FINANCIAL IMPACTS OF A BOVINE SPONGIFORM ENCEPHALOPATHY OUTBREAK ON NORTH DAKOTA AGRICULTURAL BANKS

A Thesis
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

Ryan Harold Anderson

In Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE

Major Department:
Agribusiness and Applied Economics

October 2004

Fargo, North Dakota

Graduate School Approval Page

ABSTRACT

Anderson, Ryan Harold; M.S.; Department of Agribusiness and Applied Economics; College of Agriculture, Food Systems, and Natural Resources; North Dakota State University; October 2004. Financial Impacts of a Bovine Spongiform Encephalopathy Outbreak on North Dakota Agricultural Banks. Major Professor: Dr. Cheryl S. DeVuyst.

Catastrophic events, including, but not limited to, animal disease outbreaks such as Bovine Spongiform Encephalopathy (BSE) and Foot-and-Mouth Disease (FMD) and severe weather conditions such as widespread flooding, can cause major losses to North Dakota's economy. Given the history of BSE occurrences worldwide and the recent discovery of BSE in Washington, there is a need to study the potential short- and long-term market impacts an outbreak would have on North Dakota banks given their small asset sizes, compositions of loan portfolios, and highly concentrated areas of beef cattle production. In this study, simulation models were developed to determine how agricultural producers and financial institutions in North Dakota would be impacted financially by a BSE outbreak. Operating- and term-credit scoring models were utilized to determine the current credit risk exposure of the data set containing 482 North Dakota producers. Agricultural loan portfolios of representative North Dakota banks were simulated using the General Algebraic Modeling System (GAMS) to account for asset size and location throughout the state. A series of beef cattle price factors was derived to account for BSE outbreaks occurring throughout the cattle cycle. BSE outbreak scenarios were applied to the model to determine the diminished credit quality of North Dakota producers and asset quality ratings of the representative banks' agricultural loan portfolios. The fluctuations in asset quality are reflected by the necessary increase in the allowance for agricultural loan loss reserve account and the diminished value of available collateral for securing loans.

ACKNOWLEDGMENTS

I would like to express sincere gratitude to my graduate advisor, Dr. Cheryl S. DeVuyst, for her guidance and motivation throughout the process of formulating and executing this study. I would also like to thank my committee members, Dr. William E. Nganje, Dr. F. Larry Leistritz, and Dr. Marc L. Bauer, for their meaningful contributions.

I am especially grateful to Dr. William E. Nganje, my undergraduate advisor, for his enthusiasm and encouragement of my pursuit of a graduate degree. His insightful recommendations for undergraduate coursework helped prepare me for graduate school. His willingness to help students, no matter how busy his schedule, reflects his dedication.

Recognition is extended to Dr. Eric A. DeVuyst for his involvement in the successful completion of this thesis. His expert assistance in GAMS enabled me to complete the modeling simulations.

I would like to thank my sister, Alicia, for the time she took out of her hectic schedule to accommodate my seemingly endless requests throughout the editing process.

I would also like to thank my wife, Summer, for her support and patience throughout my graduate career at North Dakota State University.

TABLE OF CONTENTS

ABSTRACT iii

ACKNOWLEDGMENTS iv

LIST OF TABLES ix

LIST OF FIGURES xii

CHAPTER 1. INTRODUCTION 1

Background and Brief History of BSE 2

North Dakota Agricultural Financial Institutions 3

North Dakota Agricultural Producers 7

North Dakota Cattle Industry 9

Problem Statement 10

Objectives 14

Hypotheses 15

Methodology 15

Organization 18

CHAPTER 2. LITERATURE REVIEW 19

North Dakota and Agriculture 20

Financial Characteristics of North Dakota Farms 21

Characteristics of North Dakota Agricultural Banks 28

Credit Evaluation Procedures 29

Qualitative Credit Evaluation 29

Quantitative Credit Evaluation 31

Background and History of BSE 35
Characteristics of National Cattle Industry 36
USDA-APHIS Response to BSE 40
Economic Impacts and Animal Disease Modeling 42
Consumer Demand Analysis 42
Agribusiness Impact Analysis 45
Producer Impact Analysis 46
BSE Outbreak Modeling 46
Simulation Modeling in Agriculture 50
Simulation Modeling of Financial Institutions 53
CHAPTER 3. DATA AND METHODOLOGY 57
North Dakota Agricultural Producer Model 59
Data and Assumptions 60
Producer Model 62
Balance Sheet 62
Income Statement 65
Statement of Cash Flows 66
BSE Economic Impact Analysis 67
Credit-Scoring Model 79
Bank Model 86
Agricultural Loan Portfolio Distribution Simulations 87
Collateral Value 89
Allowance for Agricultural Loan Losses 92

CHAPTER 4. RESULTS 94
Results of the Base Case Agricultural Producer Model 94
Current Ratio 96
Equity/Asset Ratio 96
Return on Equity 97
Net Income from Operations Ratio 98
Term-Debt Coverage Ratio 98
Credit-Scoring Model Results for the Base Case 99
Results of the BSE Outbreak Scenarios and Price Factor Fluctuations 100
All Producers 101
Beef Producers 104
Crop Producers 111
Crop and Beef Producers 111
"Other" Producers 112
Credit-Scoring Results 113
Results of the Agricultural Financial Institution Model 113
Fluctuations in Asset Quality 116
Agricultural Asset Quality Results 125
Collateral Risk Results 134
Summary 140
CHAPTER 5. CONCLUSIONS 141
Review of Problem 141
Agricultural Producers 141

Financial Institutions....141
Review of Objectives....142
Review of Methodology....142
BSE Outbreak Scenarios and Price Factor Fluctuations....143
Review of Results....143
Base Case Results....144
Scenario Analysis Results....145
Implication of Results....147
Agricultural Producer Implications....148
Financial Institution Implications....149
Limitations of Study....150
Need for Further Research....151
Summary....152
REFERENCES....154
APPENDIX A. PRODUCER FINANCIAL STATEMENTS....163
APPENDIX B. BASE CASE CREDIT-SCORE DISTRIBUTIONS....166
APPENDIX C. BASE CASE LOAN VOLUME DISTRIBUTIONS....168
APPENDIX D. RISK RATING DEFINITIONS....169

LIST OF TABLES

Table		Page
2.1.	Sales for Final Demand, by Major Industry, North Dakota, Million Constant 2000 Dollars	20
2.2.	Composition of North Dakota Commercial Banks, Weighted Averages in Thousands	28
2.3.	Qualitative and Quantitative Credit Risk Characteristics	30
2.4.	Relative Importance of Financial Performance Indicators	33
2.5.	Reported Cases of BSE Since 1986, by Country	36
2.6.	Destination of U.S. Beef Exports (1998-2002)	40
2.7.	Results from Canadian BSE Impact Analysis	48
2.8.	The Effects of Decreased Beef Demand on Farm-Level Prices and Supply	50
3.1.	Producer Data Sample	60
3.2.	Average Real Market Prices Received by Producers in North Dakota, 1994-2002	69
3.3.	Beef Cattle and Calves Inventory in North Dakota, 1994-2002	71
3.4.	Percentage Reductions in Beef Cattle Prices Due to a BSE Outbreak	72
3.5.	Factoring Percentages for Beef Cattle Prices	75
3.6.	Price Factor Range for Beef Cattle Prices	76
3.7.	Average Values of Rented Land and Feeder Cattle Prices in North Dakota	76
3.8.	Beef Cattle Price Correlation Matrix	77
3.9.	Summary Statistics for Pastureland Regression Model	77
3.10.	Summary Statistics for Hay Land Regression Model	78
3.11.	Producer Credit-Scoring Model – Operating Credit	82
3.12.	Producer Credit-Scoring Model – Term Credit	84

3.13. Ranges and “Target” Agricultural Assets of Representative Banks 87

3.14. Representative Agricultural Loan Portfolios 88

3.15. Actual Agricultural Portfolios by Representative Banks 90

3.16. Commercial and Commercial Real Estate Loan Loss Factors 93

4.1. Base Case Average Financial Performance Results for Producer Classifications 95

4.2. Base Case Average Credit Score Results for Producer Classifications 100

4.3. Key Indicators of All Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values) 102

4.4. Key Indicators of Beef Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values) 105

4.5. Key Indicators of Crop Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values) 106

4.6. Key Indicators of Crop and Beef Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values) 107

4.7. Key Indicators of Other Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values) 108

4.8. Average Credit Scores of All Producers Given Various BSE Outbreak Scenarios 114

4.9. Average Credit Scores of Beef Producers Given Various BSE Outbreak Scenarios 114

4.10. Average Credit Scores of Crop Producers Given Various BSE Outbreak Scenarios 114

4.11. Average Credit Scores of Crop and Beef Producers Given Various BSE Outbreak Scenarios 115

4.12. Average Credit Scores of Other Producers Given Various BSE Outbreak Scenarios 115

4.13. Average Allowance for Agricultural Loan Losses as a Percentage of Total Agricultural Loans 126

4.14. Average Fluctuations in Available Collateral as a Percentage of Base Case Collateral.....135

LIST OF FIGURES

Figure		Page
1.1.	Geographic distribution of North Dakota commercial banks	6
1.2.	Geographic distribution of producer enterprises in data set	8
1.3.	Geographic distribution of cattle in North Dakota, 2002	10
2.1.	Interstate cattle outflows from North Dakota, 2001	38
2.2.	Interstate cattle inflows into North Dakota, 2001	39
4.1.	Agricultural loan volume by AQR for bank size 1, LP1, PF4	117
4.2.	Agricultural loan volume by AQR for bank size 1, LP1, PF1	118
4.3.	Agricultural loan volume by AQR for bank size 1, LP1, PF7	119
4.4.	Agricultural loan volume by AQR for bank size 1, LP2, PF4	120
4.5.	Agricultural loan volume by AQR for bank size 1, LP2, PF1	121
4.6.	Agricultural loan volume by AQR for bank size 1, LP2, PF7	122
4.7.	Agricultural loan volume by AQR for bank size 2, LP1, PF4	123
4.8.	Agricultural loan volume by AQR for bank size 3, LP1, PF4	124
4.9.	Agricultural loan volume by AQR for bank size 4, LP1, PF4	124
4.10.	Allowance for agricultural loan losses for bank size 1, LP1-LP3	128
4.11.	Allowance for agricultural loan losses for all bank sizes with a beef-concentrated agricultural loan portfolio	129
4.12.	Allowance for agricultural loan losses as a percentage of total outstanding loans for all bank sizes with a crop-concentrated agricultural loan portfolio	130
4.13.	Allowance for agricultural loan losses as a percentage of total outstanding loans for all bank sizes with a beef-concentrated agricultural loan portfolio	131
4.14.	Fluctuations in available collateral for bank size 1, LP1-LP3	138

4.15. Fluctuations in available collateral for all representative bank classifications with a beef-concentrated agricultural loan portfolio.....139

CHAPTER 1. INTRODUCTION

On December 23, 2003, the United States Department of Agriculture (USDA) announced that a presumptive positive case of Bovine Spongiform Encephalopathy (BSE) was diagnosed in an adult Holstein cow in the state of Washington (USDA, 2003). An animal disease outbreak such as BSE has the potential to greatly diminish the profitability of the nation's agricultural beef sector. In 2000, the gross receipts from the sales of cattle and calves represented 21 percent of all agricultural receipts, or $40.8 billion (National Cattlemen's Beef Association [NCBA], n.d.). The $40.8 billion beef industry also incorporates $147.4 billion of economic output, which totals $188.2 billion of direct and indirect economic activity throughout the U.S. economy (NCBA, n.d.).

The portion of North Dakota's economic base attributable to agriculture (i.e., sales of livestock and crops) in 2000 was 24.9 percent, or $3.6 billion (Leistritz, Lambert, & Coon, 2002). Sales of agricultural crops represent $3.2 billion, or 90.4 percent of the agricultural base, with livestock sales accounting for the remaining $400 million, or 9.6 percent. Furthermore, approximately 36 percent of all exports of goods and services are derived from agriculture. North Dakota ranks second in the nation in the percentage of gross state product derived from agriculture (Leistritz et al., 2002).

Outstanding agricultural loans in North Dakota on September 30, 2003, totaled $2.6 billion, or 18.8 percent of total loans outstanding in the state; by comparison, agricultural loans represent 1.6 percent of total loans outstanding for the nation. These statistics illustrate North Dakota's dependence on agriculture and the degree to which lenders rely on agricultural producers' abilities to repay loans. The statistics also provide an understanding

of how an animal disease outbreak such as BSE would impact the profitability and credit portfolio quality of agricultural banks in the state.

Background and Brief History of BSE

BSE, commonly referred to as "mad cow disease," is a slowly progressing degenerative disease affecting the central nervous system of adult cattle and is inevitably fatal (Bervejillo & Jarvis, 2003). The disease is thought to be transmitted to other animals through the feeding of contaminated rendered meat and bone meal. BSE has an incubation period of two to eight years, and no test currently exists to detect the disease in a live animal, nor is there a vaccine to prevent the disease (USDA-APHIS, 2003). A positive diagnosis of BSE can only be made post-mortem. The Animal Disease Risk Assessment, Prevention, and Control Act of 2001 states that veterinary pathologists must confirm the presence of BSE by a post-mortem microscopic examination of the brain tissue or by the detection of an abnormal prion protein in tissues. Therefore, BSE could exist in a herd of livestock and not be detected for many years.

A form of the disease also can be transmitted to humans through the consumption of BSE-infected tissues. Research indicates that the disease is linked to a variant form of Creutzfeldt-Jakob Disease (vCJD). vCJD, a form of Transmissible Spongiform Encephalopathies (TSE) linked to BSE, is a chronic neurodegenerative disease that affects humans and is also fatal. Thus far, 147 cases of vCJD have been reported worldwide, with only one case identified in the United States (Andrews, 2004). Due to the possibility of human infection, the response by consumers to the introduction of BSE is an extremely vital element in the determination of overall losses assumed by the economy. BSE also has received much attention recently due to the discovery of the disease in one cow in the state

of Washington on December 23, 2003, one cow in Canada, eight reported cases in Japan, and the massive outbreak that occurred in the United Kingdom.

BSE was first discovered in the United Kingdom in 1986 and has since ballooned to over 182,000 total cases. As of 2002, an estimated $5.6 billion in total losses have been experienced by the UK cattle industry as a result of BSE (Bervejillo & Jarvis, 2003). Other BSE cases have since been reported in Ireland (837), Portugal (615), France (515), Switzerland (408), Germany (138), Spain (84), Japan (8), and more recently Canada (1). The Canadian cattle industry experienced a single case of BSE in May 20, 2003 on a dairy farm in the province of Alberta. On January 6, 2004, the USDA announced with certainty that the BSE case reported in the United States was linked to the Canadian case.

Since the discovery of BSE, the Animal and Plant Health Inspection Service (APHIS) has placed much emphasis on control and eradication. APHIS is the division of the USDA charged with the prevention, control, and eradication of invasive species. The average annual expenditures of this division were approximately $10.4 million between the years of 1991-1995 (Kim & Lewandrowski, 2003). They increased to roughly $232 million between the years of 1999-2001 and will undoubtedly continue this upward trend with the introduction of the United State's first case of BSE in the year 2003.

North Dakota Agricultural Financial Institutions

Financial institutions that service agricultural loans are indirectly affected by animal disease outbreaks, because they rely on producers' abilities to repay outstanding operating and term loans. Financial institutions in North Dakota are characterized as having a relatively low level of assets and a high percentage of their outstanding loans in the agricultural sector. Banks located in the central and western portions of the state, where

livestock are heavily concentrated, are especially vulnerable to loan losses as a result of BSE impacts.

The Board of Governors of the Federal Reserve System (2002) terms banks “agricultural” when the ratio of farm loans to total loans exceeds the unweighted average at all banks. The minimum farm loan ratio that banks must have to be termed "agricultural" for the third quarter of 2003 was 14.9 percent. The farm loan ratio for the third quarter of 2003 was utilized, because it corresponds to the financial institution data in this study. This study utilizes financial institution data from September 30, 2003, which indicates that 91 percent of the banks in North Dakota are termed "agricultural" according to the Federal Reserve System’s definition.

Financial institutions are required by law to report their financial condition via a Thrift Financial Report (TFR) to the Federal Reserve System, Office of the Comptroller of Currency, and the Office of Thrift Supervision to ensure safety and soundness in the banking industry. The TFRs are an excellent source of information regarding a financial institution's statements of condition and schedules that help to determine and support the balances reported. Agricultural loans are distinguished in the TFRs as loans secured by farmland, including farm residential and other improvements, and loans to finance agricultural production, which includes all other loans to farmers.

The Federal Deposit Insurance Corporation (FDIC) categorizes banking institutions as either commercial banks or savings institutions. Commercial banks are defined as establishments primarily engaged in accepting demand and other deposits and in making commercial, industrial, and consumer loans (U.S. Census Bureau, 2002). Over 97 percent of financial institutions in North Dakota that submitted TFRs on September 30, 2003 are

classified as commercial. Commercial banks reported total assets of $19.2 billion or 95.2 percent of the state's financial institutions' total assets on September 30, 2003. The FDIC classified the remaining 3 percent of financial institutions in the state as savings institutions. Savings institutions are defined as establishments primarily engaged in accepting time deposits, making mortgage and real estate loans, and investing in high-grade securities (U.S. Census Bureau, 2002). They reported total assets of $974 million or approximately 4.8 percent of the total assets for financial institutions in the state of North Dakota. The remaining 102 banks in the state are commercial financial institutions. The commercial banking industry in North Dakota will be the focus of this study, because it is responsible for loaning funds to agricultural producers and agribusinesses in the state.

There were 102 commercial FDIC-insured institutions in North Dakota that submitted TFRs on September 30, 2003. They can be classified into four "sizes" based on total asset levels (Figure 1.1). Banks having less than $25 million in total assets will be termed "bank size 1", $25 to $50 million as "bank size 2", $50 to $100 million as "bank size 3", and more than $100 million in total assets as "bank size 4".

Only 21.6 percent of commercial financial institutions in North Dakota that report to federal regulators have asset portfolios totaling over $100 million. The "bank size 3" classification incorporates 26.5 percent of commercial financial institutions in the state. The "bank size 2" category composes 36.3 percent or 37 commercial banks in the state. The remaining 15.7 percent of commercial financial institutions in North Dakota are the most agriculturally loan-oriented due to the smallest average asset size and an average loan portfolio that is composed of 59 percent agricultural loans. Financial institutions reporting over $100 million in total assets had, on average, only 13 percent of outstanding loans

classified as agricultural. Banks reporting between $50 and $100 million in total assets had, on average, 51.2 percent of outstanding loans classified as agricultural. The banks falling under the "bank size 2" classification reported an average of 59.5 percent of their loan portfolio as agricultural, and the "bank size 1" classification reported an average agricultural loan portfolio of 59 percent.

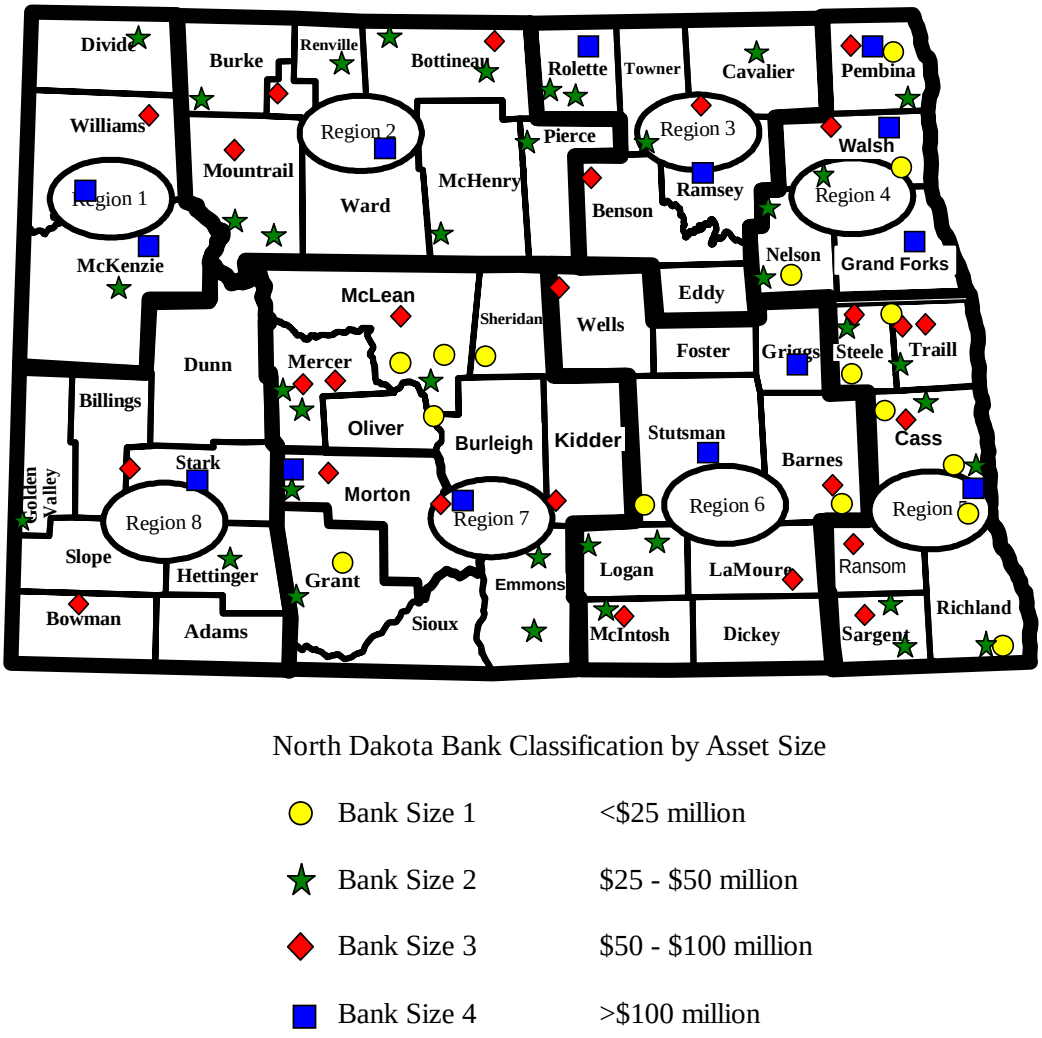

Figure 1.1. Geographic distribution of North Dakota commercial banks. Source: FDIC (2003).

