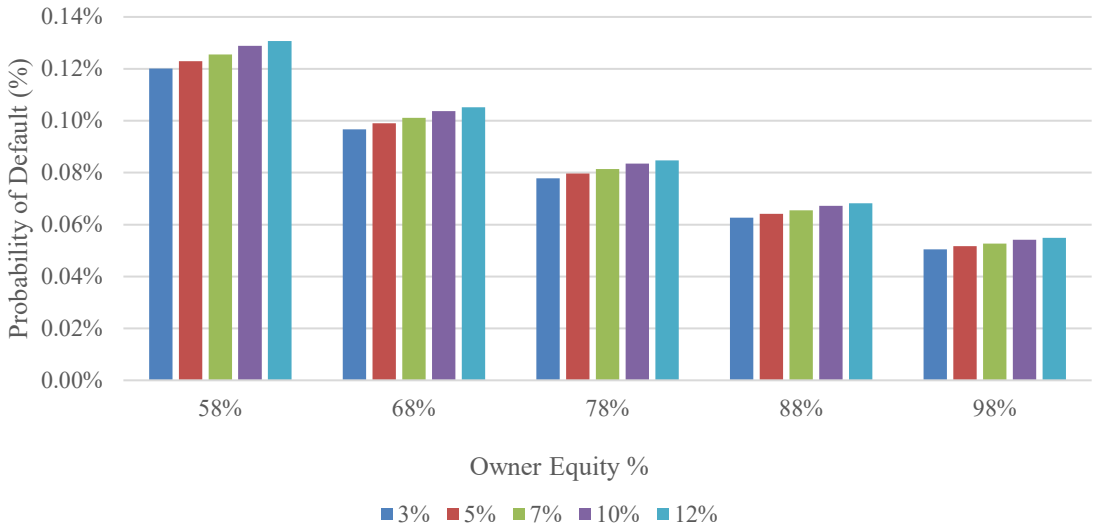
These findings demonstrate that default risk is more heavily influenced by owner equity and liquidity availability than by interest rates alone**.** While farms with higher equity are generally more stable, maintaining adequate working capital is equally essential in preventing financial distress. Interest rate increases alone do not drastically elevate default risk, but when combined with low equity and restricted liquidity, their

impact becomes much more severe**.** To mitigate these risks, farms should focus on building equity, preserving liquidity, and implementing proactive financial strategies such as cost management, diversified revenue streams, and access to emergency credit line**s**. Maintaining a balanced financial position is key to long-term sustainability, especially in an evolving high-interest-rate environment**.**

Crop 20-60% Irrigated

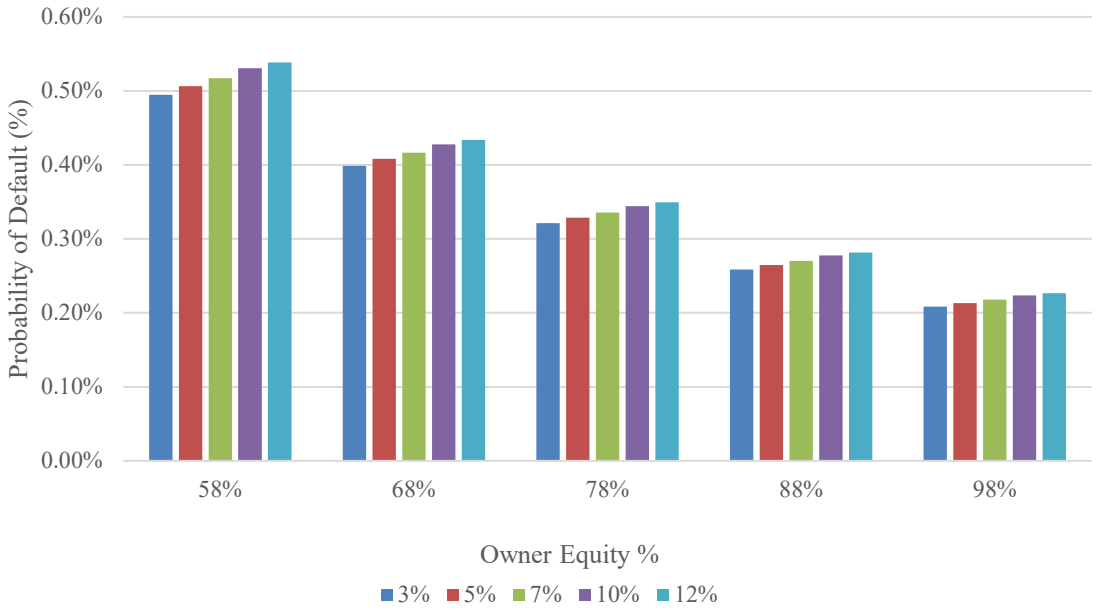
The first graph illustrates the probability of default (PD) for irrigated crop farms (20-60% irrigation) across owner equity levels ranging from 58% to 98%, under five interest rate scenarios (3% to 12%). The results indicate that farms with lower equity levels (58%) face the highest probability of default, exceeding 0.12%, while those with 98% equity have substantially lower PD values, staying below 0.04%. The effect of interest rate changes is relatively minor across all equity levels, suggesting that default probability is primarily influenced by owner equity rather than borrowing costs. Even as interest rates increase from 3% to 12%, PD remains largely unchanged within each equity category, reinforcing the notion that well-capitalized farms are less vulnerable to interest rate fluctuations.