North Dakota Agricultural Producers

In this study, the financial characteristics and classifications of representative North Dakota farms are analyzed to determine the overall financial conditions of agricultural producers in the event of a BSE outbreak. Swenson (2003) analyzed the "Financial Characteristics of North Dakota Farms" and calculated various financial ratios of crop, livestock, and mixed farming operations. In 2002, 62.4 percent of farms were classified as crop, 19.3 percent as livestock, and 18.3 percent as mixed enterprise. Farms were classified as crop farms if 70 percent or more of annual sales resulted from the sales of crop commodities. Conversely, farms were classified as livestock farms if 70 percent or more of annual sales resulted from the sales of livestock commodities. The remaining farms were classified as mixed.

This study assumes four groups of like producers in the state to differentiate between classifications of livestock producers. These groups include beef, crop, beef and crop, and “other” producers. Farm enterprises are classified as beef production enterprises if 70 percent or more of sales are a result of the production of cattle. Farm enterprises are classified as crop production if 70 percent or more of sales are the result of the production of crops. Farm enterprises are classified as crop and beef production if 70 percent or more of sales are the result of crop and beef production combined. The fourth category termed “other” includes all other enterprises where the production of beef, dairy, crops, hogs, and sheep, taken together, account for greater than or equal to 70 percent of gross sales. The geographic distribution of farm enterprises in the data set is illustrated in Figure 1.2.

Crop production farms represent the greatest percentage of farm enterprises in North Dakota at 43 percent. The “other” category represents the second highest percentage

at 27 percent. The third highest category is crop and beef production enterprises, which represent 18.2 percent of the data set. Finally, the beef production farms account for 11.8 percent of the total enterprises. The 2002 data set used in this study includes 482 enterprises. The data set was derived from farm management programs across the state and further developed by Swenson (2003).

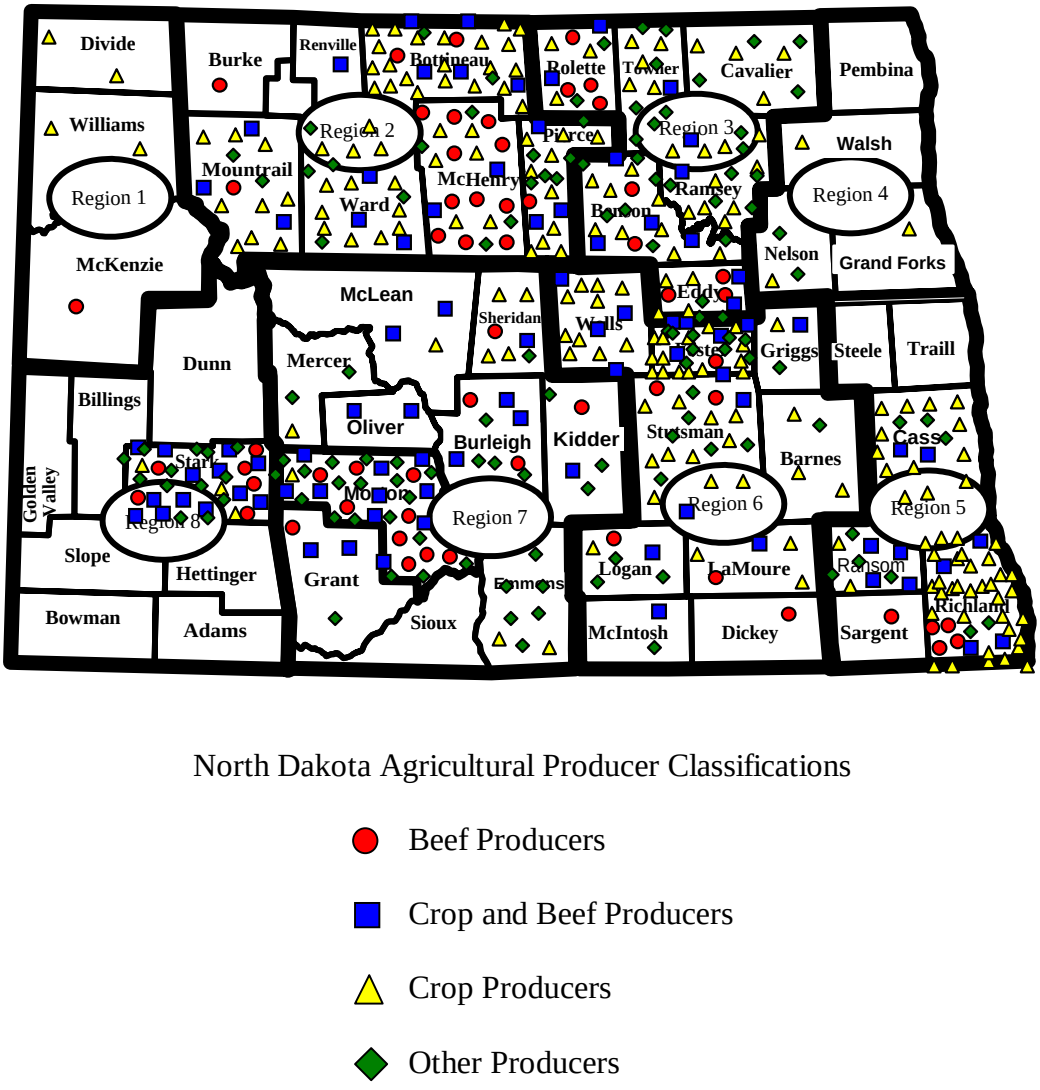

Figure 1.2. Geographic distribution of producer enterprises in data set.
Source: Swenson (2003).

North Dakota Cattle Industry

The distribution of cattle in the state of North Dakota is also a decisive factor in the overall determination of the negative impacts to be absorbed by the financial institutions as a result of a potential BSE outbreak. Small community banks located in the western and central portions of the state rely more heavily on beef production operations due to cattle concentration. The Red River Valley provides excellent conditions in terms of soil fertility for agricultural crop producers; whereas, the western and central portions of North Dakota provide a greater proportion of pastureland and hay land acreage for livestock.

According to the National Agricultural Statistics Service (NASS), there were approximately 11,800 cow/calf producers in 2002 in North Dakota (USDA-NASS, 2004a). This represented 91 percent of cattle enterprises and 39 percent of total agricultural operations. The USDA reported total cattle and calves inventory for the United States in 2003 of 96.1 million head. The state of North Dakota represented 2 percent of the total U.S. inventory or approximately 1.9 million head of cattle and calves. Figure 1.3 illustrates the geographic distribution of cattle in North Dakota.

Region 7 in North Dakota was the most heavily livestock-oriented region in the state and represented 31 percent of the state's total cattle inventory. Regions 3, 4, and 5 (Red River Valley) contained the fewest cattle in the state. Swenson's (2003) report supports the USDA's geographical livestock distribution tabulations for the state of North Dakota in 2003. The report indicated that 97.4 percent of farm enterprises in the Red River Valley were crop farms. North central North Dakota was composed of 73.6 percent crop farms, 15.4 percent livestock, and 11 percent mixed. The south central region was composed of 52.3 percent crop farms, 21.5 percent livestock, and 26.2 percent mixed. The

western region of the state had the highest percentage of livestock enterprises at 37.1 percent livestock, 31.4 percent crop, and 31.4 percent mixed.

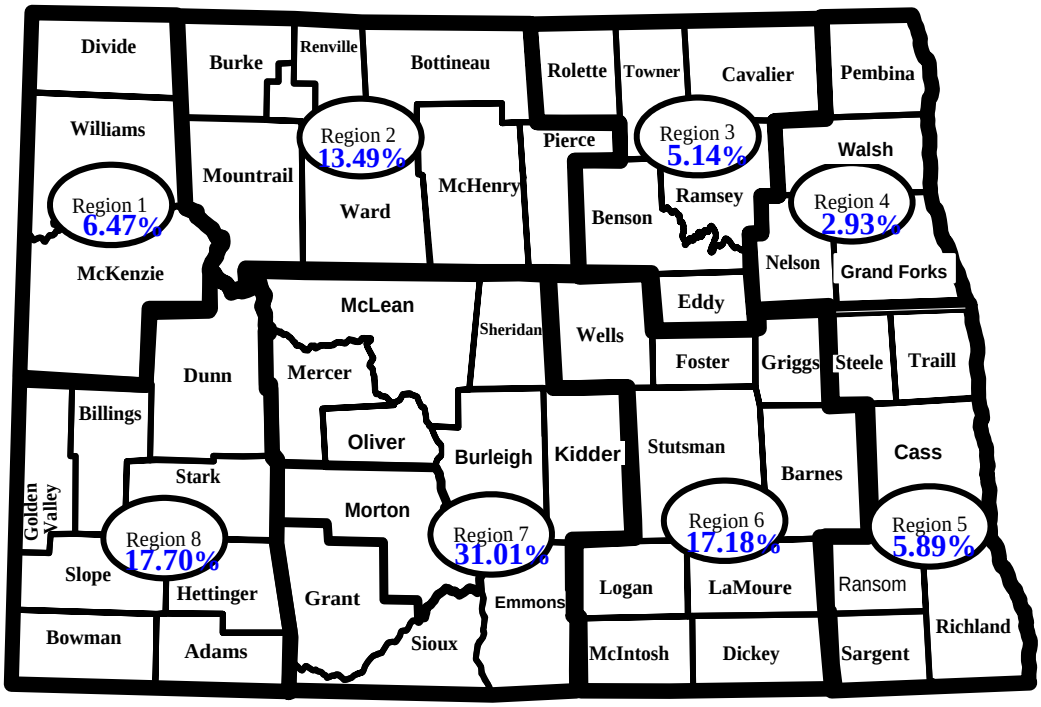

Figure 1.3. Geographic distribution of cattle in North Dakota, 2002.
Source: USDA-NASS (2004b).

Problem Statement

Catastrophic events, including but not limited to animal disease outbreaks such as BSE and Foot-and-Mouth Disease (FMD) and severe weather conditions such as widespread flooding, can cause major losses to North Dakota's economy. Given the history of BSE occurrences worldwide and the recent discovery of BSE in the state of Washington, there is a need to study the potential short- and long-term market impacts an outbreak

would have on North Dakota banks given their small asset sizes, compositions of loan portfolios, and highly concentrated areas of beef cattle.

Agricultural producers, financial institutions, and consumers may be directly or indirectly affected by the introduction of BSE into North Dakota's livestock herds. Jin, Skripnitchenko, and Koo (2004) predicted that a single, isolated case may reduce domestic consumption by 5-10 percent. The estimate was proven overstated when consumer demand decreased by only 0.6 percent from the fourth quarter of 2003 to the first quarter of 2004 (Virginia Polytechnic Institute and State University, 2004). This minimal decrease in consumer demand may be partially attributed to the USDA in its efforts to track cattle and cattle products that had any possibility of infection and its abilities to further inform and persuade consumers about the safety of the U.S. beef supply. Jin et al. (2004) also estimated that additional occurrences (i.e., extensive outbreak) may reduce the consumption of beef products by as much as 20 percent, which would be more problematic to the U.S. cattle industry. They also anticipate that U.S. exports would decrease by 50-100 percent depending on importers' responses to the magnitude of the BSE outbreak. This estimation proved accurate when the amount of beef and veal exports decreased by 96 percent from December 2003 to January 2004 (USDA-ERS, 2004b). The magnitude of consumption and export reduction, size of the quarantined region, and timeliness of indemnification payments by the government affect the producers' abilities to limit losses from the production of livestock impacted by BSE.

Many agricultural producers may experience difficulty meeting financial loan obligations due to declines in the price of beef and mandatory eradication policies enforced on infected herds by the USDA and APHIS. The majority of losses resulting from a BSE

outbreak are attributed to market or price impacts. However, government-enforced eradication policies also contribute to losses assumed by a limited number of producers. The eradication of infected and high-risk livestock herds would be enforced immediately, while indemnification payments (i.e., compensation payments from the government) may not be received for a significant period of time. The case of BSE reported in the United States resulted in the depopulation of approximately 450 animals (USDA, 2004). This limited number of euthanized animals is insignificant when compared to the U.S. cattle industry and total market or price impacts. Extensive research would need to be conducted on quarantine zones and eradication policies to correctly model such impacts that carry little significance. Therefore, this study accounts strictly for market price impacts based on their contribution to financial losses as compared to the impacts of eradication.

A partial compensation package for decreased market prices due to a BSE outbreak in Canada has been extended to cattle producers. According to Lawrence, Strohbehn, Loy and Clause (2003), the Canadian government announced the details of a partial compensation package on June 18, 2003, approximately one month after the discovery of the single case of BSE in Alberta. The compensation package allowed producers to receive partial compensation for a larger-than-expected price decline relative to the U.S. market (Lawrence et al., 2003). Even though the plan was announced in a timely manner, some producers had no choice but to sell their cattle for cash flow or because the cattle were market weight and the benefits of feeding the cattle for an extended period of time were outweighed by the costs. The Canadian government's recovery program was established because domestic beef cattle prices had decreased drastically. To date, the United States has not released such a plan, because the drop in beef prices due to the single case of BSE

was short-term. Therefore, the model will not account for any type of compensation package when determining financial impacts to producers or financial institutions.

The historical financial characteristics of North Dakota livestock producers establish a foundation for analyzing their abilities to maintain current financial conditions in the event of a BSE outbreak. The producers' abilities to meet financial obligations in a timely manner and diminished credit quality are the determining factors in the magnitude of the effect a BSE outbreak would have on financial institutions. Highly agriculturally specialized financial institutions would assume increased loan losses as a result of beef producers' inabilities to meet loan interest and principal payments. The diminished credit quality also would require financial institutions to increase their allowance for loan losses.

Consumers will respond differently in the event of a BSE outbreak in the United States, depending on the magnitude of the occurrence. Extensive research has been conducted on consumer confidence in the food supply and consumer perception to an animal disease outbreak (Jin, Skripnitchenko, & Koo, 2004; Jin, Sun, & Koo, 2003; Burton & Young, 1996; Latouche, Rainelli, & Vermersch, 1998; Pennings, Wansink, & Meulenberg, 2002). Extremely risk averse consumers would discontinue consumption of beef products, because they pose a perceived threat to their health from the possibility of contracting vCJD. Other consumers will increase consumption of beef products due to the decreased prices of traditionally expensive choice steaks and recognition that the possibility of contracting vCJD is extremely low. The final group of consumers will remain indifferent to consumption of beef products given an animal disease outbreak such as BSE due to lack of information or the perception that the risk of contracting vCJD is

low. Due to this uncertainty, it is possible only to estimate how U.S. consumers will react to the introduction of BSE in the domestic food supply.

Jin et al. (2004) estimate that decreased domestic consumption will vary between 5-20 percent based on the magnitude of the outbreak in their BSE model. They note that BSE outbreaks in the United Kingdom and Japan reduced domestic consumption and increased beef imports. Therefore, they concluded that U.S. demand for beef would likely follow these historical trends. The expected decrease in consumer demand will act to draw down market prices to entice consumers to purchase the products. However, this magnifies the problem livestock producers face when trying to market their cattle since its value decreases even more. Lower beef market prices result in lower revenues, ultimately leading to loan defaults by livestock producers. Therefore, the increase in loan defaults of producers decreases the profitability of agricultural financial institutions and erodes asset quality, which may result in severe financial distress for highly specialized institutions in rural North Dakota that service beef production operating loans and farm real estate loans to beef producers.

Objectives

The main objectives of this study are to determine how various BSE outbreak scenarios may affect North Dakota agricultural producers' repayment capacity and overall financial condition (credit-score) as well as lead to fluctuations in financial institutions' agricultural loan portfolio and collateral quality. Specific objectives include:

- Identify the financial impacts that a BSE outbreak would have on North Dakota's beef producers and their repayment capacity;

- Simulate various agricultural loan portfolio scenarios that accurately reflect financial institutions' risk exposure to an animal disease outbreak;
- Develop a series of slaughter, feeder, and breeding cattle price factors that allow a static model to exhibit dynamic modeling properties;
- Adapt term credit and operating credit-scoring models to determine changes in credit quality for two cases: farm-only, and farm and non-farm; and
- Incorporate the impacts of a BSE outbreak on representative agricultural banks' allowance for agricultural loan losses and collateral quality.

Hypotheses

The hypotheses to be tested in the analysis of the impacts of a BSE outbreak on North Dakota agricultural banks and their ability to withstand adverse financial conditions include: (1) a BSE outbreak would have a negative effect in decreasing the asset quality of banks due to high agricultural loan-specialized positions and some livestock producers' current inability to make operating and term debt payments as they come due; (2) specialized banks in North Dakota that are highly dependent on the financial performance of beef producers will be affected the most by a BSE outbreak; and (3) a BSE outbreak during the expansion phase of the cattle cycle would affect producers much more severely than the current liquidation phase.

Methodology

Producer financial statements, including the balance sheet, income statement, and statement of cash flows, are developed based on representative farm enterprises in North

Dakota. An additional set of producer financial statements is developed that incorporates the farm enterprise and non-farm assets, liabilities, equity, income, and expenses. The latter set of financial statements is more representative of agricultural enterprises in North Dakota, because in 2002, 90.1 percent were individual/family owned and operated (USDA-ERS, 2004c). Therefore, business and personal assets should be considered when determining the overall financial conditions of agricultural producers.

Term credit and operating credit-scoring models adapted from Splett, Barry, Dixon, and Ellinger (1994) are utilized to analyze fluctuations in the financial performance of agricultural producers given various scenarios of BSE outbreaks. The Sixth Farm Credit District and Splett et al. (1994) derived the risk rating classes in the credit-scoring models using a comprehensive financial analysis. The financial analysis incorporates liquidity, solvency, profitability, repayment capacity, and financial efficiency of the agricultural producers. The key financial performance measurements that form the basis of the model include the current ratio, equity/asset ratio, return on equity (ROE), net income from operations ratio, and term-debt coverage ratio.

The models developed by Splett et al. (1994) are selected for the analysis due to their quantitative nature, which parallels the data set. Two sets of credit-scoring models will be developed to reflect the financial conditions of the agricultural operation as a business entity and the operation inclusive of non-farm financial condition. The existing model developed by Splett et al. (1994) requires qualitative analysis to differentiate between categories of high-risk loans. Qualitative variables, such as borrower character and management ability, and quantitative variables, such as number and frequency of late payments and financial trends of operations, are not available. Therefore, quantitative risk

rating benchmarks were extended in this study to differentiate between the categories of high-risk loans.

Representative commercial banks also are developed based on the asset sizes of all banks in North Dakota ranging from large, well-diversified banks to small, specialized banks. Detailed loan portfolios (i.e., producer classifications that secured the loans) of the financial institutions in the data set were not available (i.e, only provides totals for agricultural loans secured by farmland, operating and all other loans to farmers, and total agricultural loans). Three representative agricultural loan portfolios are simulated (see Table 3.15) for each of the four representative bank classifications to account for variability among banks of different asset size (diversified or specialized) and location in the state (crop or livestock concentration).

The simulations are conducted using the General Algebraic Modeling System (GAMS, 1998). A random number generator is developed to select a specified number of producers from the data sample from a specified percentage (i.e., representative of the desired agricultural loan portfolios) of the four representative producer categories (i.e., crop, beef, crop and beef, "other"). Therefore, a total number of producers will be entered in the model along with the percentages from each category to approximate the total agricultural loans for each representative bank. The simulation process allows for a close approximation of the total volume and composition of the agricultural loan portfolios.

The degree of demand decrease and extent of export reduction accounted for by Jin et al. (2004) in their BSE outbreak model is used to determine expected beef cattle price reductions and their effect on cattle producers' sales revenues as well as the valuation of breeding herds, pastureland, and hay land. A range of beef cattle prices is also developed

that reflects a BSE outbreak occurring during different phases of the cattle cycle. Outbreaks occurring during the liquidation and expansion phases of the cattle cycle would be representative of a time period with high and low cattle prices, respectively.

The fluctuations in producer financial performance resulting from a BSE outbreak are illustrated by changes in the corresponding credit-scores. The increased credit risk of producers then will transfer to the financial institutions that are responsible for loaning funds to the producers via fluctuations in asset quality. Diminished asset quality of the simulated agricultural loan portfolios would require representative financial institutions to increase their allowance for agricultural loan losses (i.e., reserve account) and to reevaluate their increased collateral risk.

Organization

Within this thesis, Chapter 2 further discusses economic impacts related to BSE and producer modeling that incorporates a BSE animal disease outbreak. Previously conducted research regarding the economic modeling of financial institutions, credit-scoring, and other relevant economic theory will be addressed. Chapter 3 describes the data, assumptions, and methodology selected to address the objectives of this study. Chapter 4 illustrates the results of the various scenarios derived in the study. Conclusions, implications, limitations, and the need for further research are addressed in Chapter 5.

CHAPTER 2. LITERATURE REVIEW

Commercial financial institutions in North Dakota rely on agricultural producers' abilities to successfully produce and market their crops and livestock. Banks located in the central and western portions of the state are especially susceptible to financial distress given a BSE outbreak due to the relatively higher degree of cattle loans in their agricultural loan portfolios. Extensive literature is available on BSE and historical outbreaks. Studies also have been conducted on the impacts that animal diseases have on producers, international trade, and consumer reactions to food safety concerns. However, economic modeling of an animal disease outbreak and the effect it may have on agricultural financial institutions has yet to be developed.

This literature review will be composed of eight sections involving BSE and the effect an outbreak would have on producers and financial institutions in North Dakota. An overview of North Dakota and the importance of agriculture to the state's economy will be addressed first. Then, credit evaluation procedures, including qualitative and quantitative measures, will be discussed to provide an understanding of how financial institutions assess credit quality. Third, background information and a brief history of the discovery and spread of BSE across several countries will be discussed to provide the reader a basic understanding of the negative consequences that arise with a BSE outbreak. The fourth section will provide an overview of the national cattle industry and North Dakota's involvement in the production of cattle. This section also will cover state inflows and outflows of cattle, regional livestock movements in the United States, beef exports, and the national distribution of cattle production phases. The fifth section will discuss the response by USDA and APHIS regarding the single case of mad-cow disease discovered in the state

of Washington. The sixth section provides a discussion of BSE modeling, economic impacts associated with BSE, and the effect of BSE on consumer confidence and consumer demand for beef. The importance of stochastic simulation in applied agricultural research will be emphasized in the seventh section and accompanied by examples. The final section will highlight applications of stochastic simulation to financial institution modeling.

North Dakota and Agriculture

Agriculture has been and continues to be the foundation of the North Dakota economy. Leistritz, Lambert, and Coon (2002) researched the role of agriculture in the North Dakota economy. They highlighted sales by major industry, individual sectors' shares of North Dakota's gross state product, and agricultural employment by region across the state. Table 2.1 illustrates sales for final demand (i.e., activities that produce products or services sold to markets outside North Dakota) by major industry from 1960-2000.

Table 2.1. Sales for Final Demand, by Major Industry, North Dakota, Million Constant 2000 Dollars

Year	Crops	Lvsk.	Total	Ag. % of total	Mft.	Energy Ext. and Conv.	Tourism	Expt. Serv.	All Primary Industry	Federal Payment	Total
1960	1,885.7	846.1	2,731.8	62.86%	318.9	135.0	96.0	0.0	3,281.7	1,064.2	4,345.9
1965	2,495.5	1,113.9	3,609.4	58.98%	352.8	193.1	198.0	0.0	4,353.3	1,766.0	6,119.3
1970	2,471.5	1,003.7	3,475.2	46.75%	545.5	230.2	420.7	0.0	4,671.6	2,761.5	7,433.1
1975	4,159.9	1,210.7	5,370.6	53.82%	819.8	366.3	401.1	0.0	6,957.8	3,020.8	9,978.6
1980	3,230.6	1,466.3	4,696.9	43.86%	1,055.0	1,225.5	361.6	0.0	7,339.0	3,369.4	10,708.4
1985	3,756.8	1,014.4	4,771.2	43.53%	848.8	1,620.7	368.1	0.0	7,603.8	3,352.3	10,961.1
1990	2,807.8	1,006.6	3,814.4	37.12%	864.4	1,443.6	433.7	0.0	6,556.1	3,720.2	10,276.3
1995	3,147.1	617.2	3,764.3	33.58%	1,106.8	1,329.3	883.9	0.0	7,084.3	4,125.6	11,209.9
2000	3,220.9	339.4	3,560.3	24.91%	1,788.2	2,829.7	2,829.7	381.6	10,008.0	4,282.9	14,290.3

Source: Leistritz et al. (2002).

Table 2.1 indicates the declining percentage of agriculture's sales for final demand. The authors attribute this decline to the significant increase in the tourism sector and

increases in the manufacturing, energy extraction and conversion, and all primary industry sectors. However, in 2000, agricultural commodity exports continued to account for 24.9 percent, or $3.6 billion of North Dakota's economic base. Furthermore, agriculture directly employed 10.9 percent of the state's total workforce as farmers, ranchers, and farm wage and salary employees. The research report also indicates that 7.9 percent of North Dakota's gross state product can be attributed to agriculture, which ranks second in the nation. The statistical data presented by Leistritz et al. (2002) indicates agriculture's importance not only to the North Dakota economy but also to the agricultural financial institutions that loan funds to producers and agribusinesses across the state.

Financial Characteristics of North Dakota Farms

Swenson (2003) analyzed financial characteristics of North Dakota agricultural producers for the years 2000-2002. The study addresses the composition of farm enterprises in the state, farm sales, farm sizes, cropland tenure, and, most importantly, numerous key financial ratios used to analyze the performance of farm enterprises. The study indicates that livestock producers in the state have experienced significantly lower net incomes than crop producers or mixed farm enterprises. In 2002, livestock producers reported a median net income of $16,935 as compared to crop producers and mixed producers, who reported median net incomes of $60,591 and $17,645, respectively. The data for the years 2000-2001 also indicate that livestock producers have been much less profitable when compared to crop and mixed farm enterprises.

Financial components used by Swenson (2003) to analyze the performance of agricultural producers include liquidity, solvency, profitability, repayment capacity, and financial efficiency. Each component of financial performance contains between two and

five key ratios that are used to illustrate the farm enterprises' financial well-being. Splett et al. (1994) use similar financial performance ratios that measure the key financial components described above. This study will use the same financial ratios as Splett et al. (1994) except for the repayment capacity indicator. Their study incorporates the capital debt repayment margin ratio-long run as an indicator of the producers' abilities to repay outstanding loans. This study will replace the capital debt repayment margin ratio-long run with the term-debt coverage ratio. The substitution was necessary given limitations in the availability of data. The formulas for the financial performance ratios were provided in Oltmans, Klinefelter, and Frey (1998).

The financial ratios utilized by Splett et al. (1994) were chosen for this analysis, because they combine to form the credit-scoring model that will ultimately measure how producers are impacted by a BSE outbreak. As a result, this study will address the current ratio as a liquidity measure, the equity/asset ratio as a solvency measure, the farm return on equity as a profitability measure, the term-debt coverage ratio as an indicator of repayment capacity, and finally, the net farm income from operations ratio as a measure of financial efficiency.

The liquidity measure used in the agricultural producer analysis is the current ratio. The current ratio measures the extent to which current assets will cover current liabilities that are due within 12 months. The formula for the current ratio is

$$\frac{\textit{Total Current Farm Assets}}{\textit{Total Current Farm Liabilities}} \qquad (1)$$

According to Swenson (2003), the current ratio in 2002 for the upper quartile of livestock producers was 1.7. The lower quartile and median ratios were 0.9 and 1.3, respectively. The crop producer classification reported an upper quartile of 2.5, a lower quartile of 1.0, and a median value of 1.3. The mixed producer classification indicated an upper quartile of 1.9, a lower quartile of 0.9, and a median value of 1.3. The livestock producer ratios were lower than both crop and mixed farm operations in North Dakota, indicating that livestock producers are less able to meet short-run obligations without disrupting normal business operations.

Solvency is another financial performance measurement that analyzes the risk exposure to a firm, and is equally important to the producer analysis. The equity/asset ratio measures the proportion of net worth to the total assets of the firm. As the ratio increases, the firm has an increased ability to obtain additional debt financing at favorable interest rates and outlive adverse economic conditions. The formula for the equity/asset ratio is

$$\frac{Total\ Farm\ Equity}{Total\ Farm\ Assets} \tag{2}$$

The equity/asset ratio for the upper quartile of livestock producers was 0.59; the lower quartile was 0.25; and the median ratio was 0.41. The crop producer classification reported an upper quartile of 0.68, a lower quartile of 0.32, and a median value of 0.50. The mixed producer classification indicated an upper quartile of 0.59, a lower quartile of 0.20, and a median value of 0.42. Again, the livestock producer ratios were considerably less than crop enterprises. However, they were comparable to the mixed enterprises. This indicates that livestock producers in North Dakota would have a more difficult time

borrowing funds at favorable interest rates and surviving adverse economic conditions as compared to agricultural producers who operate crop-only enterprises.

Farm return on equity is used as the financial performance measurement that best describes a producer's ability to profit from farming operations. The ratio measures the rate of return on the owner's equity capital that is employed in the farm or ranch (Oltmans et al., 1998). The formula for the farm return on equity is

$$\frac{\textit{Net Farm Income From Operations} - \textit{Apparent Family Living Expenses}}{\textit{Total Farm Equity}} \quad (3)$$

Swenson (2003) cites a high ratio as an indicator of under-capitalization or a highly leveraged firm, while a low ratio indicates a conservative operation. The farm return on equity ratio for the upper quartile of livestock producers was 4.7 percent; the lower quartile was -6.9 percent; and the median value was 0.0 percent. Crop-only enterprises performed significantly better with an upper quartile of 21.5 percent, while mixed operations performed at a comparable level to livestock operations.

The net farm income ratio represents financial efficiency of the agricultural enterprise. According to Swenson (2003), the ratio is a measure of how efficient the producer is at generating net income from gross revenue. The formula for the net farm income ratio is

$$\frac{\textit{Net Farm Income}}{\textit{Gross Farm Revenues}} \quad (4)$$

The net farm income ratio for livestock producers for the upper quartile was 21.6 percent; the lower quartile was 1.8 percent; and the median value was 13.1 percent. Again, the ratios were much lower than for crop-only producers and comparable to mixed operations. The crop-only operations reported an upper quartile of 30.1 percent, a lower quartile of 10.1 percent, and a median value of 20.8 percent. The mixed operations reported an upper quartile of 23.1 percent, a lower quartile of -3.0 percent, and a median value of 11.7 percent.

The financial performance ratio representing financial efficiency in the credit-scoring models utilized in this study is slightly different. The net farm income from operations ratio measures how efficient the producer is at generating net farm income from operations as a percentage of gross revenue. The formula is as follows:

$$\frac{Net\ Farm\ Income\ From\ Operations}{Gross\ Farm\ Revenues} \tag{5}$$

The final and most important financial performance measurement used in the livestock producer analysis is repayment capacity. The repayment capacity measurement used is the term-debt coverage ratio. The term-debt coverage ratio measures the borrower's ability to cover all term debt payments. The formula for the term-debt coverage ratio is

$$\frac{\left(\begin{array}{l} Net\ Farm\ Income\ From\ Operations + Depreciation\ And\ Other \\ Capital\ Adjustments + Net\ Non\ Farm\ Income + Scheduled\ Interest \\ On\ Term\ Debt - Apparent\ Family\ Living\ Expenses\ \&\ Taxes\ Paid \end{array}\right)}{Scheduled\ Principal\ \&\ Interest\ Payments\ On\ Term\ Debt} \tag{6}$$

In 2002, the upper quartile for livestock operations was 1.4; the lower quartile was 0.4; and the median value was 0.9. The upper quartile for crop producers was 3.1; the lower quartile was 0.8; and the median value was 1.6. The upper quartile for mixed producers was 1.9; the lower quartile was 0.3; and the median value was 0.9. Again, these ratios were lower than crop-only enterprises, indicating that the majority of North Dakota's livestock producers may be unable to meet financial obligations in the event of a BSE outbreak due to beef price reductions and the resulting diminished revenues.

Additional financial performance measurements were developed to reflect the producers' financial well-being inclusive of personal assets and non-farm income, while maintaining the credit-classification system. The financial condition of non-farm assets, liabilities, net worth, and income are extremely important, because combined with business operations, they reflect the overall ability of producers to withstand adverse economic conditions. The current ratio and term-debt coverage ratio remained the same for both scenarios. The current ratio was not altered, because non-farm assets and liabilities were not divided among current, intermediate, and long-term classification in the data set. The term-debt coverage ratio was not altered because the farm-only equation in Oltmans et al. (1998) already included net non-farm income. However, the equity/asset ratio, net farm income from operations ratio, and farm return on equity were altered to include the financial conditions of producers, including their personal assets and non-farm income. The equity/asset ratio reflecting both business and personal financials is

$$\frac{Net\ Worth}{Total\ Assets} \tag{7}$$

The return on equity reflecting all aspects of the producer is

$$\frac{\left(\begin{array}{l}\textit{Net Farm Income From Operations} + \textit{Non Farm} \\ \textit{Income} - \textit{Apparent Family Living Expenses}\end{array}\right)}{\textit{Total Equity}} \tag{8}$$

The net income from operations ratio reflecting both personal and business financial performance is

$$\frac{\textit{Net Farm Income From Operations} + \textit{Non Farm Income}}{\textit{Gross Farm Revenues}} \tag{9}$$

Taylor, Koo, and Swenson (2003) developed an agricultural outlook for the state of North Dakota based on 24 representative farms. The objectives of the study were to determine expected changes in net farm income and debt/asset ratios for the representative farms, evaluate the reaction of cropland prices and cash rental rates to the farm income estimates, and estimate changes in net farm income under various commodity price estimates until 2012. The farms represent the average, low, and high profit producers as well as the small, medium, and large sized farms in various regions of the state. The state is divided into four regions: Red River Valley, North Central, South Central, and Western.

Taylor et al. (2003) found that expected increases in expenses will not be offset by expected increases in yields. Therefore, the large, medium, and small sized farms and high, average, and low profit farms will all experience gradual declines in expected net farm income through 2012. The expected decrease in net farm income will result in a

greater demand for non-farm income and a smaller number of farms with increased acreage. The expected decline in net farm incomes received by livestock producers will create additional problems, due to the comparably lower net farm incomes currently reported by North Dakota livestock producers.

Characteristics of North Dakota Agricultural Banks

The existence of rural commercial banks in the state of North Dakota is vital to agricultural communities, because banks provide credit and financial services to agricultural producers. North Dakota banks are extremely reliant on producers' performance due to the composition of their loan portfolios. Table 2.2 was derived from TFRs for North Dakota that are available on the FDIC Internet site. The table illustrates the average asset sizes of North Dakota banks based on predetermined representative "asset sizes" and the importance of agricultural loans to the institutions' portfolios.

Table 2.2. Composition of North Dakota Commercial Banks, Weighted Averages in Thousands

Bank Classification	Asset Size (millions)	# of Banks	Total Assets	Total Loans	Ag. Loans Secured by Farmland	Ag. Production Loans	Ag. Loans as a % of Total Loans
Bank size 1	< $25	16	$18,666	$11,289	$2,131	$4,908	58.96%
Bank size 2	$25 - $50	37	$36,892	$22,095	$4,122	$8,969	59.49%
Bank size 3	$50 - $100	27	$72,620	$49,391	$7,420	$17,720	51.19%
Bank size 4	> $100	22	$2,793,767	$1,882,682	$59,469	$90,470	13.37%

Source: FDIC (2003).

Rural agricultural banks in the state are characterized as having a relatively low level of total assets and a high percentage of agricultural loans. Approximately 52 percent of the commercial banks in North Dakota have fewer than $50 million in total assets and a

loan portfolio consisting of 59 percent agricultural loans. The TFRs on a national level indicate that agricultural loans (i.e., agricultural production loans and agricultural loans secured by farmland) consist of 1.6 percent of total loans outstanding in the nation. Furthermore, 91 percent of commercial banks in the state can be classified as agricultural according to the FRB definition of an agricultural bank (see Chapter 1). The statistics presented help provide an understanding of the importance that agriculture has on North Dakota's economy and, more specifically, the agricultural commercial banks that loan funds to producers.

Credit Evaluation Procedures

Two main methods of credit evaluation exist: price and non-price (Miller, Ellinger, Barry, & Lajili, 1993). Pricing, or quantitative credit evaluation procedures, refers to charging risk-adjusted interest rates on loans. Non-price, or qualitative credit evaluation procedures, refers to adjustments in collateral requirements, downpayments, maturities, and repayment schedules (Miller et al., 1993). The importance of qualitative credit evaluation has been emphasized by Pederson and Chellappan (1991); Schmiesing, Edelman, Swinson, and Kolmer (1985); and Miller, Barry, and Ellinger (1993). Quantitative credit evaluation procedures, or "formal" agricultural credit-scoring models, are much more prevalent and have been researched by Lins, Ellinger, and Lattz (1987); Miller et al. (1993); Ellinger, Splett, and Barry (1992); Pederson and Chellappan (1991); Barry and Ellinger (1989); Splett et al. (1994); and Walraven and Barry (2003).

Qualitative Credit Evaluation

A qualitative approach for credit evaluation is used far less in comparison to quantitative methods, when determining risk-adjusted interest rate pricing due to its

subjective nature. Qualitative credit evaluation is considered a more "informal" method of evaluation, because producer financial statements are required less frequently by banks in comparison to credit-scoring systems (Pederson & Chellappan, 1991). However, qualitative characteristics are almost always used to complement more "formal" methods, such as credit-scoring techniques.

Miller, Barry, and Ellinger (1993) conducted a survey of agricultural banks' perceived abilities to distinguish between borrower risk types and the relative importance of varying borrower characteristics. The survey was submitted to banks in Illinois, Indiana, and Iowa that had a ratio of agricultural loans to total loans that was greater than or equal to 0.25. Table 2.3 illustrates the importance of various qualitative and quantitative credit evaluation measurements.

Table 2.3. Qualitative and Quantitative Credit Risk Characteristics

Borrower Characteristics Which Signal Differences in Credit Risk*	
Signal	Ranking
Past financial performance	4.60
Farm production efficiency	4.20
Risk management ability	4.10
Collateral offered	4.00
Borrower's personal attributes	4.00
Borrower's experience	4.00
Projected financial performance	3.90
Reputation in community	3.50
Education	2.60

*Average rankings are based on a scale of 1 to 5 with 1 indicating low importance, 3 medium importance, and 5 high importance.

Source: Miller, Barry, & Ellinger (1993).

The risk management ability of producers was considered the most important qualitative characteristic when determining credit risk. The collateral offered, personal

attributes, experience, and reputation in the community were also found to be good qualitative indicators of credit. However, the most important characteristic was past financial performance, a quantitative characteristic. Other qualitative indicators of credit quality cited include capital expenditure limitations, downpayment, co-signatures, crop insurance, payment plans, Farm Service Agency or state loan guarantees, government program participation, and deposit balances. The credit evaluation procedure survey conducted by Pederson and Chellappan (1991) identified similar qualitative credit evaluation characteristics. Their research also indicated that the majority of banks follow a more "formal" credit-scoring procedure.

Quantitative Credit Evaluation

The majority of agricultural financial institutions today utilize risk-adjusted pricing or quantitative credit evaluation procedures, such as credit-scoring models. According to Barry and Ellinger (1989), "credit-scoring provides a systematic, comprehensive way in which to assess the borrower's financial data and, along with the lender's judgment and other relevant information, reach a valid assessment of the borrower's credit worthiness." The definition provided by Barry and Ellinger (1989) describes a process of evaluating credit that encompasses both quantitative and qualitative variables. However, objective credit-scoring procedures utilize financial ratios that can be measured and classified through the use of a risk-rating system.

According to Ellinger et al. (1992), four purposes for using credit-scoring models exist. They include assisting in loan approval decisions, risk-adjusted loan pricing, controlling and monitoring credit risk over the length of the loan, and evaluating the quality of outstanding loans for regulatory and management decisions. Ellinger et al. (1992) also

provide a framework for the function of credit-scoring models. The steps to the framework include (1) identifying key variables that accurately depict the producers' financial conditions; (2) selecting appropriate financial performance measurements for each selected variable; (3) weighting the measurements according to managements' beliefs regarding importance; (4) scoring the credit risk with respect to chosen weights; and (5) deriving the credit risk categories that accurately classify the score.

The five key measurements of financial performance provide the foundation for many credit-scoring models. These measurements include profitability, liquidity, solvency, repayment capacity, and financial efficiency. These performance measurements have been defined and relevant examples provided in the section titled *Financial Characteristics of North Dakota Farms.* However, other categories do exist such as collateral, management, and "other". Financial indicators of collateral include the collateral coverage ratio, collateral protection, collateral liquidity, collateral margin, and guarantee. Examples of management include general management; individual, character, or cooperation; credit management; and production management. Examples of "other" include farm records, documentation, previous bankruptcy or restructuring, collected balance, communications, years to amortize, accounting status, enterprise trends, officer servicing time, split financing, and years farming (Pederson & Chellappan, 1991).

Ellinger et al. (1992) developed a table (Table 2.4) that illustrates the weights or relative importance percentages for the financial performance measurements outlined above. The results have been compiled through the use of 87 credit-scoring models and are, therefore, quite comprehensive. The table indicates the diversity of financial measurements used to estimate the variables. Ellinger et al. (1992) provide three reasons

for the widely differing credit scoring models. First, models may vary according to the purpose or use in lenders' decisions to grant credit to borrowers. The models can be used as a sole indicator of credit or in combination with other financial and non-financial factors, when making credit decisions. The models also can vary based on their use in loan approval and/or pricing decisions. Second, models may differ dependent on varying risk attitudes by agricultural lenders. Risk attitudes affect the risk rating classification system and, ultimately, affect loan pricing. Third, models may be dissimilar due to lenders' relative abilities to collect accurate and comprehensive financial data, reflecting lenders' level of experience or producers' abilities or desires to maintain adequate financial records.

Table 2.4. Relative Importance of Financial Performance Indicators

Weights Given the Different Variables and Number of Measures for Each Variable, 87 Credit Scoring Models.