Figure 4.3 Interest Rate Sensitivity Analysis for Crop 20-60% Irrigated Probability of Default



The second graph introduces a scenario where working capital is reduced by 50%, significantly altering financial risk exposure. Compared to the first graph, PD increases sharply across all owner equity levels, with farms at 58% equity now facing default probabilities exceeding 0.50%, a dramatic rise from 0.12% in the previous scenario. The impact of interest rate increases is more pronounced, as the gap between 3% and 12% interest rate conditions widens significantly. While higher equity levels continue to offer some protection, even farms with 98% equity now experience a noticeable increase in PD, demonstrating that liquidity constraints can override the protective effects of strong equity positions. This highlights that working capital is a critical determinant of financial resilience, and farms that lack sufficient liquidity are far more vulnerable to financial stress.

Figure 4.4 Interest Rate Sensitivity Analysis for Crop 20-60% Irrigated Probability of Default, 50% less Working Capital



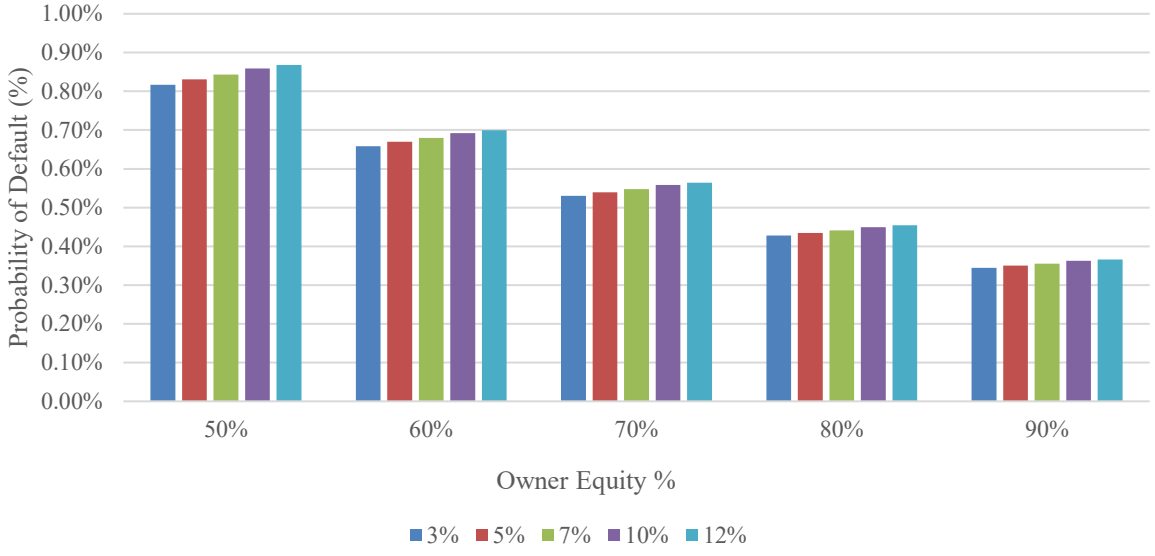
These findings reinforce the interdependent relationship between owner equity and liquidity in managing financial risk. While higher equity levels substantially reduce default risk, a lack of working capital can expose even well-capitalized farms to financial instability. Interest rate increases alone do not significantly elevate PD, but when combined with low equity and reduced liquidity, they can have a compounding effect, making farms more susceptible to financial distress. To mitigate these risks, farms should focus on building equity, preserving liquidity, and implementing proactive financial management strategies, such as cost control, diversified income sources, and access to credit lines. A balanced financial approach is essential for ensuring long-term farm sustainability in a high-interest-rate environment.