	Weight Class				
	Proportion of Credit Scoring Models with Variable Weights in Each Class (%)				
Variable	0%	1 to 10%	11 to 30%	Greater than 30%	Number of Different Measures Used To Estimate The Variable
Profitability	21.80	3.50	71.30	3.50	8
Liquidity	6.90	5.80	60.90	26.40	7
Solvency	0.00	3.50	81.60	14.90	6
Repayment Capacity	54.00	3.50	35.60	6.90	10
Financial Efficiency	92.00	1.20	5.80	1.20	5
Collateral	8.10	15.00	67.80	9.20	5
Management	64.40	5.80	29.90	0.00	4
Other	77.00	3.50	19.60	0.00	11
Total					56

Source: Ellinger et al. (1992).

Lins et al. (1987) researched financial stress in agriculture and the most effective measurement method. Financial stress is related to annual net income and net worth relative to the needs of the operation. The definition of financial stress provided by Lins et

al. (1987) indicates that both the balance sheet and income statement are required to analyze the credit quality of a firm. They found that the debt/asset ratio historically was used as the sole indicator of credit. However, this financial performance measurement does not accurately portray financial condition. They concluded that a multiple classification criteria model that is accrual-based would eliminate classification errors.

A multiple classification criteria model developed by Splett et al. (1994) was selected as an appropriate model to analyze the credit quality of agricultural producers in this study. The model consists of a joint experience and statistical approach to credit-scoring term and operating loans. The experience model was derived based on lenders' experience, knowledge of the industry, and intuition (Splett et al., 1994). A statistical approach, logit regression, then was used to more accurately measure and test the experience model. The logit regression applies exact financial ratios when determining the credit score; whereas, the experience model applies the risk rating applicable to the scoring range. Therefore, the logit regression model should be more accurate; however, the results of their study indicate that the experience model accurately reflects the statistically estimated model.

The Splett et al. (1994) scoring model was developed for the Sixth Farm Credit District and utilizes financial performance measurements suggested by the Farm Financial Standards Task Force (FFSTF). The FFSTF was composed of 45 credit experts who analyzed 287 measures to obtain sixteen measures that could be used universally for agricultural analyses. Of these measures, five were selected to form the term-loan model, and four were selected to form the operating-loan model. The term-loan model applies greater importance or weight to the condition of the balance sheet, because the long-term

stability of the enterprise is of great significance. The operating-loan model applies greater weight to the income statement, due to the importance of short-term profitability and repayment capacity. The detailed structure of the model can be found in Chapter 3.

Background and History of BSE

Much emphasis has been placed on BSE since its discovery in the United Kingdom in 1986. Scientists were unable to immediately pinpoint the cause of the disease, thus resulting in a massive outbreak that totaled 182,000 cases and damages in excess of $5.6 billion for the United Kingdom cattle industry alone. The Central Veterinary Laboratory (CVL) of Great Britain eventually identified the animal disease in 1987 and concluded that it was caused by the consumption of meat and bone meal (MBM) made from the carcasses of infected cattle (Bervejillo & Jarvis, 2003).

Bervejillo and Jarvis (2003) cited the slow response by the United Kingdom in restricting MBM from being a source of the animal feed supply as one of the main factors contributing to the outbreak. This source of animal feed supply was finally banned in July 1988. However, the ban on MBM as a source of animal feed was given a "grace period" by the government to draw down existing stocks. Furthermore, the ban on MBM as a feed source for cattle did not stop manufacturers in the United Kingdom from exporting MBM to other countries until 1996, when a link between BSE and vCJD was officially recognized (Bervejillo & Jarvis, 2003). Therefore, infected MBM may have been fed to cattle for over 8 years after the ban was enacted.

Another factor contributing to the devastation was the inadequate research regarding risks to human health. Mechanically recovered meat (MRM) was not banned from use in human food in the United Kingdom until December 1995 (Bervejillo & Jarvis,

2003). MRM is a product that is derived from using jets of water to remove meat scraps from the vertebral column of slaughtered livestock. They note that humans were subject to contracting vCJD through 1995, because BSE-infected meat was still in the food supply. This delayed reaction by the UK government contributed to the approximately 147 documented cases of vCJD to date. According to Andrews (2004), there is statistically significant evidence that cases of vCJD are no longer increasing exponentially. A quadratic model suggests that the disease has already peaked for onsets and deaths.

The total number of BSE cases reported worldwide from 1986-2001 are summarized in Table 2.5. The UK cattle industry has experienced a significant percentage of the total reported BSE cases to date. However, BSE has directly impacted other countries' cattle industries as well including Canada and the United States.

Table 2.5. Reported Cases of BSE Since 1986, by Country

Country	1986-1995	1996-2001	Total Cases
UK	161,322	20,804	182,126
Ireland	115	722	837
Portugal	32	583	615
France	13	502	515
Switzerland	186	222	408
Germany	4	134	138
Spain	0	84	84
Other countries[a]	2	165	167
TOTAL	161,674	22,897	184,571

[a]Includes other European countries, plus three cases in Japan.
Source: Bervejillo & Jarvis (2003).

Characteristics of National Cattle Industry

To understand why interstate livestock movements and exports of beef products are so vital in modeling an animal disease outbreak, one must review the U.S. cattle industry.

Distinct regional flows of cattle and production phases, large volumes of exported beef, and interstate cattle movements characterize the U.S. cattle industry. In 2000, the gross receipts from the sales of cattle and calves totaled $40.8 billion or 21 percent of all agricultural receipts, making the beef sector the largest of all U.S. agricultural sectors (NCBA, n.d.). In 2002, the National Agricultural Statistics Service (NASS) reported total cattle and calves inventory for the United States at 96.7 million head (USDA-NASS, 2004c). According to Shields and Matthews (2003), about half of the U.S. beef cow inventory is located between the Mississippi River and Rocky Mountains, while the majority of feeder cattle are concentrated in the Southern Plains and southern portion of the Northern Plains. More specifically, North Dakota accounts for 1.97 million head or approximately 2 percent of the nation's total cattle and calves inventory.

Shields and Matthews (2003) have researched the composition of the national cattle industry and, more specifically, interstate livestock movements and the impact they would have on an animal disease outbreak such as BSE or foot-and-mouth disease (FMD). More than 30 FMD outbreaks around the world have been attributed to livestock importations or other livestock movements (Shields & Matthews, 2003). The magnitude of an animal disease outbreak is also highly dependent on the degree of interstate livestock movements. By tracking livestock through a national identification system, animal disease outbreaks can be more effectively contained and adverse effects minimized. For example, interstate livestock movements could be halted temporarily to limit spread. Halting livestock movements as a method of disease control would minimize overall losses to the economy, however, would greatly increase costs to producers due to overcrowded facilities, extra

feed, increased management, and animals becoming increasingly stressed and more easily infected.

Shields and Matthews (2003) reported that 57 percent of cattle are moved interstate throughout the production process. The majority of the interstate cattle movements in North Dakota are outflows, due to the state engaging in primarily cow-calf production. According to the Economic Research Service (ERS), 1.1 million head of cattle were transported from North Dakota in 2002, primarily to South Dakota, Iowa, Kansas, and Minnesota (see Figure 2.1). However, cattle also were shipped as far away as California, Oregon, Texas, and Georgia. Only 111,000 head of cattle were transported into the state in 2002. These shipments were received primarily from South Dakota, Montana, and Minnesota (see Figure 2.2).

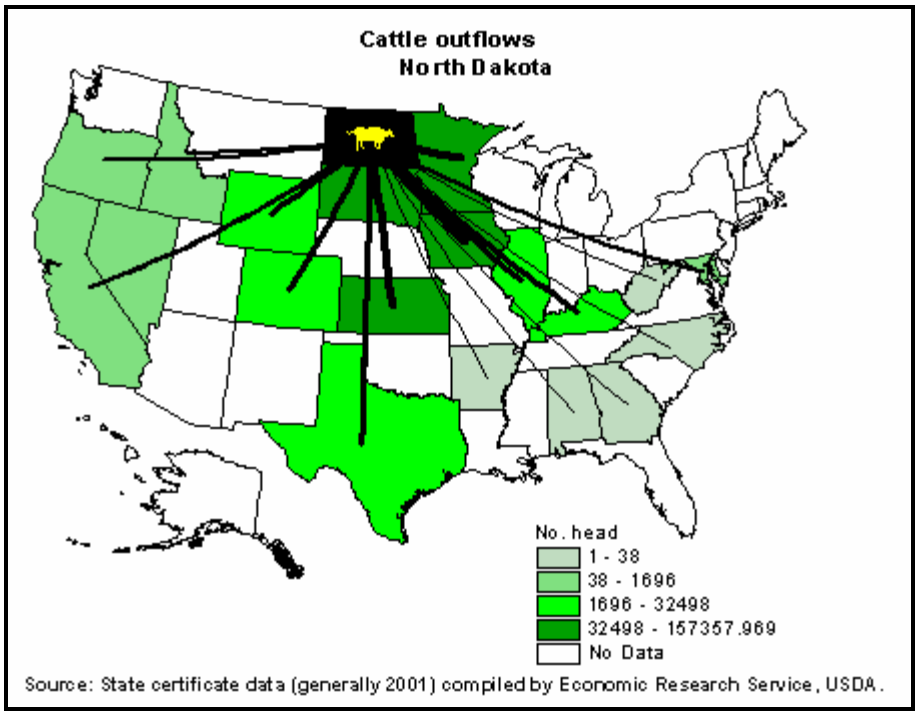

Figure 2.1. Interstate cattle outflows from North Dakota, 2001. Source: USDA-ERS (2001).

North Dakota also has three Canadian-U.S. border ports where cattle are transported into the country (Green, 2003). The ports are located in Portal, Dunseith, and Pembina and were responsible for the importation of approximately 3.23 million head of cattle in 2002, collectively. The single case of BSE in the state of Washington resulted from the importation of an infected cow from a dairy operation in the Canadian province of Alberta.

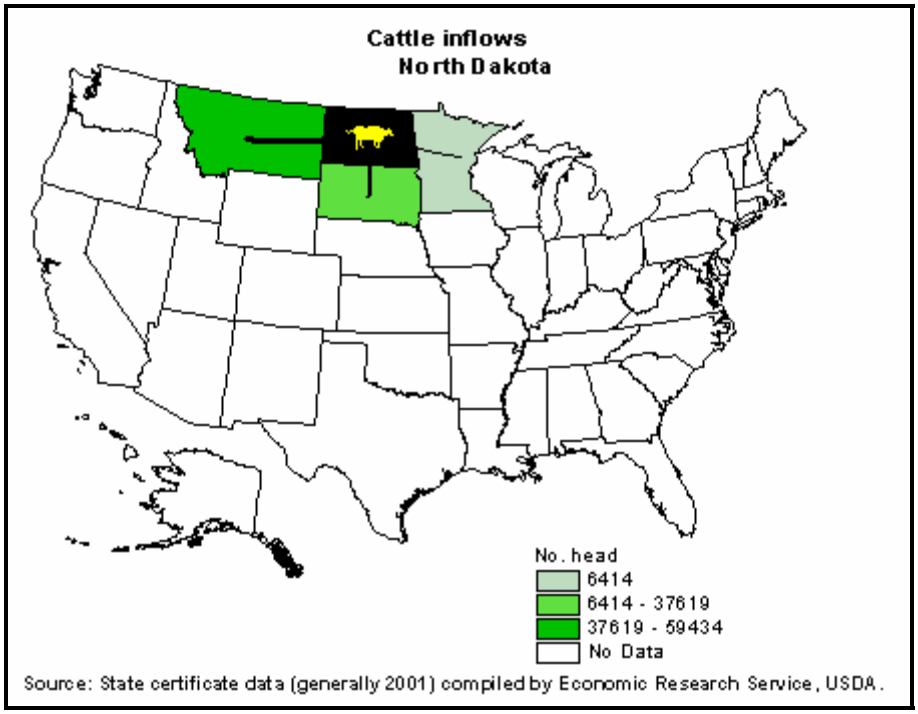

Figure 2.2. Interstate cattle inflows into North Dakota, 2001.
Source: USDA-ERS (2001).

Shields and Matthews (2003) cite three economic reasons for the pattern of livestock movements in the United States. First, the relative costs of transporting animals are lower in comparison to transporting feed/forage. Often, transporting live animals to pastureland is more cost effective, because the animal consumes such a large volume of

feed that is expensive to ship. Second, farms, feeding operations, and processors have specialized in areas of the production system to gain a cost advantage over competitors, contributing to the large volume of interstate cattle shipments. The third economic aspect is the geographic differences in forage availability and prices, which are affected by weather patterns, production technology, species of livestock, and time of year.

Francl (2003) researched the impacts that BSE would have on the United States and provided an overview of the importance of beef exports. Japan, South Korea, and Mexico were among the 24 nations that temporarily halted beef imports from the United States (Jin et al., 2004). Table 2.6 illustrates the top four importing countries of U.S. beef products. In 2002, they accounted for approximately 91 percent of U.S. beef exports with Japan, South Korea, and Mexico accounting for over 81 percent.

Table 2.6. Destination of U.S. Beef Exports (1998-2002)

	Million metric tonnes				
Destination	1998	1999	2000	2001	2002
Canada	87,402	85,004	87,501	80,424	83,826
Japan	371,228	358,924	366,536	333,055	251,889
South Korea	53,492	106,227	137,348	130,940	212,769
Mexico	142,051	158,054	173,081	177,528	206,766
Subtotal	654,173	708,247	764,466	721,947	755,250
Rest of World	62,247	95,717	70,450	58,062	73,417
Total	716,420	803,964	834,916	780,009	828,668

Source: Francl (2003).

USDA-APHIS Response to BSE

Control and preventive measures have become a top priority for the USDA and APHIS, since the recent discovery of BSE in the state of Washington on December 23, 2003. The USDA immediately euthanized 450 calves that belonged to the same herd as the

infected Holstein cow (USDA, 2003). It also recalled 10,410 pounds of raw beef that may have been exposed to tissues containing BSE. The USDA (2004) also issued five new regulations to address the sole case of BSE. First, downer cattle are prohibited from entering the food supply. Second, product must be held until confirmation is received that cattle have passed inspection. Third, specified risk material is prohibited from entering the human food supply. Fourth, advanced meat recovery product can be labeled as "meat" and is safe for human consumption, because current regulations prohibit spinal cord from entering the product. Last, air injection stunning (i.e., method of stunning cattle during the slaughter process) is prohibited to prevent possible contamination of the meat supply. The actions taken by the USDA, APHIS, and Food Safety and Inspection Service (FSIS) act to minimize risk and limit losses incurred by the agricultural sector.

A more comprehensive analysis of measures taken by the USDA to guard against the spread of BSE and other animal diseases and the economic impacts associated with animal diseases can be found in the Animal Disease Risk Assessment, Prevention, and Control Act of 2001 (USDA-APHIS, 2003). The contents of the report are outlined in the summary as follows:

- The economic impacts associated with the potential introduction of FMD, BSE, and related diseases into the United States;
- The risks to public health from possible links of BSE and other spongiform encephalopathies to human illnesses;
- Action by federal agencies to prevent FMD, BSE, and related diseases; and
- The sufficiency of legislative authority to prevent or control FMD, BSE, and related diseases in the United States.

Economic Impacts and Animal Disease Modeling

Numerous impact analysis studies have been conducted on BSE outbreaks and their impacts on aspects of the agricultural sector in various countries around the world (Green, 2003; Canadian Animal Health Coalition, 2003; Lawrence, Strohbehn, Loy, & Clause, 2003; Francl, 2003; Henson & Mazzocchi, 2002; Jin & Koo, 2003; Jin, Skripnitchenko, & Koo, 2004; Jin, Sun, & Koo, 2003; Burton & Young, 1996; Latouche, Rainelli, & Vermersch, 1998; Pennings, Wansink, & Meulenberg, 2002). The economic aspects of an animal disease outbreak involve cattle producers, crop producers (i.e., devaluation of pastureland and hay land), agribusinesses including financial institutions, consumer demand for beef, consumer perception of the relative safeness of beef, beef exports, U.S. live cattle futures prices, cash beef prices, and other short- and long-term effects involving the economy. All economic aspects listed will, in some way, affect agricultural financial institutions that service cattle producers. This section provides an overview of studies that focus on consumer demand analysis, agribusiness impact analysis, producer impact analysis, and animal disease outbreak modeling.

Consumer Demand Analysis

BSE has received much attention by consumers due to the small possibility of contracting vCJD from the consumption of BSE-infected beef products. To date, 147 cases of vCJD have been reported worldwide (Andrews, 2004). According to Jin, Sun, and Koo (2003), new information about the safety of a food product can stimulate drastically reduced demand due to consumers' intolerance of defective food products. Decreased demand for beef products in the event of a massive BSE outbreak, ultimately, will result in

huge losses to the cattle industry; therefore, consumer demand deserves much consideration.

Burton and Young (1996) have researched the impact of BSE in Great Britain on the demand for beef and other products by consumers. Their structural econometric model was a dynamic, almost ideal demand system (AIDS) that distinguished between short- and long-term responses to changes in market conditions. Their model indicated that short-term demand for beef products was reduced by 6 percent, and long-term demand (i.e., 3-4 years) was reduced by 4.5 percent. The model also indicated that the long-term effects were not attributable to changes in consumers' tastes and preferences. Burton and Young found that consumption of meat products in Great Britain shifted to lamb, pork, and poultry when BSE was first linked to vCJD.

Jin et al. (2003) conducted a study on consumer preferences in Japan after BSE was discovered. They found a drastic decrease in the consumption of both domestic and imported beef. Japanese consumers have substituted products such as pork and chicken for beef and have continued the upward trend of consuming substitute products. Jin et al. (2003) also found that Japanese consumption of beef has been undergoing a structural change due to tighter U.S. supplies, higher prices, health concerns, and the appreciating dollar. The outbreak of BSE in Japan occurred during this change and magnified the downward trend of imported beef consumption. A food safety problem such as BSE resulted in decreased domestic beef consumption and the willingness to pay premiums for imported beef from BSE-free countries.

Pennings et al. (2002) decompose consumer risk response to a BSE outbreak into risk perception and risk attitude. Risk perceptions reflect the consumers' interpretation of

the degree of risk in contracting the vCJD disease. Risk attitude is defined as the consumer's general predisposition to risk in a consistent way. Therefore, if the consumption of beef is driven by risk perception, educating consumers through the use of the media will help to curb the adverse effects of consumer response. Conversely, if consumption is driven by risk attitude, the beef industry has no choice but to increase expenditures on testing for BSE in cattle. Pennings et al. (2002) also note that the consumption of beef can be driven by a combination of the two components of risk response. Application of this theory to a BSE outbreak indicated that American consumers were driven by risk perception, because they had a great deal of trust in the Food and Drug Administration (FDA) and a relatively low level of risk aversion regarding contracting vCJD. According to their results, educating Americans about BSE would be the most effective way to negate adverse consumer responses to the BSE outbreak.

Latouche et al. (1998) researched food safety and how BSE affected French consumers. A survey was conducted on French consumers' willingness to pay for beef products certified to be "BSE free". They found that BSE results in a drastic loss in consumer confidence in the food supply, as well as farm production systems. Therefore, consumers were willing to pay a premium of between 13.7 and 22 percent for "BSE free" beef products. The authors also stress consumers' desire and WTP to know the origin of beef products and production processes.

Jin et al. (2004) estimate that the BSE case in the state of Washington could reduce domestic consumption by 10 percent and exports by 75 percent, potentially decreasing the price of beef by 15 percent. However, given additional occurrences, consumption of beef could decrease by more than 20 percent with nonexistent exporting activity. This scenario

could reduce prices of beef products by up to 26 percent. The Jin et al. (2004) study will receive much more attention in the *Producer Impact Analysis* section as well as discussions of the research project model.

Agribusiness Impact Analysis

The impacts of a BSE outbreak are experienced by all cattle producers due to market impacts; however, producers are at further risk of loss when located at or near the source of the outbreak in which the eradication of livestock herds is mandatory. Agribusinesses across the United States, such as agricultural financial institutions, beef processors, wholesalers and retailers of beef products, suppliers of feed and other inputs to beef producers, and manufacturers of dairy products, are also drastically affected. Reductions in U.S. beef exports to major beef trading partners (Canada, Japan, South Korea, and Mexico) have been the main cause of loss by the agribusinesses outlined above. According to Jin and Koo (2003), Japanese wholesalers and retailers of beef products experienced declines in sales ranging from 5-50 percent when BSE surfaced in their cattle industry. U.S. retailers have experienced less drastic declines in sales revenue. However, some of the nation's beef processors also reported losses in the form of initial (i.e., immediate, temporary) layoffs in excess of 20 percent (Davidson, 2004). Similar decreases in sales volume and revenue can be expected in related industries due to decreased beef prices and exports.

Henson and Mazzocchi (2002) conducted an event study on equity prices of agribusinesses after a possible link between BSE and vCJD was established in the United Kingdom on March 20, 1996. They cited this food "scare" as being an extremely difficult situation for agribusinesses to address, because there is no time to adjust and economic

losses rapidly begin to multiply. The study incorporates a total of 24 companies in the beef processing, other meats, dairy processing, animal feed, and pet food industries. They found that the beef and animal feed and pet food categories were most negatively affected. The dairy sector also reported negative abnormal returns; however, they were lower in absolute terms. The other meats sector was the sole sector analyzed that experienced a gain by the established link between BSE and vCJD. Henson and Mazzochi (2002) also reported that beef processors had the most substantial losses overall in the agribusiness sector.

Rural agricultural financial institutions, such as those in North Dakota, have not received attention as to how they are affected by an animal disease outbreak. This study attempts to establish the link between losses assumed by the cattle producers and banks that service their outstanding operating and farm real estate loans.

Producer Impact Analysis

Cattle producers are the core of the nation's beef industry, thus benefiting from increased beef prices during economic upswings and suffering significantly from low beef prices such as the case with a prolonged outbreak of BSE. The magnitude of losses experienced by cattle producers is directly related to the number of BSE cases discovered and the longevity of substantially reduced beef prices. Therefore, an increasing number of cattle producers would default on operating and farm real estate loans given reduced prices over an extended period of time. An overview of modeling price reductions of beef commodities received by cattle producers is discussed in the following section.

BSE Outbreak Modeling

The majority of the research studies conducted thus far with respect to BSE are characterized as macro studies (i.e., estimations of total economic losses). This study is the

first research project to address the link between a BSE outbreak and financial losses by agricultural financial institutions on a micro level. Research regarding BSE outbreak modeling in the United States and neighboring Canada is limited, due to the relatively recent discovery of the disease in 1986. The majority of reported cases of BSE early on were located in the United Kingdom, Switzerland, and Ireland. However, BSE has received more attention by the United States recently due to the discovery of one case of BSE in Canada and, more importantly, the discovery of BSE in the state of Washington. Jin et al. (2004), Francl (2003), the Canadian Animal Health Coalition (2003), and the USDA-APHIS (2003) all have developed models that identify macroeconomic impacts.

The Canadian Animal Health Coalition prepared a BSE economic impact assessment on June 20, 2003, in response to the discovery of BSE on May 20, 2003. The research was conducted on national and regional levels and based on two response scenarios: a one-month trade ban and a four-month trade ban. The scenarios provide general economic conditions as well as numerous assumptions regarding trade loss and other economic and industrial aspects. A listing of these conditions and assumptions can be found in the BSE Economic Impact Assessment (Canadian Animal Health Coalition, 2003). The study emphasized losses assumed by sectors of the Canadian economy. Losses were estimated under both scenarios for direct and indirect impacts as well as trade losses (Table 2.7). Direct impacts include losses attributed to detection and surveillance, cow-calf sector, feeder industry, and the processing sector. Indirect impacts include losses sustained by the farm and processing sectors.

The rapid or delayed recovery impacts reflect any loss due to trade and additional marketing and trading costs once the one- or four-month trade ban has been lifted. The

rapid recovery scenario was defined by rapid recovery of the market share following the lifting of a ban and before market shares stabilize at a level that is 90 percent of the pre-incident level. The delayed recovery scenario was defined by the market share recovering at a slower rate, but ultimately stabilizing at the same 90 percent level. The severity of a single case of BSE is summarized in Table 2.7 with overall expected losses ranging from $1.5-4 billion. The results also indicate that cattle producers would lose an estimated $25.5 million under the one-month trade ban scenario. The four-month trade ban scenario indicated a significantly larger loss of approximately $350 million.

Table 2.7. Results from Canadian BSE Impact Analysis

	Response/Recovery Scenarios (000's)	
Impact/Cost	One Month Ban	Four Month Ban
Direct Sector Impacts	$166,295	$707,563
Indirect Sector Impacts	$40,018	$426,833
Total Industry Impacts	$206,313	$1,134,397
Trade Losses	$368,555	$1,474,219
Total Sector Impacts	$574,868	$2,608,615
Consumer Surplus	-$33,600	-$55,136
Net BSE Impacts	$541,268	$2,553,479
Rapid Recovery	$1,000,000	$1,000,000
Delayed Recovery	$1,500,000	$1,500,000

Source: Canadian Animal Health Coalition (2003).

Francl (2003) developed an economic impact analysis of BSE in the United States and compared the outbreak to Canada's recent experience with the disease. Canadian prices fell from $107 CND to $30 CND within eight weeks of the occurrence. However, Francl concluded that the U.S. case of BSE would be much less dramatic for the following reasons. Canada historically exported 50 percent of its beef as live cattle or beef. Of that amount, 80 percent of Canada's live cattle exports and 40 percent of its beef was shipped to

the United States. This market was closed after the announcement of BSE in Canada. The United States exports only about 10 percent of beef produced. The United States is better able to adjust international trade, meaning import less and consume more domestic beef.

Francl's (2003) research also produced estimates for prices, consumption, U.S. beef trade, and beef producer impacts. Average beef prices are expected to decline by $10.50 in the first quarter of 2004 as a result of BSE. Live cattle futures contracts also were estimated to decline by $5-10 for the second half of the year. Francl's (2003) research indicated the net decline in U.S. consumption of beef to be around 450 million pounds for the first quarter of 2004. U.S. beef trade for the year was estimated to decline by almost $2 billion, given lower export quantities and decreased prices. The combination of these factors was estimated to result in a total loss of $3.5 billion to beef producers (i.e., $2.5 billion decline in sales revenues due to price decline and $1 billion decline in revenues due to decreased export volume).

Jin et al. (2004) developed a model illustrating the impacts of the BSE case in the United States on the beef and cattle industry. This study specifically evaluates the effects of decreased beef demand on farm-level prices and supply. The prices received by producers for slaughter and feeder cattle given scenarios of decreased demand and exports due to a BSE outbreak are summarized in Table 2.8.

Pre-BSE prices and quantities are provided as baseline measures for the analysis. Then, the impacts associated with an outbreak are applied to the model, and BSE affected prices are developed. Jin et al. (2004) conclude that a single, isolated case may reduce domestic consumption by 5-10 percent. This decline could potentially reduce the domestic price of slaughter cattle by 13.5 percent and the domestic price of feeder cattle by 16

percent. However, additional cases of BSE could result in a 20 percent reduction in demand and the discontinuation of the international beef trade. This scenario would result in decreases of slaughter and feeder cattle prices of 20.9 percent and 24.5 percent, respectively. The Jin et al. (2004) impact assessment will be applied to the producer model in this study as a means of measuring the impacts of a BSE outbreak in the United States.

Table 2.8. The Effects of Decreased Beef Demand on Farm-Level Prices and Supply

Scenarios		Price of Slaughter Cattle	Quantity of Slaughter Cattle	Price of Feeder Cattle	Quantity of Feeder Cattle	Producer Surplus
Demand Decrease	Exports Decrease	Base Prices				
		$67.14	35.8	$80.07	32.7	$22,974.00
5%	50%	$61.63	36.6	$72.25	32.7	$21,562.00
	75%	$59.99	36.9	$69.96	32.7	$21,137.00
	100%	$58.34	37.1	$67.66	32.7	$20,706.00
10%	50%	$59.64	36.9	$69.46	32.7	$21,045.00
	75%	$58.05	37.2	$67.26	32.7	$20,630.00
	100%	$56.46	37.4	$65.05	32.7	$20,210.00
15%	50%	$57.79	37.2	$66.89	32.7	$20,561.00
	75%	$56.26	37.5	$64.77	32.7	$20,156.00
	100%	$54.71	37.7	$62.65	32.7	$19,745.00
20%	50%	$56.08	37.5	$64.52	32.7	$20,108.00
	75%	$54.59	37.8	$62.47	32.7	$19,711.00
	100%	$53.09	38.0	$60.43	32.7	$19,310.00

Source: Jin et al. (2004).

Simulation Modeling in Agriculture

Simulation in agricultural economic modeling has been widely adopted by researchers as a method to account for stochastic commodity prices, weather conditions, crop yields, and policy effects. The use of stochastic simulation as a modeling tool has been applied to evaluate farm financial performance (Schnitkey, Barry, & Ellinger, 1987),

farmland investments (Schnitkey, Taylor, & Barry, 1989), machinery investment decisions (Gustafson, Barry, & Sonka, 1988), and the production of maize, including harvesting and drying costs that are weather dependent (Peart, Ogilvie, Barrett, & Bender, 1985).

Schnitkey et al. (1987) describe the properties of the Farm Financial Simulation Model (FFSM) and apply it to a crop farm. The FFSM is a modeling tool for analyzing the various managerial strategies implemented by farm managers and the effects that government policy change has on the financial structure of individual farms through the use of simulation over a four-year period. Emphasis is placed on financial components such as sales and purchases of farm assets, financing terms, debt management, cash flows, tax obligations, consumption levels, and growth rates. Financial performance measurements, including profitability, liquidity, and solvency, are derived to measure the change in one or more of the variables listed above and the effect of the change on the farm's financial condition. The scenarios that were applied to the FFSM included a 35 percent reduction in the farm's initial indebtedness, a 35 percent reduction in interest rates, a deferral of debt principal and interest payments for two years, a sale of 35 percent of the farm's assets with no lease back, and an infusion of new equity capital in the amount of 35 percent of the farm's total indebtedness. Schnitkey et al. (1987) indicated that the FFSM was developed in response to the farm crisis of the 1980s when farmers experienced decreasing profitability and had difficulty meeting scheduled debt payments. The decline of farm financial performance drastically affected agricultural lenders, agribusinesses, and rural communities that relied heavily on agriculture to sustain their local economy.

Gustafson et al. (1988) applied the FFSM created by Schnitkey et al. (1987) to machinery investment decisions for Illinois farmers. The farmers included in the study

were located in central Illinois; 95 percent or more of their crop acreage was from corn, soybeans, and wheat; livestock receipts could not exceed 5 percent of total cash receipts; and farm acreage exceeded 300 acres. This sample was further divided into representative categories based on tenure position, leverage ratios, and the ages of owned machinery. The stochastic elements of the problem were elicited from each farmer in the sample and included highest, most likely, and lowest (i.e., triangular distribution) expected commodity prices and yields, interest rates, and inflation rates. Financial ratios measuring profitability, liquidity, and solvency were estimated using the simulation process for the selected like groups in the sample. Gustafson et al. (1988) concluded that the level of machinery investment was statistically related to the tenure and leverage of farm owners, current economic conditions, and age of existing machinery. Various policy impacts influenced the timing of machinery investment decisions, however, did not influence total investment amounts.

Schnitkey et al. (1989) evaluated optimal farmland investment decisions given stochastic production returns and farmland prices. Purchasing additional farmland through the use of debt financing increases debt leverage and risk faced by the farm owner. Therefore, an optimal level of owned farmland acreage exists given stochastic production returns and farmland prices. Their model incorporated direct returns (i.e., gross revenue minus variable costs) as the only stochastic variable. Non-stochastic variables considered in the analysis included previous farmland prices, the number of owned acres, and current debt-to-farm-asset ratio.

Peart et al. (1985) define simulation as providing a way of analyzing proposed systems or policies without actually implementing them. They applied simulation

modeling to maize production, including harvesting and drying that is weather dependent. Their model can be used to select the capacity of new farm machinery and equipment, such as a dryer or combine, and different planting schedules or seed varieties with different maturities.

Simulation Modeling of Financial Institutions

The use of simulation modeling in financial institutions has been widely adopted as a means of analyzing and understanding situations with uncertain outcomes. Financial officers encounter complex issues in a stochastic environment and, therefore, rely on simulation to make sound decisions. Simulation has been applied to issues in agricultural finance such as credit scoring, loan pricing, and farm business performance (Barry & Ellinger, 1989); loan portfolio funding requirements (Albright, n.d.); bank capital adequacy (Stokes, n.d.); and agricultural loan portfolio risk (Gallagher, 2002).

Barry and Ellinger (1989) developed a multiperiod simulation model that endogenizes farm investment decisions, credit evaluations, and loan pricing based on the credit scoring procedures of agricultural lenders. Their model was used to analyze the relationship over time between farm performance and loan financing terms given alternative investment strategies, economic conditions, and initial financial positions. The loan pricing or credit scoring procedure is composed of five variables. The variables are equally weighted and include solvency, liquidity, cash flow, profitability, and debt exposure. Solvency is measured by the ratio of debt to total assets; liquidity is represented by the current ratio; cash flow is measured by the debt servicing ratio; profitability is measured by the rate of return on assets; and debt exposure is measured by the value of farm production plus non-farm income divided by total liabilities. A score is applied to the

loan pricing procedure based on how well the farm business performed in each category. The weighted average score of the farm business corresponds to an interest rate or loan price designated by the financial institution. Therefore, a well-established farm with an exceptional borrowing history will receive loans that are priced comparatively lower than a beginning farmer who has little or poor borrowing history. The results of the analysis indicate credit-scored pricing yields time patterns of performance, credit classifications, and interest rates that parallel the farm's investment, financing, and debt servicing activities (Barry & Ellinger, 1989).

Albright (n.d.) illustrated the use of simulation as a method of estimating loan portfolio funding requirements. Financial institutions must monitor their funding supply carefully to ensure an adequate level of funding exists to service customer loans. An excess funding supply or allocation of funds leads to additional loan servicing costs; whereas, an insufficient funding supply leads to liquidity problems. "Open-ended" loans or lines of credit represent a significant source of uncertainty with respect to the funding supply, because withdrawal and repayment rates and values are unknown. Simulation was incorporated to apply relevant probability distributions to model credit utilization behavior, repayment patterns, and risk characteristics. Funding criteria then is established to minimize liquidity risk assumed by the financial institution.

Federal regulation and the Basle Agreement established in 1999 require banks to maintain a level of risk-based capital (Barry, Ellinger, Hopkin, & Baker, 2000). According to the Basle Agreement, capital is divided into two categories; tier 1 or "core capital" and tier 2 or "supplemental capital." Tier 1 capital is composed of primarily tangible equity capital, and tier 2 is composed of subordinated debt, loan loss reserves, and intermediate-

term preferred stock (Barry et al., 2000). Tier 1 capital must be at least 4 percent of risk-adjusted assets, and total capital (i.e., tiers 1 and 2) must be 8 percent of risk-adjusted assets. Assets are classified into risk-adjusted categories and assigned weights to determine total risk-adjusted assets. Cash and U.S. government securities carry no default risk and, therefore, are assigned a zero weight. Cash items in the process of collection as well as mortgage-backed U.S. government and U.S. government agency securities are given a 20 percent weight. The 50 percent weight category includes assets such as state and local revenue bonds and first mortgages on home loans. Finally, the 100 percent category includes assets that are high risk such as commercial and agricultural loans. Agricultural banks, therefore, must have a large amount of capital on hand (i.e., 8 percent of outstanding agricultural loans) due to the 100 percent category regulatory requirement.

Stokes (n.d.) claims that banks and regulators have differing opinions as to necessary minimum capital requirements, because holding excess capital is expensive and provides shareholders with a minimal return on their investment. Excess capital must be held by financial institutions to guard against future, unexpected losses that are attributed to credit, market, and operational risks in lending money. However, the amount of capital that must be held by financial institutions to guard against losses has been debated. Stokes (n.d.) provides an alternative analysis of bank capital adequacy using simulation. The optimal level of risk-based capital can be determined by selecting the percentile of the simulated loss distribution associated with the bank's target level of insolvency probability (Stokes, n.d.). The example cited assumes that the bank desires to maintain a good credit rating and, therefore, chooses a probability of solvency of 99.97 percent or a probability of

insolvency of 0.03 percent. This target level of insolvency was applied to the simulation model, and loss distributions were estimated for credit, market, and operational risk.

Gallagher (2002) developed a simulation model that incorporates farm-level production risk (i.e., crop-yield risk) and intra- and inter-temporal correlation of yields and prices over a ten-year period, when determining the reserve for agricultural loan losses. Gallagher (2002) defined loan loss as the loss to the lender resulting from a loan balance including interest that exceeds pledged collateral value after accounting for production sales that were applied to the loan. Currently, a point estimate approach is most widely used. It includes short-term point estimates for yields, prices, interest rates, and other income in projecting future earnings and the ability of farm firms to repay loans. This method does not consider the benefits of borrower portfolio diversification (i.e., correlation among crop yields and prices). Simulation output enables a more comprehensive analysis by providing probability distributions for alternate strategies; whereas, the point estimate approach produced only a single estimate or most likely outcome. Therefore, the proposed methodology allows for a more comprehensive analysis that provides a more realistic outlook for the loan loss account.

CHAPTER 3. DATA AND METHODOLOGY

The decreased farm-level prices received by agricultural producers in the event of a BSE outbreak can be particularly troublesome, especially if low prices persist for an extended period of time. U.S. cattle producers have experienced decreased prices for beef cattle since the case of BSE was discovered in December of 2003. However, price impacts to U.S. producers have been minimal due to the current stage of the cattle cycle and the government's swift action to prevent any additional BSE cases from occurring. Cattle prices are currently quite favorable to producers mainly due to the cattle cycle. The present cattle cycle is in its tenth year with two more years of the liquidation phase likely (USDA-ERS, 2004a). Therefore, low cattle inventory levels have resulted in high prices, allowing producers to more successfully withstand the nation's first case of BSE. The USDA and APHIS also have expended a vast amount of resources to negate any additional cases of BSE from occurring and to ensure the safety of the meat supply in limiting losses resulting from decreased exports and consumer demand for beef products.

Additional cases of BSE can have a much greater impact on consumer demand, exports, and domestic farm-level prices of cattle. In Japan, on September 10, 2001, a single case of BSE was discovered, as was the case with the United States. Strict European standards were adopted, and one million cattle were tested for BSE in an attempt to prevent the spread of the disease (Jin et al., 2004). However, the attempts to contain the disease failed when additional cases of BSE were discovered two months later. The Japanese cattle industry was significantly affected as farm-level prices and domestic consumption of beef products drastically declined due to public perception of food safety issues and limited exports. Cattle producers in the United States could experience considerable price declines

similar to the Japanese outbreak if additional cases of BSE were to be discovered. A more significant decline in cattle prices could result in financial difficulty for many of the nation's beef producers and, ultimately, have a great impact on agricultural financial institutions that lend funds to cattle operations.

Fluctuations in beef cattle prices (i.e., breeding cows, breeding bulls, bred heifers, steers and heifers, and feeder calves) will be applied to the appropriate producer financial statements and act as the driving variables in the agricultural producer model. Jin et al. (2004) simulated various scenarios of BSE outbreaks in the United States and determined changes in retail meat prices and farm-level prices and supply of slaughter and feeder cattle. Using the Jin et al. model, the changes in valuation of breeding cattle herds are estimated in this study and will be addressed under the *BSE Economic Impact Analysis* section that follows. Cattle producers' diminished abilities to repay loans stem from lost sales revenues and the devaluation of breeding cattle herds, pastureland, and hay land. The resulting changes in key financial performance measurements, such as the current ratio, equity/asset ratio, return on equity, term-debt coverage ratio, and net farm income from operations ratio, are applied to the bank model through the use of a credit-scoring model developed by Splett et al. (1994).

The bank model consists of simulated agricultural loan portfolios (see Table 3.15) of representative financial institutions in North Dakota that would be indirectly affected by a BSE outbreak. Financial intermediaries are indirectly affected, because they rely on maintaining positively performing agricultural asset portfolios. Cattle producers' inabilities to meet financial obligations for an extended period of time and their resulting

diminished credit quality may cause substantial losses to banks in terms of both the need to increase the allowance for loan loss reserve account and diminished profitability.

The agricultural financial impact analysis model consists of the following four sections: producer model, BSE impact analysis, credit-scoring model, and bank model. The producer model is composed of a balance sheet, income statement, and statement of cash flows. The BSE economic impact analysis addresses relevant data and how the model accounts for the price impacts derived by Jin et al. (2004). The operating and term credit-scoring models are adapted from Splett et al. (1994). These models provide a comprehensive financial analysis (i.e., liquidity, solvency, profitability, repayment capacity, and financial efficiency) of producers' financial conditions pre- and post-outbreak. The bank model provides an analysis of fluctuations in the allowance for agricultural loan losses, collateral value, and agricultural loan volume by asset quality rating. Each section of the empirical analysis discusses assumptions, data used in the analysis, and key variables. This chapter also discusses how the producer and bank models are interrelated and the methodology utilized in the study.

North Dakota Agricultural Producer Model

The producer model is essentially a set of interrelated financial statements that reflect North Dakota agricultural producers' financial well-being as of December 31, 2002. The main inputs to the model are obtained from financial data including the balance sheet, income statement, and statement of cash flows for the 482 producer data set (Andrew L. Swenson, personal communication, March 15, 2004). The basic structure of the modeling framework is illustrated in Appendix A. The one-period framework is modeled to account for various scenarios of BSE outbreaks, ranging from the current situation in the United

States to the more extensive outbreak that occurred in Japan. The modeling framework exhibits dynamic modeling properties by allowing the beef prices to be adjusted, which is reflective of the BSE outbreak occurring throughout the cattle cycle. A detailed analysis of the impacts or shocks of a BSE outbreak can be found in the *BSE Economic Impact Analysis* section. In this section, the modeling assumptions, data set, variables, and producer model are described.

Data and Assumptions

The main assumption of the producer model is that the data sample reflects the composition of production agriculture in North Dakota. The data sample is comprised of 482 producers, and the majority of counties in the state are represented (see Figure 1.2). This study assumes four groups of like producers in the state: beef producers, crop producers, beef and crop producers, and "other" producers. Table 3.1 illustrates the number and percentage of producers by representative category and the percentages that each category contributes to the total gross cash farm income of the data set.

Table 3.1. Producer Data Sample

Producer Categories	Number of Farms	Percentage of Total Farms	Percentage of Gross Cash Farm Income
Beef Production Farms	57	11.83%	8.46%
Crop Production Farms	207	42.95%	51.71%
Crop and Beef Production Farms	88	18.26%	19.19%
"Other" Production Farms	130	26.97%	20.64%
Total	482	100.00%	100.00%

Source: Swenson (2003).