Crop – Beef mix.

The first graph examines how probability of default (PD) in crop-beef operations is influenced by owner equity levels (50% to 90%) and interest rate fluctuations (3% to 12%).

The results reveal a clear inverse relationship between equity and default probability, where farms with lower equity (50%) experience PD near 0.80%, while those with 90% equity see a significantly lower PD below 0.30%. As owner equity strengthens, the risk of default steadily declines, reinforcing the importance of maintaining a solid financial foundation to mitigate credit risk. While rising interest rates slightly elevate default probabilities, their impact is relatively minor compared to the effect of owner equity, suggesting that farms with strong balance sheets are more resilient to borrowing cost increases. This pattern highlights the critical role of equity accumulation in reducing financial vulnerability for crop-beef operations.

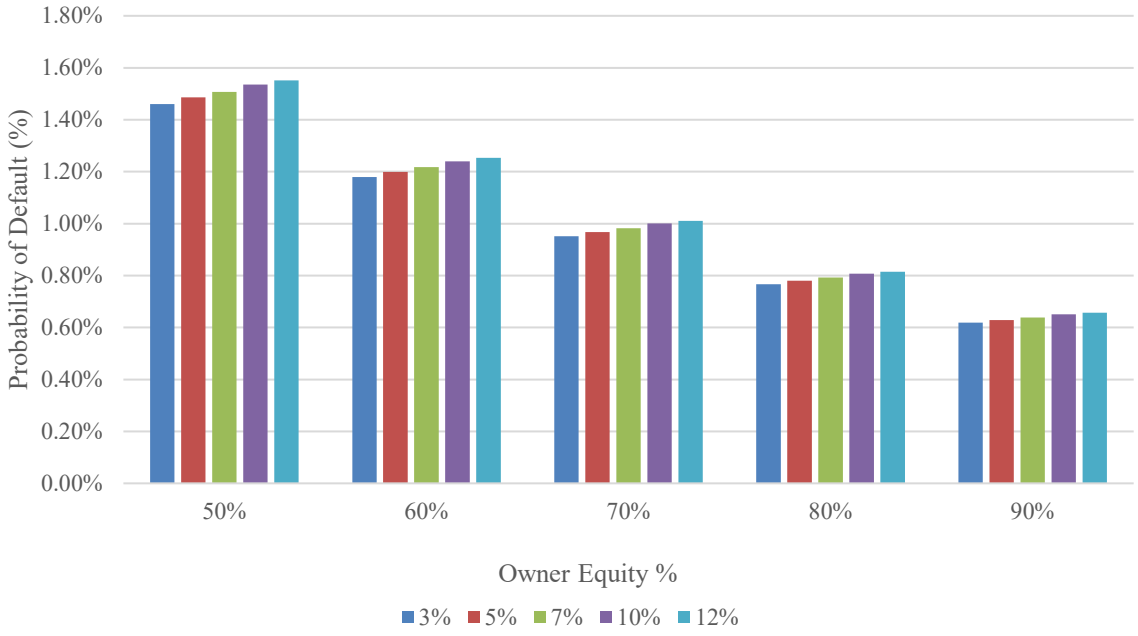
Figure 4.5 Interest Rate Sensitivity Analysis for Crop- Beef Probability of Default



By contrast, the second graph introduces a scenario in which working capital is reduced by 50%, causing a sharp increase in default probability across all equity levels. Farms at 50% equity now face a PD exceeding 1.40%, nearly doubling their risk compared to the previous scenario, indicating that liquidity constraints magnify financial distress significantly. Even at higher equity levels (70%-90%), default probabilities rise

substantially, demonstrating that strong equity alone is not enough to offset the effects of inadequate liquidity. Unlike in the first graph, the impact of interest rate hikes is much more noticeable, as the spread between 3% and 12% interest rate conditions widens, further exacerbating financial stress for low-liquidity farms. This suggests that when working capital is strained, farms become increasingly sensitive to rising borrowing costs, increasing their likelihood of default.