Farm enterprises are classified as beef production enterprises if 70 percent or more of their sales are a result of cattle production. The crop producer category incorporates

those producers in which the sales of crops represent 70 percent or more of the total sales. The beef and crop producer category incorporates those producers in which the sales of beef and crops combined account for 70 percent or more of the total sales. The fourth category, termed "other", includes all other enterprises where the production of beef, dairy, crops, hogs, and sheep taken together account for greater than or equal to 70 percent of gross sales. The data set was divided into the representative categories for two main reasons: (1) to determine how each type of producer would be impacted financially by a BSE outbreak, and (2) to properly model various scenarios of agricultural loan portfolios.

A one-period modeling framework allowed many accrual accounting adjustments that would normally be applied to the income statement to be considered fixed. Accrual accounting adjustments include inventory changes and depreciation and other capital adjustments. The adjustments considered in the producer model are the inventory change for market livestock and the depreciation and other capital adjustments entry on the income statement for breeding livestock. The accrual accounting adjustments for inventory changes that are assumed fixed in the analysis include crops and feed, accounts receivable and other current assets, prepaid expenses and supplies, and accounts payable and accrued expenses. The accrual accounting adjustments for depreciation and other capital adjustments that are assumed fixed in the analysis include machinery and equipment, buildings and improvements, and other capital assets.

Another significant assumption of the producer model is that it ignores any effects on dairy income. Dairy cattle and beef cattle are equally at risk of contracting BSE. However, dairy products such as milk are marketed differently than beef cattle and thus would require additional research on the impacts of BSE to the dairy market. This study

does not intend to model BSE outbreaks by determining how the disease affects cattle and cattle products. Rather, this study utilizes research previously conducted by Jin et al. (2004) as to how the disease impacts beef prices. The objectives of this study are to determine how the price impacts affect agricultural producers and, more importantly, the financial institutions that service beef production loans. The data sample utilized in the study indicates that only $3.4 million or 2.7 percent of total North Dakota gross cash farm income is derived from dairy production. Therefore, the assumption underestimates losses.

Producer Model

The producer model is designed to apply slaughter, breeding, and feeder cattle price reductions resulting from various magnitudes of BSE outbreaks to the current financial conditions of North Dakota agricultural producers. Sections that follow discuss how the balance sheet, income statement, and statement of cash flows are impacted by the price reductions and how the model accounts for these changes. The diminished abilities of agricultural producers to repay operating and other real estate loans and their overall credit quality are applied to the financial conditions of banks in North Dakota.

Balance Sheet. The balance sheet of agricultural producers is affected by BSE outbreaks in a variety of ways. The current farm assets section is composed of cash and checking, crops and feed held for sale, market livestock, and other current assets. Cash and checking, crops and feed held for sale, and non-farm assets, including savings and stocks and bonds, are referred to as cash and cash equivalents when determining producers' repayment abilities.

Market livestock is valued on a total dollar basis and consists of dairy cattle, beef cattle, hogs, and sheep. Due to aggregated data, it was not possible to determine the value

per head or inventories of livestock on the producer level. The valuation of beef cattle must be determined to apply BSE price impacts accurately. Hogs and sheep are assumed to be unaffected by a BSE outbreak. Therefore, prices and valuations of substitute products are assumed fixed. Also, price impacts to dairy cattle are not considered for the reasons described above. An assumption was made that the total valuation reported for market livestock on the producer level will be allocated among beef cattle, dairy cattle, hogs, and sheep based on their respective contribution or percentage of total livestock sales.

Representative of statewide cattle inventories, the beef cattle valuation is further divided into dollars contributed by slaughter and feeder cattle. Again, this determination was necessary to model and apply the BSE price impacts accurately. This method of determining the market livestock valuation on the balance sheet results in a beef cattle combination of 39 percent slaughter inventory and 61 percent feeder inventory. The beef cattle contribution to the market livestock entry in the current assets section of the balance sheet was calculated using North Dakota cattle inventory data from 1994-2002 as reported by NASS. A more detailed description of the beef cattle ratio can be found in the *BSE Economic Impact Analysis* section. This portfolio mix will be utilized when modeling the percentage price effects outlined below. The other current assets entry represents current assets that are not affected by a BSE outbreak and, consequently, will be assumed fixed throughout the analysis.

The intermediate farm asset section of the balance sheet also will be affected by a BSE outbreak. The valuation of breeding livestock herds was reported on a total dollar value basis and is assumed to be entirely composed of beef breeding cattle. However, it was not possible to distinguish between dollar values contributed by bred cows, bred bulls,

or bred heifers. A bred heifer is defined as a cow that is pregnant with its first unborn offspring; whereas, a cow is part of the breeding herd and has already born a calf. Again, an assumption was made that the total valuation reported for breeding livestock was to be divided based on state-level inventories between breeding cows, breeding bulls, and breeding heifers when applying percentage price reduction effects (see *BSE Economic Impact Analysis* section).

The long-term farm asset section of the balance sheet will be affected by decreased farmland values in the event of a BSE outbreak. The North Dakota Agricultural Statistics Service publishes an annual report titled *North Dakota County Rents and Values Report*. The report contains cash rental rates and land values for North Dakota and distinguishes between pastureland, hay land, and cropland. A regression analysis indicates that pastureland and hay land values are significantly affected by decreased feeder cattle prices, while changes in cropland value are statistically insignificant. The analysis is described in detail in the *BSE Economic Impact Analysis* section. This section explains how the impacts are accounted for in the model.

The long-term assets were reported as a total value on the producer level. Therefore, a few important assumptions were made regarding long-term farm assets in the modeling process. According to Sherrick and Lins (2000), farmland represents approximately 75 percent of the aggregate value of the assets in the agricultural sector. Crop producers typically own more farmland than livestock producers. However, the data set only provides a total valuation for long-term farm assets. Therefore, an assumption was made that 75 percent of long-term assets are farmland and 25 percent are other assets, including buildings and machinery. A farmland portfolio was developed that is dependent

on the composition of sales receipts. Therefore, if a producer receives a majority of his/her income from crop production, it is assumed that he/she owns cropland. Conversely, if a producer receives a majority of his/her income from livestock production, it is assumed that he/she owns pastureland and hay land. In this case, it is assumed that an equal amount of pastureland and hay land is owned. This ensures that only pastureland and hay land are affected by decreased beef cattle prices in the modeling process.

Income Statement. The income statement also will experience losses resulting from decreased beef income or gross cash farm income. Estimated reductions in slaughter and feeder cattle prices will decrease the profitability of beef cattle producers. The statewide slaughter and feeder cattle inventory ratio developed for the balance sheet will be applied to the total income reported from beef sales. This ratio allows the respective percentage price reductions to be applied to the producer income statement.

Decreased net income also will result from accrual accounting adjustments such as changes to the market livestock inventory valuation, breeding livestock depreciation, and other capital adjustments. The cash operating expenses are assumed fixed in the analysis. The market livestock inventory valuation will be altered due to a change in the final valuation reported on the balance sheet. The market livestock inventory change is calculated as follows:

$$\textit{Ending Inventory} - \textit{Beginning Inventory} \qquad (10)$$

It was necessary to distinguish between inventory changes due to dairy cattle, beef cattle, hogs, and sheep. An approach similar to the balance sheet market livestock portfolio

determination was utilized. The portfolio mix and corresponding percentages were determined and multiplied by the total inventory change to distinguish among the inventory change attributed to beef cattle, dairy cattle, hogs, and sheep. Then, the percentage price effects were applied only to the inventory change attributed to beef cattle.

The breeding livestock depreciation and other capital adjustments accrual accounting entry also is altered by diminished beginning and ending inventory valuations and decreased sales and purchase values. The breeding livestock depreciation, capital adjustment, is calculated as follows:

$$\begin{pmatrix} Ending\ Inventory + Capital\ Sales - \\ Beginning\ Inventory - Capital\ Purchases \end{pmatrix} \tag{11}$$

The ending inventory valuation for breeding livestock is found under the intermediate assets section of the December 31, 2002, balance sheet. The beginning inventory valuation for breeding livestock was taken from the December 31, 2001, balance sheet. Both entries were adjusted for estimated price reductions due to a BSE outbreak. The capital sales and purchases of breeding livestock were also adjusted for estimated price decreases. They can be found on the statement of cash flows. The remaining accrual accounting adjustments were considered fixed in the analysis.

Statement of Cash Flows. The statement of cash flows is the final financial statement utilized in the producer model. The cash flows from operating and investing activities are impacted by a BSE outbreak. The cash from operating activities section again will be impacted by decreased beef income resulting from losses in cash sales due to price

declines. The decreased beef income on the statement of cash flows is computed in the same manner as the income statement.

The cash from investing activities section will be impacted by fluctuations in sales and purchase prices of breeding livestock and farmland. Breeding livestock, pastureland, and hay land will be purchased and sold for discounted prices, while cropland values will remain fixed. All other purchases and sales of capital items will be considered fixed. The statement of cash flows is vital to the producer and bank analyses, because an inadequate cash supply will result in the failure of the producer operation and losses to financial institutions.

BSE Economic Impact Analysis

The BSE economic impact analysis was established primarily using research conducted by Jin et al. (2004) in response to the BSE case in the state of Washington. They simulated various BSE outbreak scenarios in the United States and estimated reductions in farm-level prices due to decreased consumer demand and loss of exports for slaughter and feeder cattle (see Table 2.6). Their research indicates that a single, isolated case of BSE, such as the U.S. experience, may reduce domestic consumption by 5-10 percent and exports by as much as 100 percent. This scenario would have a short-term effect and minimal declines in farm-level cattle prices. An outbreak that is more representative of the Japanese experience may reduce consumer demand for beef by up to 20 percent and exports by 100 percent. This scenario is more troublesome due to long-term effects and drastically reduced farm-level beef prices and pastureland and hay land values.

This study extends the Jin et al. (2004) analysis to incorporate estimates of the farm-level price declines for breeding cattle in addition to slaughter and feeder cattle. It

also incorporates the effect that decreased beef cattle prices have on pastureland and hay land as well as the importance of land values to the financial conditions of producers and banks. This study also establishes base prices for slaughter, breeding, and feeder cattle that reflect cattle production over the past nine years. A nine-year time frame was selected, because the average cattle cycle lasts between 8 and 12 years and the data was readily available from NASS. The calculated base prices allow for sensitivities to be conducted that represent the fluctuations in beef cattle prices throughout the cattle cycle.

The cattle cycle is composed of two distinct phases that are extremely important in the determination of farm-level prices. The expansion phase of the cycle exhibits high inventory levels, which equate to low prices and financial instability for ranchers. The liquidation phase of the cattle cycle exhibits low inventory levels, which equate to high prices and relatively improved financial conditions. The current cattle cycle began in 1990 and has been abnormally extended to 2004. According to Price (2003), the main reason for the extended liquidation phase of the cattle cycle is drought conditions in the Southern Plains, the Northwestern United States, and much of western Canada. The pastureland in these regions simply cannot support herd expansion. Other reasons for an extended liquidation phase include risks inherent with animal diseases such as BSE, the possibility of bioterrorism, the recession in the American economy, and the increasing average age of ranchers.

Base prices that reflect the average price received by agricultural producers for beef cattle over the current cattle cycle were established for modeling purposes. The base prices were determined by converting nominal North Dakota farm-level prices from 1994-2002 to real (i.e., inflation-adjusted) prices using the producer price index. Then, the average real

prices received by farmers over the nine-year period were calculated. Sensitivities were conducted with respect to the base prices to reflect the nature of the cattle cycle and the theoretical financial conditions of ranchers. Table 3.2 illustrates inflation-adjusted, average farm-level prices received in North Dakota from 1994-2002.

Table 3.2. Average Real Market Prices Received by Producers in North Dakota, 1994-2002

Year	Breeding Cows[1]	Breeding Bulls[2]	Bred Heifers[3]	Steers & Heifers	Calves	Breeding Cattle[4]
2002	$49.47	$79.70	$72.51	$79.70	$89.60	$54.21
2001	$52.18	$84.59	$76.43	$84.59	$94.26	$57.20
2000	$52.77	$83.88	$79.63	$83.88	$101.71	$58.10
1999	$49.28	$77.26	$72.28	$77.26	$91.04	$53.91
1998	$45.14	$74.41	$65.20	$74.41	$82.81	$49.41
1997	$49.40	$74.31	$70.59	$74.31	$79.58	$53.62
1996	$33.64	$61.05	$46.55	$61.05	$57.24	$36.81
1995	$41.34	$68.74	$62.26	$68.74	$75.15	$45.65
1994	$53.28	$83.47	$76.41	$83.47	$94.76	$58.04
Base Prices	$47.39	$76.38	$69.10	$76.38	$85.13	$51.88

Note. Prices reported in $/Cwt

[1] Assumed 1,500 pound average.

[2] Value equal to cull value after initial purchase.

[3] Assumed 975 pound average.

[4] Agreggated beef breeding cattle valuation.

Source: USDA-NASS (2004b) and Petry (personal communication, June 29, 2004).

The prices reported by NASS for steers and heifers and calves were listed in units of dollars per hundred weight ($/Cwt). The prices for breeding cattle (i.e., breeding cows, bred heifers, and breeding bulls) were reported in dollars per head ($/head). It was necessary to convert the prices of breeding cattle to $/Cwt for modeling purposes. According to Kunkle, Sand, and Garces-Yepez (2002), the target weight at the beginning of the breeding season for the successful development of heifers is 65 percent of the mature weight of a cow. The mature or average weight of a cow is between 1,400-1,600 pounds

(Marc Bauer, personal communication, September 24, 2004). The model assumes that the mature weight is 1,500 pounds, which indicates that the implied weight of breeding heifers utilized in the model is 975 pounds.

Bulls command a premium when sold for breeding purposes due to superior traits of the animal. However, once a bull is purchased for breeding purposes, it remains on the same ranch for about 2-3 years, which is approximately the useful life of the animal. Throughout this period of time, a breeding bull is valued on the producers' balance sheets at approximately the same price as cull bulls (Timothy A. Petry, personal communication, June 29, 2004). This decreased value is placed on the breeding bull, because the animal can no longer be resold to another ranch for fear of the spread of disease. Therefore, when the cull bull is sold for slaughter, it will command a price similar to market livestock. Table 3.2 illustrates the pricing relationship among steers and heifers, and breed bulls. Breeding bulls, bred cows, and bred heifers are referred to as breeding cattle in the model. Steers and heifers are referred to as market cattle or slaughter cattle.

With regard to cattle production, North Dakota is involved in mainly cow/calf operations. Cow/calf operations are defined as the breeding of cows for the raising and selling of calves. In 2002, approximately 11,800 cow/calf operations existed in North Dakota. They accounted for 91 percent of total cattle operations and 39 percent of total agricultural operations (USDA-NASS, 2004a). Table 3.3 illustrates the inventory levels of the cattle categories and the total beef cattle and calves in North Dakota. Beef breeding cows and calves represent the majority at 58.8 percent of the total beef cattle and calves.

The model utilizes a nine-year simple average for the inventory as well as for the inflation-adjusted farm-level prices. Beef breeding cattle account for 64.3 percent of the

nine-year simple average total inventory. Feeder cattle account for 21.8 percent, and the remaining 13.9 percent is attributed to slaughter cattle.

Table 3.3. Beef Cattle and Calves Inventory in North Dakota, 1994-2002

Year	Breed Cows - calved beef	Breed Bulls - 500+ lbs.	Heifers - 500+ lbs. - beef repl.	Heifers - 500+ lbs. - other	Steers - 500+ lbs.	Calves less than 500 lbs.	Total Beef Cattle and Calves
	1000 head						
2002	1008	57	155	260	315	118	1913
2001	1004	60	170	260	310	116	1920
2000	970	55	160	240	270	120	1815
1999	980	55	165	210	270	175	1855
1998	906	50	160	210	280	140	1746
1997	950	60	165	230	290	165	1860
1996	947	60	175	220	295	180	1877
1995	975	60	190	225	275	150	1875
1994	941	60	190	215	280	145	1831

Source: USDA-NASS (2004b).

The producer financial statements indicate a total valuation for market livestock (i.e., current asset) and breeding livestock (i.e., intermediate asset). Therefore, it was necessary to determine a representative portfolio of market livestock and breeding livestock when applying percentage price reductions to the model. The nine-year average breeding cattle portfolio represents 64.3 percent of total cattle inventory and is composed of 52 percent breeding cows, 3.1 percent breeding bulls, and 9.2 percent bred heifers. The data for other heifers and steers was reported in greater than 500 pounds. For modeling purposes, an assumption was made that 50 percent of the other heifers and steers would be classified as slaughter cattle and 50 percent as feeder cattle. This resulted in a nine-year average inventory for slaughter cattle of 13.9 percent and the remaining 21.8 percent as

feeder cattle. Therefore, the market livestock inventory on the producer balance sheet was composed of 39 percent slaughter cattle and 61 percent feeder cattle.

The inventory and price data described above was used to determine base prices and corresponding percentage price reductions to be applied to the model. The percentage price reductions for slaughter and feeder cattle farm-level prices were determined based on research conducted by Jin et al. (2004). The percentage price reductions for breeding cattle were computed in this study and are illustrated in Table 3.4.

Table 3.4. Percentage Reductions in Beef Cattle Prices Due to a BSE Outbreak

Scenarios	Demand Decrease	Exports Decrease	Slaughter Cattle	Feeder Cattle	Breeding Cattle
1	0%	0%		Base Case - No Change	
2	5%	50%	-0.08207	-0.09766	-0.05558
3	5%	75%	-0.10649	-0.12626	-0.07211
4	5%	100%	-0.13107	-0.15499	-0.08876
5	10%	50%	-0.11171	-0.13251	-0.07565
6	10%	75%	-0.13539	-0.15999	-0.09169
7	10%	100%	-0.15907	-0.18759	-0.10772
8	15%	50%	-0.13926	-0.16461	-0.09431
9	15%	75%	-0.16205	-0.19108	-0.10974
10	15%	100%	-0.18514	-0.21756	-0.12538
11	20%	50%	-0.16473	-0.19421	-0.11155
12	20%	75%	-0.18692	-0.21981	-0.12658
13	20%	100%	-0.20926	-0.24529	-0.14171

Note. Adapted from Jin et al. (2004).

The pricing relationships among breeding heifers and slaughter cattle, and breeding cows and slaughter cattle were determined using the historic price data described in Table 3.2. The prices for breeding bulls were assumed equal to slaughter cattle prices. This relationship exists, because breeding bulls cannot be resold to other ranchers after the initial purchase for fear of the spread of sexually transmitted diseases (Petry, personal

communication, June 29, 2004). An aggregated base price for breeding cattle had to be developed to parallel farm managers' reporting methods, because the producer balance sheets indicate a total valuation for breeding cattle. The base price established for breeding cattle was $51.88/Cwt. Based on the composition of breeding cattle in North Dakota, a weighted average breeding cattle and slaughter cattle relationship then was developed. This pricing relationship incorporated all three types of breeding cattle and was necessary due to the methods used by farm managers when reporting values of ranchers' breeding cattle herds. The pricing relationship among breeding cattle and slaughter cattle indicated that breeding cattle in North Dakota have historically been valued at 32.3 percent less than slaughter cattle. This percentage was multiplied by the percentage price decreases of slaughter cattle under the scenarios derived by Jin et al. (2004). Table 3.4 illustrates the price reductions of farm-level prices given various characteristics of BSE outbreaks.

Sensitivities were conducted with respect to the base prices to reflect periods of time with high and low commodity prices and the effect that various scenarios have on the producers' abilities to repay loans. In order to conduct sensitivities, imputed base quantities for the beef cattle and their various financial statement entries had to be calculated. Imputed base quantities are calculated in a per hundred pound basis (Cwt) due to pricing units ($/Cwt). This process was conducted as follows:

$$Base\ Price * Quantity = Total\ Valuation \tag{12}$$

The base price computations for breeding, slaughter, and feeder cattle were addressed above. The total valuation represents the total dollar value reported on the

financial statements derived in this study. The imputed base quantity is then determined as follows:

$$Imputed\ Base\ Quantity = \frac{Total\ Valuation}{Base\ Price} \tag{13}$$

Now, the percentage price reductions for breeding, slaughter, and feeder cattle can be applied to the financial statement entries described in the producer model. The financial statement entries are replaced by

$$\begin{pmatrix} Base\ Price * Price\ Factor * Imputed\ Base \\ Quantity * (1 + Percentage\ Price\ Reduction) \end{pmatrix} \tag{14}$$

The factor represents a means to alter the base price or financial condition of producers to reflect high and low commodity prices. This methodology allows a static model to incorporate a more dynamic presence by illustrating a range of commodity prices or both phases of the cattle cycle. The current liquidation phase of the cattle cycle has provided strong commodity prices. However, a BSE outbreak that could potentially occur during the expansion phase in which high inventories exist may result in massive losses and a much higher producer bankruptcy rate.

The factoring range was used to determine the base prices. The high and low prices of the data set were used as the upper and lower bounds of the factoring range, with the base prices representing the average prices of market, feeder, and breeding cattle over the years 1994-2002. A total of five additional factoring levels were calculated to reflect the

variation about the mean. It was necessary to calculate percentages with respect to the base prices or average prices over the years 1994-2002 to accurately model the factor variables. The factoring percentages are illustrated in Table 3.5.

Table 3.5. Factoring Percentages for Beef Cattle Prices

Factor Range	Breeding Cows	Breeding Bulls	Bred Heifers	Slaughter Cattle	Feeder Cattle	Breeding Cattle[1]
low	0.7099	0.7993	0.6737	0.7993	0.6724	0.7090
.	0.8066	0.8662	0.7825	0.8662	0.7816	0.8060
.	0.9033	0.9331	0.8912	0.9331	0.8908	0.9030
base	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
.	1.0414	1.0358	1.0508	1.0358	1.0649	1.0425
.	1.0829	1.0717	1.1016	1.0717	1.1299	1.0850
high	1.1243	1.1075	1.1525	1.1075	1.1948	1.1275

[1]Aggregated beef breeding cattle factor.

The corresponding price factor range is derived by multiplying the factoring percentages for beef cattle prices by the base prices provided in Table 3.2. The price factor range for beef cattle prices allows the one-period model to exhibit dynamic modeling properties. It is important to note that all other prices of commodities, such as crops and other livestock, remain constant. This allows the decreased beef cattle prices to act as the only variables driving the model. The price factor range is illustrated in Table 3.6.

Farmland also may experience substantial declines in value due to decreased beef cattle commodity prices. The regression analysis utilized in the producer model was developed to determine effects for long-term assets such as pastureland and hay land. The data utilized in the analysis was real (i.e., inflation-adjusted) price data for feeder cattle prices received by North Dakota farmers and land values for crops, pasture, and hay during the years 1995-2002 (Table 3.7).

Table 3.6. Price Factor Range for Beef Cattle Prices

Price Factor Range	Breeding Cows	Breeding Bulls	Bred Heifers	Slaughter Cattle	Feeder Cattle	Breeding Cattle[1]
PF 1	$33.64	$61.05	$46.55	$61.05	$57.24	$36.78
PF 2	$38.22	$66.16	$54.07	$66.16	$66.54	$41.82
PF 3	$42.81	$71.27	$61.58	$71.27	$75.83	$46.85
PF 4	$47.39	$76.38	$69.10	$76.38	$85.13	$51.88
PF 5	$49.35	$79.11	$72.61	$79.11	$90.65	$54.08
PF 6	$51.32	$81.86	$76.12	$81.86	$96.19	$56.29
PF 7	$53.28	$84.59	$79.64	$84.59	$101.71	$58.49

[1]Aggregated beef breeding cattle price.

Table 3.7. Average Values of Rented Land and Feeder Cattle Prices in North Dakota

Year	Non-Irrigated Cropland	Non-Irrigated Pastureland	Non-Irrigated Hay land	Feeder Cattle ($ per Cwt)
2002	$395	$178	$173	$89.60
2001	$383	$173	$164	$95.50
2000	$377	$175	$167	$101.00
1999	$381	$170	$161	$87.20
1998	$389	$166	$162	$77.90
1997	$381	$167	$164	$75.50
1996	$368	$154	$151	$54.10
1995	$362	$158	$148	$69.20

Source: USDA-NASS (2004b).

The regression model encompassing feeder cattle prices as the sole explanatory variable was found to be superior to multi-explanatory variable models that included feeder, slaughter, and breeding cattle prices. This is due to the great degree of correlation among independent variables, resulting in multicollinearity problems. According to Koo (2003), numerous solutions exist to correct multicollinearity problems. Solutions include use of dropping variables, ridge regression, first differences, ratios, and more relevant data. The solution selected in this study was to drop two independent variables due to the great degree of correlation among beef cattle prices. The matrix, representing the great degree of

correlation among calves, steers and heifers, bred cows, breed bulls, and bred heifers, is illustrated in Table 3.8.

Table 3.8. Beef Cattle Price Correlation Matrix

	Calves	Steer & Heifers	Bred Cows	Breed Bulls	Bred Heifer
Calves	1.0000				
Steer & Heifers	0.9710	1.0000			
Bred Cows	0.9606	0.9700	1.0000		
Breed Bulls	0.9710	1.0000	0.9700	1.0000	
Bred Heifer	0.9782	0.9679	0.9927	0.9679	1.0000

The results from the regression models indicate that both pastureland and hay land values are affected by feeder cattle price changes; whereas, cropland value changes were found to be statistically insignificant. The summary output for regressing feeder cattle prices on pastureland is illustrated in Table 3.9.

Table 3.9. Summary Statistics for Pastureland Regression Model

Regression Statistics				
R Square	0.870040616			
Adjusted R Square	0.848380718			
Standard Error	3.168974075			
Observations	8			
ANOVA				
	df	*SS*	*MS*	*F*
Regression	1	403.3857064	403.3857064	40.16827048
Residual	6	60.25438013	10.04239669	
Total	7	463.6400865		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	127.0472161	6.485063706	19.59074295	1.14633E-06
Feeder cattle price	0.498255704	0.078615958	6.337844308	0.000722215

The resulting formula for the pastureland regression model is as follows:

$$Pastureland\ (\$PerAcre) = \$127.0472 + .498255 * Feeder\ Cattle\ Price \quad (15)$$

The regression summary indicates that a $1 decline in the price of feeder cattle will decrease the value of pastureland by approximately $0.50. The F statistic, t statistic, and P-value show that the feeder cattle price as an explanatory variable is statistically significant in the determination of pastureland value. The R^2 statistic indicates that 87 percent of the variation in pastureland values is explained by feeder cattle price fluctuations. This value demonstrates that the model could be improved by incorporating additional explanatory variables. However, the regression model does not seek to model pastureland values. The model was developed to determine the impacts that decreased feeder cattle prices may have on pastureland values and, ultimately, the long-term asset section of the balance sheet.

The second regression model was developed to determine the effects of feeder cattle price fluctuations on the values of hay land. The regression summary for the hay land model is illustrated in Table 3.10.

Table 3.10. Summary Statistics for Hay Land Regression Model

Regression Statistics				
R Square	0.608335559			
Adjusted R Square	0.543058152			
Standard Error	5.517964041			
Observations	8			
ANOVA				
	df	*SS*	*MS*	*F*
Regression	1	283.7514186	283.7514186	9.319235993
Residual	6	182.6875629	30.44792715	
Total	7	466.4389816		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	127.0969787	11.29209248	11.25539654	2.94005E-05
X Variable 1	0.417889103	0.136889738	3.052742373	0.022432841

The resulting formula for the hay land regression model is as follows:

$$Hay\ Land\ (\$PerAcre) = \$127.0969 + .41788 * Feeder\ Cattle\ Price \quad (16)$$

The second regression summary indicates that a $1 decline in the price of feeder cattle will decrease the value of hay land by approximately $0.42 per acre. Again, the F statistic, t statistic, and P-value show that the feeder cattle price as an explanatory variable is statistically significant in the determination of hay land values. The R^2 statistic indicates that 61 percent of the variation in hay land values is explained by feeder cattle price fluctuations.

The cropland regression model demonstrates that feeder cattle price fluctuations do not statistically affect the determination of cropland values. Therefore, the model assumes cropland values to be unaffected by a BSE outbreak. They are consequently assumed fixed in the producer model.

Credit-Scoring Model

The majority of agricultural lenders use some variation of the model utilized in this study to rank or classify borrowers according to the credit risk-level inherent in their operation. This provides a quantitative approach to analyzing the fluctuations in credit quality of the representative producer classifications utilized in the producer model. A qualitative approach or combination of the two also often is used in the profession; however, a quantitative approach was most suited to this study and the available data.

The credit-scoring procedure utilized in this study is a product of various other models currently and previously employed by Farm Credit Services. The FFSTF

developed sixteen financial performance measurements in an attempt to standardize financial reporting for agriculture (Splett et al., 1994). Splett et al. (1994) designed a term credit-scoring model and an operating credit-scoring model for the former Sixth Farm Credit District that incorporated a select few financial performance measurements designated by the FFSTF. This credit-scoring model is used in the empirical analysis. It was altered slightly to account for data limitations in the study. Splett et al. (1994) also developed risk rating classes to more accurately classify performing loans in addition to existing classifications of problem loans that were previously designated by the Sixth Farm Credit District. This procedure resulted in five classifications, including four classes of performing loans and one class of designated high-risk loans. Risk Class 5, or high-risk loans, includes Other Assts Especially Mentioned (OAEM), Substandard Viable, Substandard Nonviable, Doubtful, and Loss (see Appendix D for detailed descriptions).

The model developed by Splett et al. (1994) provided only benchmark values or interval ranges for risk classes 1-5. Financial ratios that were less than or equal to a certain value were simply grouped together in risk class 5. Additional data regarding qualitative characteristics, such as borrower character, number and frequency of delinquent payments, and the overall financial trend of the operation, were used to classify the outstanding loan as OAEM, Substandard Viable, Substandard Nonviable, Doubtful, or Loss. Data limitations prevent this study from analyzing such qualitative characteristics. Therefore, it was necessary to create interval ranges for the remaining risk classes 6-9 that parallel the existing credit risk ratings.

Four of the financial performance measurements and benchmark figures are taken from the Splett et al. (1994) credit-scoring model. The term-debt coverage ratio defined by

Oltmans et al. (1998) replaced the capital debt repayment margin ratio-long run. This alteration in the Splett et al. (1994) credit-scoring model was necessary given data limitations. The formulas and definitions of the financial performance measurements included in the credit-scoring models can be found in the *Financial Characteristics of North Dakota Farms* section in Chapter 2.

Splett et al. (1994) did not discuss detailed descriptions of risk classes. However, risk class descriptions were provided by AgCountry Farm Credit Services (2004). They are consistent with the Splett et al. (1994) credit-scoring model (see Appendix D).

The Splett et al. (1994) credit-scoring model is composed of both an operating and a term credit-scoring model to allow for more accurate financial analysis and risk classification. The credit-scoring model accounts for both farm-only (i.e., business only) and farm and non-farm financial performance measurements. This methodology allows for the analysis of strictly business impacts resulting from a BSE outbreak (i.e., does not take into account personal assets). The second scenario, farm and non-farm, includes personal assets when determining the pre- and post-financial conditions of agricultural operations. This scenario may provide a more accurate financial impact analysis, because the majority of farming operations are not limited liability corporations. In the event of bankruptcy, the bank that wrote the note would liquidate all business and personal assets.

Operating loans are written for short-term loans (i.e., less than one year). Term-loans are written for longer periods of time. Examples of term-loans include loans written for the purchase of breeding cattle, machinery, buildings, and farmland.

The operating credit scoring-model stresses the importance of income statement financial performance measurements such as farm return on equity and the term-debt

coverage ratio. These ratios are allocated the most weight due to the firm's necessity to perform strongly in the short-run to meet repayment agreements. The term credit scoring-model reflects the importance of balance sheet financial performance measurements such as the equity/asset ratio and current ratio. Now, emphasis is placed on the financial position of the operation and its ability to perform over time.

The operating credit-scoring model adapted from the Splett et al. (1994) study is illustrated in Table 3.11 and accounts for both the farm-only and farm and non-farm scenarios outlined in the producer model.

Table 3.11. Producer Credit-Scoring Model – Operating Credit

Credit-Scoring Model - Operating Credit			
VARIABLES/MEASURES	Interval Ranges	Intervals	Weights
LIQUIDITY	>2.00	1	
Current Ratio	1.60-2.00	2	
	1.25-1.60	3	
	1.00-1.25	4	
	1.00-0.80	5	
	0.80-0.60	6	
	0.60-0.40	7	
	0.40-0.20	8	
	<0.20	9	____*0.15=____
SOLVENCY	>0.80	1	
Equity/Asset Ratio	0.70-0.80	2	
	0.60-0.70	3	
	0.50-0.60	4	
	0.50-0.30	5	
	0.30-0.10	6	
	0.10-(0.10)	7	
	(0.10)-(0.30)	8	
	<(0.30)	9	____*0.20=____
PROFITABILITY	>0.10	1	
Farm Return on Equity	0.06-0.10	2	
	0.04-0.06	3	
	0.01-0.04	4	
	0.01-(0.01)	5	
	(0.01)-(0.03)	6	

Table 3.11. (continued)

	(0.03)-(0.05)	7	
	(0.05)-(0.07)	8	
	<(0.07)	9	____*0.30=____
REPAYMENT CAPACITY	>1.50	1	
Term-Debt Coverage Ratio	1.35-1.50	2	
	1.20-1.35	3	
	1.00-1.20	4	
	1.00-0.00	5	
	0.00-(1.00)	6	
	(1.00)-(2.00)	7	
	(2.00)-(3.00)	8	
	<(3.00)	9	____*0.35=____
		Total Score (Numeric)	_____
Credit Score	1.00-1.90	Class 1	
	1.91-2.60	Class 2	
	2.61-3.30	Class 3	
	3.31-4.00	Class 4	
	4.01-5.00	Class 5	
	5.01-6.00	Class 6	
	6.01-7.00	Class 7	
	7.01-8.00	Class 8	
	8.01-9.00	Class 9	
		Credit Score (Class)	_____

The model specifies interval ranges for the various financial performance measurements included in the model. A score ranging from 1 to 9 is applied, depending on the financial performance measurement reported. The score then is multiplied by the designated weight. This procedure is performed for each measure and summed to determine the overall risk-rating class of the borrower. The term credit scoring-model adapted from Splett et al. (1994) follows the same procedure and is illustrated in Table 3.12.

Table 3.12. Producer Credit-Scoring Model – Term Credit

Credit-Scoring Model - Term Credit			
VARIABLES/MEASURES	Interval Ranges	Intervals	Weights
LIQUIDITY	>2.00	1	
Current Ratio	1.60-2.00	2	
	1.25-1.60	3	
	1.00-1.25	4	
	1.00-0.80	5	
	0.80-0.60	6	
	0.60-0.40	7	
	0.40-0.20	8	
	<0.20	9	____*0.10=____
SOLVENCY	>0.80	1	
Equity/Asset Ratio	0.70-0.80	2	
	0.60-0.70	3	
	0.50-0.60	4	
	0.50-0.30	5	
	0.30-0.10	6	
	0.10-(0.10)	7	
	(0.10)-(0.30)	8	
	<(0.30)	9	____*0.35=____
PROFITABILITY	>0.10	1	
Farm Return on Equity	0.06-0.10	2	
	0.04-0.06	3	
	0.01-0.04	4	
	0.01-(0.01)	5	
	(0.01)-(0.03)	6	
	(0.03)-(0.05)	7	
	(0.05)-(0.07)	8	
	<(0.07)	9	____*0.10=____
REPAYMENT CAPACITY	>1.50	1	
Term-Debt Coverage Ratio	1.35-1.50	2	
	1.20-1.35	3	
	1.00-1.20	4	
	1.00-0.00	5	
	0.00-(1.00)	6	
	(1.00)-(2.00)	7	
	(2.00)-(3.00)	8	
	<(3.00)	9	____*0.35=____
FINANCIAL EFFICIENCY	>0.40	1	
Net Farm Income from Operations Ratio	0.30-0.40	2	
	0.20-0.30	3	

Table 3.12. (continued)

	0.10-0.20	4	
	0.10-0.00	5	
	0.00-(0.10)	6	
	(0.10)-(0.20)	7	
	(0.20)-(0.30)	8	
	<(0.30)	9	____*0.10=____
		Total Score (Numeric)	_____
Credit Score	1.00-1.80	Class 1	
	1.81-2.70	Class 2	
	2.71-3.60	Class 3	
	3.61-4.50	Class 4	
	4.51-5.00	Class 5	
	5.01-6.00	Class 6	
	6.01-7.00	Class 7	
	7.01-8.00	Class 8	
	8.01-9.00	Class 9	
		Credit Score (Class)	_____

This model differs only slightly in that an additional performance measurement is used, the weights vary from the operating credit model, and the credit score classifications are more relaxed. A measure of financial efficiency is added to the model to reflect the importance of successful long-term operations and increased loan length. The weights have been altered to account for the additional financial performance measurement and the increased emphasis on the financial position of the operation versus short-term profitability. The risk-rating classes also are altered to reflect these changes and to accurately classify the credit risk of loans.

To properly model the fluctuations in credit quality and to apply the appropriate loss factors to credit portfolios of financial institutions, it was necessary to establish

quantitative benchmark interval ranges for the high-risk loans. An area bank that wanted to remain confidential provided loss factors utilized in its allowance for credit loss calculations. The total credit loss calculation is comprised of two models: commercial loan models and commercial real estate loan models. A total of eight asset quality ratings exist in each of the models, which closely resembles the risk-rating process described by Splett et al. (1994). Asset quality rating 8 accounts for both risk classes 8 and 9 in the operating and term credit-scoring models utilized in this study. The relationship between risk rating classifications in the credit scoring model, asset quality ratings, and corresponding loss factors acts as the link between the producer and bank models. A more detailed description of the allowance for credit loss calculations is found in the following section.

Bank Model

The impacts of a BSE outbreak on the financial conditions of agricultural financial institutions in North Dakota are the focus of this study. The producer model provided the foundation for analyzing how producers' abilities to repay operating and farm real estate loans as well as the fluctuations in asset quality affect the financial stability of banks. Financial institutions in the state are vulnerable to a BSE outbreak, because the majority of their asset portfolios are heavily concentrated in the agricultural sector. The total assets, total loans, loans secured by farmland, production loans, and agricultural loans as a percentage of total loans of the four classes of commercial banks was outlined in Table 2.2. This section simulates likely agricultural loan portfolio distributions for the representative banks given varying locations in the state. It also provides a detailed description as to how the results of the producer model affect the asset quality of agricultural financial institutions throughout the modeling process. More specifically, fluctuations in the

allowance for agricultural loan losses, collateral value, and loan volume distributions according to credit quality and representative agricultural loan portfolios will be addressed.

Agricultural Loan Portfolio Distribution Simulations

The schedule of loans and lease financing receivables available on the FDIC Call Reports provides a breakdown of the total loans and leases (i.e., net of unearned income) reported on the balance sheet. Agricultural loans are separated into the following two categories: loans secured by farmland and loans to finance agricultural production and other loans to farmers. Table 3.13 illustrates the range and weighted average of agricultural loan volumes for each representative bank outlined in Chapter 1.

Table 3.13. Ranges and "Target" Agricultural Assets of Representative Banks

Representative Banks	Agricultural Portfolio Distributions		
	Low	Weighted Average	High
Bank size 1			
Loans secured by farmland	$355,000	$2,130,620	$4,418,000
Loans to finance ag. production	$674,000	$4,908,343	$9,578,000
Total	$1,029,000	$7,038,963	$13,996,000
Bank size 2			
Loans secured by farmland	$0	$4,122,121	$7,588,000
Loans to finance ag. production	$0	$8,968,847	$14,827,000
Total	$0	$13,090,968	$22,415,000
Bank size 3			
Loans secured by farmland	$533,000	$7,419,669	$20,637,000
Loans to finance ag. production	$249,000	$17,719,769	$35,199,000
Total	$782,000	$25,139,438	$55,836,000
Bank size 4			
Loans secured by farmland	$0	$59,469,432	$144,947,000
Loans to finance ag. production	$0	$90,469,665	$182,558,000
Total	$0	$149,939,097	$327,505,000

The ranges of the agricultural portfolios have a great degree of variability, especially in the large banks. However, the total weighted average or "target" agricultural

portfolios provide for analysis of the diverse asset sizes of banks across the state. The total weighted average portfolios will be referred to as “target” values in the simulation process described below.

Detailed loan portfolios of the types of producers (crop, beef, crop and beef, and "other") who secured the loans were not available. Therefore, various agricultural loan portfolios were developed that would accurately reflect the type of producer who secured the operating loans and loans secured by farmland. From this information, financial institutions can determine what loan portfolio most accurately represents their risk exposure to an animal disease outbreak given a defined asset structure and location. Table 3.14 illustrates the “target” scenarios utilized in the bank model.

Table 3.14. Representative Agricultural Loan Portfolios

Loan Portfolio	Crop Producers	Beef Producers	Beef and Crop Producers	"Other" Producers
1	20%	50%	20%	10%
2	50%	20%	20%	10%
3	25%	25%	25%	25%

Loan portfolios consisting mainly of crop producers reflect financial institutions located in the eastern part of the state or Red River Valley. Portfolios consisting mainly of beef producers reflect banks located in the central and western portions of the state, where more pastureland and hay land exists. A more evenly distributed agricultural loan portfolio reflects banks located in the remaining portions of the state. This geographic distribution of agricultural producers was illustrated in Figure 1.2.

The representative agricultural loan portfolios described above were approximated through the use of simulation to develop “actual” agricultural loan portfolios employed in

the model. A random number generator with replication was developed in GAMS that pulls a specified number of producers from the data sample (possibly multiple times) from a specified percentage of the four categories (crop, beef, crop and beef, other). Therefore, a total number of producers are entered in the model along with the percentages from each category to approximate the total agricultural loans for each representative bank. The simulation process allows for a close approximation of the total volume and composition of the various agricultural loan portfolios. Table 3.15 illustrates the "actual" agricultural portfolios by representative bank generated by utilizing the "target" agricultural loan volumes and "target" agricultural loan portfolios illustrated in Tables 3.13 and 3.14, respectively.

The "actual" total agricultural loan portfolios by representative bank also can be displayed by asset quality ratings of the producers. Therefore, the agricultural loan volumes of the nine individual asset quality rating categories equal the total "actual" agricultural loan portfolios by representative bank illustrated in Table 3.15 (see Appendix C for base case loan volume by asset quality rating). This modeling process illustrates the fluctuations in the distribution of loan volume by asset quality rating throughout the simulation process involving various BSE outbreak scenarios and price factor fluctuations.