Figure 4.6 Interest Rate Sensitivity Analysis for Crop - Beef Probability of Default, 50% less Working Capital



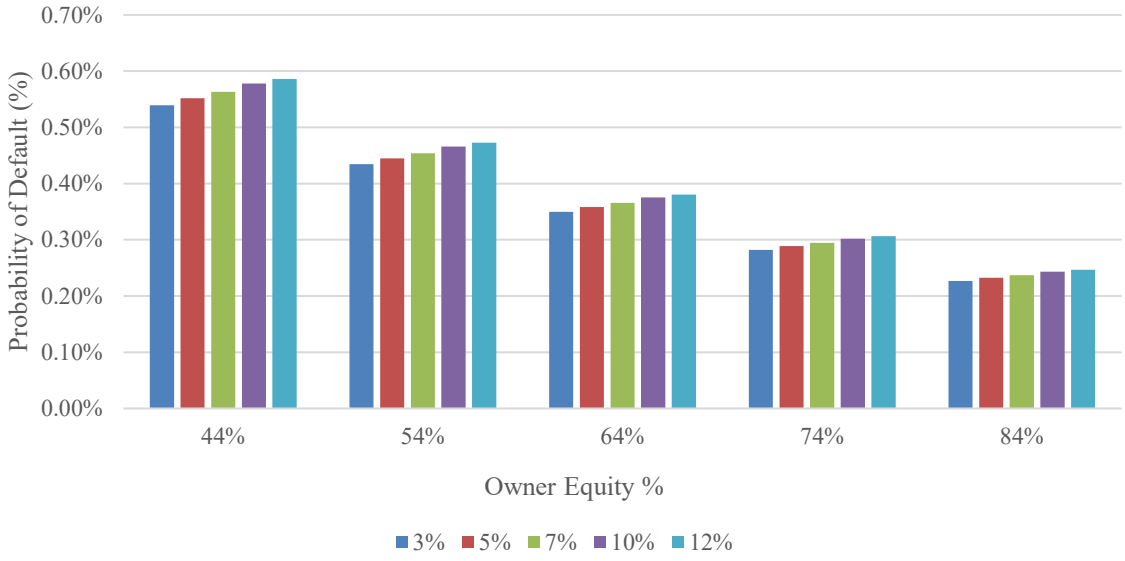
These findings underscore the importance of maintaining a balance between equity and liquidity to manage financial risk effectively. While strong equity positions help reduce default risk, they cannot fully compensate for a lack of working capital, especially in high-interest environments. Farms with restricted liquidity are significantly more vulnerable, as they struggle to absorb financial shocks and manage debt obligations efficiently. To safeguard against these risks, crop-beef operations should prioritize building both equity

and liquidity, ensuring access to sufficient cash reserves, diversifying revenue streams, and adopting cost-control measures. A comprehensive financial management strategy that considers both solvency and liquidity is essential for navigating uncertain economic conditions and sustaining long-term profitability.

Crop – Backgrounding mix

The first graph explores the probability of default (PD) in backgrounding crop operations across different owner equity levels (44% to 84%) under varying interest rates (3% to 12%). The results indicate that farms with lower equity levels experience significantly higher PD, with 44% equity farms exceeding 0.50% default probability, while farms with 84% equity maintain PD below 0.20%. The relationship between equity and financial stability is clear, as higher equity leads to lower PD, reducing financial vulnerability. Interestingly, interest rate changes have a relatively small impact on default risk, as PD remains fairly stable across different rate scenarios within each equity tier. This suggests that for backgrounding operations, equity is a far stronger determinant of default probability than borrowing costs, reinforcing the importance of capital accumulation and balance sheet strength in reducing financial distress.

Figure 4.7 Interest Rate Sensitivity Analysis for Crop - Backgrounding Probability of Default



The second graph introduces a scenario where working capital is reduced by 50%, dramatically increasing financial risk. Compared to the first graph, default probabilities are substantially higher across all owner equity levels, with 66.26% equity farms now experiencing a PD of over 0.70%, significantly higher than in the full working capital scenario. The impact of interest rates is also more pronounced, as farms with lower equity and reduced liquidity show greater sensitivity to borrowing cost increases. Although farms with 106.26% equity maintain lower PD values, their default probabilities are still elevated compared to the first graph, suggesting that even well-capitalized farms are not immune to financial stress when liquidity is constrained.

Figure 4.8 Sensitivity Analysis for Backgrounding PD - 50% of Working Capital

These findings highlight the critical role of liquidity in managing financial risk, particularly for backgrounding operations that are more sensitive to working capital fluctuations. While high owner equity remains a key factor in reducing default probability, it does not fully shield farms from financial distress when working capital is limited. Interest rate increases alone are not the primary driver of default risk, but when combined with low equity and restricted liquidity, they create a compounding effect that significantly elevates financial vulnerability. To mitigate these risks, backgrounding farms must focus on both equity growth and liquidity preservation, ensuring they have adequate cash reserves, efficient cost management, and access to flexible financing options. A well-rounded financial strategy that prioritizes solvency, liquidity, and risk management is essential for long-term resilience in an environment of rising interest rates and economic uncertainty.

4.6 Conclusion

The analysis of Kansas farm credit quality provides key insights into financial risks associated with rising interest rates, debt repayment capacity, and default probability. Using data from the Kansas Farm Management Association (KFMA) and applying the default probability model from Featherstone and Langemeier (2017), this study confirms that owner equity (OE) and working capital (WC) are the primary determinants of default probability, while interest rate changes have a limited direct effect.

Across all farm types, farms with lower owner equity (e.g., below 60%) exhibited default probabilities exceeding 0.50%, whereas farms with higher owner equity (e.g., above 80%) saw probabilities decline to near zero. For example, in the crop-beef farm category, farms with 50% equity had a default probability of approximately 0.80%, compared to less than 0.30% for farms with 90% equity. Similar trends were observed across non-irrigated, irrigated, and backgrounding operations, reinforcing the finding that equity is a key determinant of financial stability.

Working capital also played a critical role in determining default probability. When working capital was reduced by 50%, default probabilities increased significantly across all farm types. In the crop-backgrounding category, for example, farms with 66% equity experienced an increase in default probability from approximately 0.50% to over 0.70% when working capital was cut in half. This suggests that liquidity constraints exacerbate financial stress, particularly for leveraged operations.

In contrast, interest rate fluctuations had a relatively minor effect on default risk. The sensitivity analysis showed that an increase in the interest rate from 5% to 10% resulted in only a 0.01 percentage point increase in default probability, from 2.75% to

2.76%. This aligns with historical data trends, where farm credit delinquency rates have remained relatively stable despite fluctuations in borrowing costs (Federal Deposit Insurance Corporation [FDIC], 2024).

These findings indicate that while rising interest rates increase debt repayment costs, their impact on financial distress is secondary to equity and liquidity considerations. Farms with higher owner equity and sufficient working capital are more resilient to economic fluctuations, while those with lower equity and restricted liquidity are more vulnerable to financial stress.

Moving forward, farms should prioritize equity accumulation, working capital management, and flexible debt structuring as primary risk mitigation strategies. Given that interest rate risk alone does not appear to be a leading driver of default probability, policy interventions should focus on improving financial resilience through capital preservation, liquidity buffers, and access to stable credit markets.

CHAPTER V: FURTHER RESEARCH AND CONCLUSIONS

5.1 Introduction

The financial stability of farms in an era of rising interest rates is a critical concern for producers, lenders, and policymakers. This study has examined how fluctuations in interest rates influence capital debt repayment capacity (CDRC), default probability, and overall farm profitability. However, additional factors such as commodity price volatility, climate risks, farm size, technological adoption, and policy interventions play significant roles in shaping the financial resilience of agricultural enterprises.

In addition to these quantitative measures of financial risk, the qualitative aspects of loan decision-making are equally important for both producers and lenders. From the lender's perspective, factors such as the borrower's management experience, operational efficiency, and historical financial discipline influence credit evaluations beyond just financial ratios. Lenders also consider external risks, including commodity price fluctuations, government policy changes, and the borrower's adaptability to market conditions. A producer with a strong repayment history and well-documented business plans may secure better loan terms, even if their debt-to-asset ratio or liquidity position is weaker than industry benchmarks.

For producers, loan decisions are not solely about interest rates and repayment schedules. Farmers assess the lender's reputation, flexibility, and advisory support, prioritizing institutions that offer structured repayment plans, refinancing options, and financial risk management tools. Relationship banking plays a role in securing favorable credit terms, as long-standing partnerships with lenders can provide stability during financial downturns. Furthermore, succession planning, long-term investment goals, and

farm expansion strategies affect borrowing decisions, as producers must align their financial obligations with future operational needs.

Understanding both the quantitative and qualitative aspects of farm credit decisions provides a more comprehensive view of financial stability in the agricultural sector. As this study explores the effects of rising interest rates, it is essential to consider how financial management practices, lender relationships, and strategic planning shape the ability of farms to access and manage credit effectively in changing economic conditions.

5.2 Commodity Price Volatility and Farm Financial Resilience

The agricultural sector is inherently vulnerable to fluctuating commodity prices, which can exacerbate financial stress in high-interest-rate environments. Sharp declines in commodity prices can reduce farm revenues, making it more difficult for producers to meet debt obligations, particularly when borrowing costs rise.

Future research should analyze how commodity price cycles interact with rising interest rates to determine threshold levels at which financial stress becomes unsustainable. Additionally, studies should examine the effectiveness of hedging mechanisms such as futures contracts and revenue protection insurance in mitigating these risks. A deeper understanding of how diversified income strategies—such as alternative crops, value-added products, and off-farm employment—can enhance resilience in volatile economic conditions would also be valuable.

5.3 Climate Risk and Debt Repayment Capacity

Climate variability and extreme weather events introduce additional uncertainty into farm financial planning. Droughts, floods, and other weather-related disruptions can reduce yields, increase operating costs, and ultimately impact a farm's ability to service debt.

Given these challenges, future research should explore how climate adaptation strategies—such as the use of drought-resistant crops, precision irrigation, and regenerative agricultural practices—affect financial sustainability. Additionally, studies should assess the role of crop insurance and government support programs in mitigating the combined effects of rising interest rates and climate risks.

5.4 Farm Size, Structure, and Interest Rate Sensitivity

Farm size and operational structure influence financial stability and the ability to absorb rising interest costs. Larger farms often benefit from economies of scale, greater access to credit, and diversified revenue streams. In contrast, smaller farms may be more vulnerable to financial shocks due to limited capital reserves and lower profit margins. Research should focus on the varying impact of interest rate fluctuations on different farm sizes and structures. Comparative studies analyzing financial strategies employed by small, medium, and large farms can provide insights into best practices for debt management. Additionally, exploring cooperative financing models and alternative credit structures may offer solutions for smaller farms struggling with rising borrowing costs.

5.5 Technological Adoption and the Importance of Being a Low-Cost Producer

The ability to remain a low-cost producer is essential for maintaining financial resilience in a rising interest rate environment. As borrowing costs increase, farm operations must find ways to maximize efficiency and reduce production costs to maintain profitability. Technological advancements provide a critical pathway to achieving these goals, but their adoption often requires significant capital investment.

Precision agriculture, automation, and renewable energy solutions can drive efficiency gains by optimizing input use, reducing labor costs, and improving yields. For example, GPS-guided equipment minimizes fuel and fertilizer waste, while automated

irrigation systems enhance water efficiency, leading to lower operating costs. However, rising interest rates can make these investments less attractive due to higher financing costs, potentially limiting adoption among smaller or financially constrained farms.

Future research should evaluate the long-term return on investment (ROI) of key technologies, specifically in the context of varying interest rate scenarios. Additionally, policy mechanisms such as low-interest loans, tax incentives for equipment upgrades, and public-private partnerships can help offset the cost barriers associated with adopting efficiency-enhancing technologies. Ensuring that farmers have access to financial tools that enable strategic investments in cost-reducing technologies is crucial for sustaining competitiveness and profitability in an increasingly volatile economic landscape.

5.6 Policy Interventions and Support Mechanisms

Policy interventions can mitigate the adverse effects of rising interest rates on agriculture. Future studies should evaluate the effectiveness of existing programs and propose new initiatives, such as:

- **Interest Rate Subsidies:** Analyzing the impact of subsidized loan programs on farm financial resilience, such as the USDA's Farm Service Agency (FSA) Guaranteed Farm Loan Programs, which help producers access credit at lower interest rates. Evaluating how interest rate assistance programs, like the Interest Assistance Program (IAP), reduce financial strain on highly leveraged farms.
- **Disaster Relief Funds:** Developing targeted relief mechanisms for farms affected by extreme financial stress or climate-related disasters, including federal programs like the USDA's Emergency Loan Program, which offers funding to farmers impacted by droughts, floods, and hurricanes. Examining the effectiveness of ad-

hoc disaster relief bills in Congress and state-level initiatives such as the Kansas Livestock Association's Emergency Disaster Relief Fund.

5.7 Conclusion and Final Reflections

This study has examined the impact of rising interest rates on capital debt repayment capacity (CDRC), default probability, and overall farm financial stability. The findings indicate that while interest rate increases raise debt repayment costs, default probability is more strongly influenced by owner equity (OE) and working capital (WC). Across all farm types analyzed, farms with owner equity below 60% exhibited default probabilities exceeding 0.50%, whereas those with equity above 80% had near-zero probability of default. When working capital was reduced by 50%, default probability increased by more than 0.20 percentage points across multiple farm types, underscoring the importance of liquidity in mitigating financial stress.

Although interest rate changes had a limited effect on default risk in the short term, farms with high leverage and low liquidity remain vulnerable, particularly as existing fixed-rate loans mature and require refinancing at higher rates. The analysis confirms that managing equity and liquidity is more critical than focusing solely on interest rate exposure when evaluating farm financial resilience.

Beyond financial metrics, qualitative factors also play a key role in loan decision-making for both producers and lenders. From the lender's perspective, factors such as management experience, historical loan performance, and operational efficiency influence credit evaluations alongside traditional financial ratios. Borrowers with a strong repayment track record, well-documented financial plans, and diversified income streams may secure more favorable credit terms even when leverage ratios are above industry benchmarks.

Additionally, lenders assess external risks such as market volatility and policy changes, which affect repayment capacity beyond interest rate movements alone.

From the producer's perspective, loan decisions extend beyond interest rates and debt obligations. Producers consider the lender's reputation, flexibility in repayment structures, and advisory support, often favoring institutions that offer financial planning tools, refinancing options, and risk management resources. Relationship banking also plays a significant role, as long-standing partnerships between producers and lenders can provide stability during economic downturns. Furthermore, succession planning, expansion strategies, and investment in technology influence borrowing decisions, as producers seek to align their credit obligations with long-term operational goals.

To strengthen financial resilience, producers should focus on building owner equity, preserving working capital, and diversifying revenue sources to reduce dependence on debt financing. Lenders, in turn, should explore adaptive loan structures, interest rate risk mitigation options, and tailored credit products to support farm financial stability in a rising rate environment. Policymakers also play a crucial role by developing targeted financial support mechanisms, such as loan guarantees, interest rate relief programs, and expanded access to refinancing options.

Future research should explore the long-term implications of refinancing at higher interest rates, the effectiveness of financial management strategies in reducing default risk, and how farm profitability interacts with debt structuring in volatile economic conditions. By integrating quantitative financial models with qualitative assessments of borrower risk, the agricultural finance sector can develop more comprehensive credit evaluation frameworks that account for both numerical and managerial factors.

In conclusion, financial stability in agriculture is not solely a function of interest rates but rather a combination of solvency, liquidity, credit relationships, and strategic planning. By adopting holistic risk management approaches, farmers, lenders, and policymakers can enhance the long-term sustainability of the agricultural sector, ensuring continued access to credit in an evolving financial landscape.

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