Collateral Value

Loans issued by banks can be classified as either secured or unsecured. Unsecured loans are used occasionally and provided only to borrowers in excellent financial condition with proven borrowing histories. Secured loans are used the majority of the time by financial institutions, because they carry significantly less risk. According to Ellinger and Barry (n.d.), collateral refers to the assets pledged as security in a loan transaction. The

Table 3.15. Actual Agricultural Portfolios by Representative Banks

Representative Bank Agricultural Loan Portfolios	Producer Type				Total
	Crop	Beef	Crop & Beef	"Other"	
Bank Size 1					
Loan Portfolio 1					
Volume	$1,439,811	$3,788,630	$1,404,092	$727,342	$7,359,875
Percentage (volume)	19.56%	51.48%	19.08%	9.88%	100.00%
Loan Portfolio 2					
Volume	$3,425,829	$1,322,586	$1,426,942	$727,342	$6,902,699
Percentage (volume)	49.63%	19.16%	20.67%	10.54%	100.00%
Loan Portfolio 3					
Volume	$1,950,737	$1,897,976	$1,954,357	$1,635,953	$7,439,023
Percentage (volume)	26.22%	25.51%	26.27%	21.99%	100.00%
Bank Size 2					
Loan Portfolio 1					
Volume	$2,636,940	$6,349,786	$2,515,937	$1,067,809	$12,570,472
Percentage (volume)	20.98%	50.51%	20.01%	8.49%	100.00%
Loan Portfolio 2					
Volume	$6,450,104	$2,483,449	$2,740,565	$1,168,738	$12,842,856
Percentage (volume)	50.22%	19.34%	21.34%	9.10%	100.00%
Loan Portfolio 3					
Volume	$3,425,829	$3,443,951	$3,412,161	$3,174,629	$13,456,570
Percentage (volume)	25.46%	25.59%	25.36%	23.59%	100.00%
Bank Size 3					
Loan Portfolio 1					
Volume	$5,147,891	$12,515,118	$5,309,409	$2,356,861	$25,329,279
Percentage (volume)	20.32%	49.41%	20.96%	9.30%	100.00%
Loan Portfolio 2					
Volume	$12,460,578	$5,503,663	$5,044,249	$2,112,959	$25,121,449
Percentage (volume)	49.60%	21.91%	20.08%	8.41%	100.00%
Loan Portfolio 3					
Volume	$6,450,104	$6,346,601	$6,658,203	$5,296,145	$24,751,053
Percentage (volume)	26.06%	25.64%	26.90%	21.40%	100.00%
Bank Size 4					
Loan Portfolio 1					
Volume	$29,731,695	$76,494,200	$31,619,164	$13,136,860	$150,981,919
Percentage (volume)	19.69%	50.66%	20.94%	8.70%	100.00%
Loan Portfolio 2					
Volume	$75,941,710	$32,197,648	$30,063,948	$11,363,693	$149,566,999
Percentage (volume)	50.77%	21.53%	20.10%	7.60%	100.00%
Loan Portfolio 3					
Volume	$37,246,473	$37,979,099	$38,797,290	$35,902,785	$149,925,647
Percentage (volume)	24.84%	25.33%	25.88%	23.95%	100.00%

majority of farm real estate loans are secured by a mortgage or deed of trust on land. And, the majority of operating and intermediate-term loans are issued through the use of a security agreement, where the underlying asset is pledged as security.

Ellinger and Barry (n.d.) provide a listing of assets that are typically pledged as security in agricultural loans. The list is quite extensive and includes current assets such as farm supplies, crop and livestock inventories, growing crops, government payments, and deposit accounts; intermediate assets such as tractors, combines, equipment, facilities, and breeding livestock; and long-term assets such as farmland. A blanket filing also may be used so that the security agreement applies to all current and intermediate assets (Ellinger & Barry, n.d.). The data available for this study did not specify the collateral pledged against the outstanding agricultural producer loans. Therefore, an assumption was made that all producer assets are considered collateral throughout the modeling process. More specifically, the farm-only model assumes current, intermediate, and long-term farm assets are pledged as collateral; whereas, the farm and non-farm model assumes that all farm assets and non-farm assets are pledged as collateral.

Fluctuations in collateral value can have a significant impact on the risk-level inherent in any loan portfolio. Collateral values, including market livestock, breeding livestock, pastureland, and hay land, will be affected by decreased market prices of beef cattle. The decreased collateral to total agricultural loan volume ratio indicates a riskier agricultural loan portfolio due to the bank's diminished ability to recoup losses in the event of loan default. As previously stated, it was not possible to determine what assets were secured by the banks as collateral on outstanding loans. As a result, the decreased collateral to total agricultural loan volume ratio in this study always remains above 1 due to

the assumption that all assets have the potential to serve as collateral on outstanding loans, indicating that the agricultural loans in the portfolio carry no collateral risk. Therefore, it is necessary to calculate the fluctuations in available collateral as a percentage of the available base case collateral. This percentage better illustrates the direct relationship between the effects of BSE outbreak scenario and price factor fluctuations, and increased loan collateral risk.

Allowance for Agricultural Loan Losses

The bank model is affected by fluctuations in asset quality ratings that correspond to higher-level risk ratings in the producer credit scoring models. This study addresses the allowance for credit loss due to the agricultural portion of the financial institutions' loan portfolios. The Office of the Comptroller of the Currency (OCC) defines the allowance for credit loss as "a valuation reserve established and maintained by charges against the bank's operating income. As a valuation reserve, it is an estimate of uncollectible amounts that is used to reduce the book value of loans and leases to the amount that is expected to be collected." The model has been programmed to report the total allowance for credit loss for farm-only and for farm and personal financial structure. The model also reports subtotals of the allowance for loan losses according to asset quality ratings to better illustrate fluctuations in the total loan volume. The credit ratings derived in the credit-scoring model correspond to loss factors provided by an area bank that are used in the determination of the total allowance for credit loss calculation on the balance sheet. Table 3.16 illustrates the loss factors for both commercial loans and commercial real estate loans.

The farm-only model accounts for the total farm liabilities reported for each producer. The commercial loan loss factors are applied to loans to finance agricultural

production and all other loans to farmers (i.e., total current and intermediate liabilities) on the balance sheet. The commercial real estate loan loss factors are applied to loans secured by farm real estate (i.e., total long-term liabilities) on the balance sheet.

Table 3.16. Commercial and Commercial Real Estate Loan Loss Factors

Allowance for Credit Loss		
Asset Quality Rating	Commercial	Commercial Real Estate
AQR1	0.030%	0.155%
AQR2	0.060%	0.185%
AQR3	0.200%	0.325%
AQR4	0.350%	0.475%
AQR5	0.600%	0.725%
AQR6	2.825%	2.805%
AQR7	7.353%	6.930%
AQR8	28.854%	52.800%

Source: Anonymous area bank (2004).

The second model accounts for the overall financial conditions of producers, including both farm and non-farm. The data set reports only a total dollar valuation for the non-farm liabilities. Therefore, it was not possible to determine what portion of the total was the result of current, intermediate, or long-term liabilities. An assumption was made for modeling purposes that non-farm liabilities are classified as commercial when determining the allowance for loan losses. This assumption is a conservative approach to the modeling process, because the loan loss factors are significantly less than that of commercial real estate.

CHAPTER 4. RESULTS

The results of this study are presented in two sections based on the effects of a BSE outbreak on agricultural producers and financial institutions. First, the results of the agricultural producer model are addressed. Producer model results begin with an analysis of the base case financial conditions of the four producer categories and continue with the results of the BSE outbreak scenarios and price factor fluctuations. The operating and term credit-scoring models then are addressed to determine the comprehensive fluctuations in diminished credit quality of each producer category.

The second section illustrates the results of the agricultural financial institution model. The simulated base case agricultural loan portfolios by distribution of producer credit-scores (Appendix B) and corresponding loan volumes (Appendix C) provide the foundation for the analysis. The key results addressed include the required increase in the allowance for agricultural loan losses and the diminished values of collateral that potentially secure the outstanding loans. Financial institutions must increase the allowance for their agricultural loan losses reserve account as a result of the diminished agricultural asset quality of the simulated portfolios. The fluctuations in collateral value given BSE outbreak scenarios and price factor fluctuations reflect increased collateral risk to lenders in the event of foreclosure.

Results of the Base Case Agricultural Producer Model

In this study, the base case results represent the agricultural producer model results that were derived without any BSE outbreak scenario price reductions or price factor fluctuations. Table 4.1 illustrates the financial performance results for the farm-only, and farm and non-farm models for the four producer classifications, as well as an aggregated

total for all producers. The farm and non-farm base case model results indicate that a number of agricultural producers rely on non-farm income to help supplement their farm income and enhance their overall financial conditions.

Table 4.1. Base Case Average Financial Performance Results for Producer Classifications

Financial Performance Measurements	Producer Classifications				
	Crop Producers	Beef Producers	Crop and Beef Producers	"Other" Producers	All Producers
Farm-only					
Current Ratio*	2.04	1.56	1.83	1.57	1.82
E/A Ratio	0.49	0.42	0.47	0.39	0.45
Farm ROE	0.03	-0.10	0.05	0.01	0.02
NFI from Operations Ratio	0.23	0.11	0.15	0.11	0.17
Term-Debt Coverage Ratio*	2.18	1.25	1.57	1.40	1.75
Ending Equity	$451,409	$278,845	$404,819	$247,603	$367,540
Ending Cash Balance	$37,813	$13,640	$26,099	$29,152	$30,770
Farm & Non-Farm					
E/A Ratio	0.53	0.46	0.50	0.42	0.49
ROE	0.08	0.06	0.14	0.02	0.07
NI from Operations Ratio	0.30	0.47	0.29	0.35	0.33
Ending Equity	$562,397	$351,325	$471,552	$300,701	$450,315
Ending Cash Balance	$37,312	$22,819	$18,063	$21,801	$27,963

*Ratios are the same for farm-only, and farm and non-farm.

By producer type, the results of the base case indicate that crop producers perform the best financially, while beef producers present the greatest credit risk to financial institutions. This is illustrated both in Table 4.1 and in Table 4.2, where the overall financial conditions of producers are evaluated through the use of credit-scoring models. Crop producers consistently outperformed the remaining producer classifications in all key areas of financial performance (i.e., liquidity, solvency, profitability, repayment capacity, and financial efficiency); however, they would be affected by a BSE outbreak due to small portions of revenue earned from the production of beef cattle. The financial performance

measurements outlined in Table 4.1 are now discussed to provide a better understanding of the increased credit risk that beef producers pose to lenders in comparison to the strong financial conditions of crop producers.

Current Ratio

A current ratio of 1.5 to 2.0 or higher is preferred as a precautionary cushion against liquidity concerns in the event of adverse price changes and uncertain production outcomes (Oltmans et al., 1998). Therefore, the current ratio of 2.04 for crop producers is more than sufficient to satisfy these concerns. The crop and beef producer category also averaged a high ratio of 1.83. Beef producers averaged the lowest liquidity position of 1.56, which remains in the preferable range defined by Oltmans et al. (1998). However, the liquidity positions of beef producers may become less favorable depending on BSE outbreak scenarios and price factor fluctuations.

The ending cash balance values reported in Table 4.1 represent the cash amount available at the end of the 2002 year on the statement of cash flows. It is important to have sufficient cash available to meet short-term debt obligations and daily operating expenses. In the base case, crop producers have the most cash available, with beef producers reporting a significantly lower amount. Maintaining a low level of cash is potentially problematic for beef producers provided BSE outbreak scenarios and price factor fluctuations.

Equity/Asset Ratio

The average farm-only equity/asset ratio of 0.49 for crop producers indicates that 49 percent of the farm assets are financed by owners' equity. A greater equity/asset ratio indicates producers have more equity invested in their operations and, consequently, less

outstanding debt as a percentage of total assets. Therefore, a greater ratio indicates more flexibility for producers. If additional debt financing were required, producers would not have a difficult time borrowing funds from their lender. The equity/asset ratio for beef and "other" producers is lower in comparison to crop producers; however, it remains at a safe level. Producers with an extremely low equity/asset ratio will experience difficulty in obtaining additional debt financing, while a negative ratio indicates insolvency. The equity/asset ratio improves with the incorporation of non-farm financial condition, indicating that a greater percentage of equity is invested in personal assets, such as residences and automobiles, in comparison to the percentage invested in farm assets.

The ending equity reported by producers is also a measure of solvency. Crop producers have the greatest amount of equity invested in their farming operations, which indicates that they have the greatest ability to withstand adverse economic conditions or obtain additional debt financing. A negative value indicates insolvency, or the inability to satisfy all liabilities assumed by the operation when converting all assets to cash.

Return on Equity

According to Oltmans et al. (1998), a high ROE indicates a profitable operation, a relatively small equity base, or a highly leveraged business. The crop, and crop and beef producer categories have higher ROE percentages than the beef and "other" producer categories. The crop, and crop and beef producer categories also have relatively higher equity bases and equity/asset ratios than the other classifications. Therefore, the higher ROE percentages exhibited by the crop, and crop and beef producer categories illustrate a greater degree of profitability. The increased ROE percentages for the farm and non-farm

model indicate that the addition of non-farm financial performance enhances the overall financial conditions of agricultural operations through increased profitability.

Net Income from Operations Ratio

The base case results indicate that crop producers are the most efficient at producing net farm income from business operations. The beef and "other" producer classifications are the most financially inefficient with respect to the amount of net income generated from business operations. The net income from operations ratio for farm and non-farm operations differs, since total non-farm income is added to the net income earned from operating activities. There is a large increase in efficiency, because non-farm income was not earned from sales (i.e., no gross sales). Rather, it was earned through non-farm labor productivity and resulting wages. However, it was necessary to formulate the farm and non-farm model in this manner to remain consistent with the format of the credit-scoring procedure. In any case, this increase in efficiency illustrates beef and “other” producers’ increased reliance on off-farm income in comparison to crop, and crop and beef producers.

Term-Debt Coverage Ratio

According to Oltmans et al. (1998), “a higher term-debt coverage ratio indicates greater flexibility on the part of farmers to withstand and adjust to temporary adverse economic conditions.” Crop producers have the greatest ability to withstand difficult financial conditions with a term-debt coverage ratio of 2.18. This indicates that the average crop production operation has the ability to cover all term-debt obligations more than 2 times. The term-debt coverage ratio for beef producers of 1.25 signifies that they are less able to outlive poor economic conditions in comparison to the remaining producer

classifications. A ratio of less than 1 indicates that the producer would not be able to satisfy all term-debt obligations. Therefore, beef producers have a small margin available for losses resulting from a catastrophic event such as a BSE outbreak.

Credit-Scoring Model Results for the Base Case

The overall financial performance of each producer classification is represented by credit-scores for term and operating debt for the farm-only and farm and non-farm financial statements (Table 4.2). The operating credit-scoring model places more emphasis on income statement financial performance measurements, such as the ROE and the term-debt coverage ratio, due to annual profitability concerns. The current ratio (i.e., balance sheet financial performance measurement) is also emphasized in the operating credit-scoring model, because it is focused on the short-term financial condition of the firm. The term credit-scoring model places more emphasis on balance sheet financial performance measurements, such as the equity/asset ratio, due to concerns regarding the equity or wealth of a firm. However, the net income from operations ratio (i.e., income statement financial performance measurement) also was added to the term credit-scoring model, because it emphasizes the importance of efficiency in the long-term success of the operation. A producer that is efficient at producing commodities is better able to manage the farming operation through superior marketing skills or production at low cost.

All of the producer classifications averaged a performing score that was less than 5 for each of the credit-scoring models in the base case. The results of the crop producer classification, however, represent scores of approximately one point better than beef producers. Beef producers in the farm-only model averaged a score near risk class 5 (OAEM), which is a non-performing or high-risk classification. This higher credit risk

classification of beef producers equates to a riskier lending position for agricultural financial institutions. Banks must increase their allowance for agricultural loan losses (i.e., reserve account) to compensate for the additional possibility of loan default by producers.

Table 4.2. Base Case Average Credit Score Results for Producer Classifications

	Producer Classifications				
Credit Scoring Models	Crop Producers	Beef Producers	Crop and Beef Producers	"Other" Producers	All Producers
Farm-only					
Operating Credit	3.41	4.70	3.78	4.26	3.86
Term Credit	3.31	4.46	3.65	4.12	3.73
Farm & Non-Farm					
Operating Credit	2.97	3.88	3.36	3.78	3.37
Term Credit	3.06	3.82	3.36	3.75	3.40

Results of the BSE Outbreak Scenarios and Price Factor Fluctuations

The results of the BSE outbreak scenarios and price factor fluctuations indicate that all producer categories are susceptible to decreased profitability and diminished credit quality. For obvious reasons, the beef producer classification is subject to the greatest degree of losses given a BSE outbreak. However, many producers in the crop classification are also adversely affected, because they rely on income generated from the production of cattle for a portion of their revenues.

Various BSE outbreak scenarios and price factors ranging from the base case (i.e., no change) to the most severe BSE outbreak scenario were selected to illustrate the fluctuations in financial condition for individual producer categories and an aggregated total. For comparability among the numerous agricultural producer and financial institution result tables, it was necessary to establish a consistent format for the scenario changes. The worst-case price factor (i.e., 9-year low, expansionary phase of the cattle

cycle) without the presence of BSE is price factor 1, scenario 1 (PF1, S1). The worst-case price factor with a short-term BSE outbreak is price factor 1, scenario 4 (PF1, S4). The worst-case price factor with a moderate BSE outbreak is price factor 1, scenario 8 (PF1, S8). The worst-case price factor and extensive BSE outbreak scenario is price factor 1, scenario 13 (PF1, S13).

The base case scenario (i.e., 9-year average, middle of the cattle cycle) described in the prior section is designated as price factor 4, scenario 1 (PF4, S1). The 9-year average price factor and short-term BSE outbreak is price factor 4, scenario 4 (PF4, S4). The 9-year average price factor and moderate BSE outbreak is price factor 4, scenario 8 (PF4, S8). The 9-year average price factor with an extensive BSE outbreak is price factor 4, scenario 13 (PF4, S13).

The most favorable situation for both producers and financial institutions is designated price factor 7, scenario 1 (PF7, S1). This particular scenario illustrates the 9-year high price for beef cattle (i.e., 9-year high, liquidation phase of the cattle cycle) with no BSE outbreak scenario price reductions. The 9-year high price factor with a short-term BSE outbreak is price factor 7, scenario 4 (PF7, S4). The 9-year high price factor with a moderate BSE outbreak is price factor 7, scenario 8 (PF7, S8). The 9-year high price factor with an extensive BSE outbreak is price factor 7, scenario 13 (PF7, S13).

All Producers

The producer results representing the average values for the financial performance measurements of all producer categories were used to compare and contrast the various individual producer classifications (Table 4.3). Key indicators of financial performance experience more drastic decreases with a more severe BSE outbreak. Particular areas of

Table 4.3. Key Indicators of All Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values)

Financial Performance Measurements	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Current Ratio*	1.66	1.62	1.53	1.53	1.82	1.73	1.66	1.61	1.87	1.79	1.77	1.74
E/A Ratio	0.42	0.41	0.41	0.41	0.45	0.44	0.44	0.43	0.46	0.45	0.45	0.44
Farm ROE	-0.03	-0.12	-0.18	-0.18	0.02	-0.01	-0.02	-0.07	0.06	0.03	0.01	-0.01
NFI from Operations Ratio	0.10	0.07	0.07	0.05	0.17	0.14	0.14	0.12	0.20	0.17	0.16	0.15
Term-Debt Cov. Ratio*	1.25	1.12	1.07	1.00	1.75	1.37	1.37	1.27	1.95	1.62	1.59	1.45
Ending Equity	$340,710	$333,289	$332,826	$328,894	$367,540	$357,130	$356,481	$350,968	$380,692	$368,760	$368,016	$361,700
Ending Cash Balance	$18,585	$13,907	$13,616	$11,157	$30,770	$24,247	$23,841	$20,417	$37,905	$30,304	$29,831	$25,842
Farm & Non-Farm												
E/A Ratio	0.46	0.45	0.45	0.45	0.49	0.48	0.48	0.47	0.50	0.49	0.49	0.48
ROE	0.00	-0.03	-0.03	-0.07	0.07	0.03	0.03	-0.01	0.11	0.08	0.07	0.05
NI from Operations Ratio	0.29	0.27	0.27	0.24	0.33	0.31	0.30	0.29	0.35	0.33	0.32	0.31
Ending Equity	$423,485	$416,065	$415,602	$411,670	$450,315	$439,906	$439,256	$433,743	$463,468	$451,536	$450,792	$444,476
Ending Cash Balance	$15,662	$10,984	$10,693	$8,234	$27,963	$21,324	$20,918	$17,494	$34,982	$27,381	$26,909	$22,920

*Ratios are the same for farm-only, and farm and non-farm.

concern for the all producer classification are short-term financial indicators such as profitability (i.e., ROE) and repayment capacity (i.e., term-debt coverage ratio). These short-term financial indicators are impacted the most, because they deal with income or revenues most impacted by a one-time outbreak.

When comparing the base case scenario (PF4, S1) to the most extensive BSE outbreak scenario during the middle of the cattle cycle (PF4, S13), there are significant decreases in the ROE and term-debt coverage ratio. The farm-only ROE decreases from 0.02 to -0.07, or from a low level of profitability to losing money in the short-term. The term-debt coverage ratio also significantly decreases from 1.75 to 1.27. This indicates that producers, on average, remain able to satisfy all term-debt obligations; however, they have little margin for further loss. In fact, the change incorporating a short-lived, contained BSE outbreak (PF4, S4) indicates that, on average, producers' operations fluctuate from a low level of profitability to losing money. Their abilities to repay term-debt obligations and outlive extended adverse conditions also drastically diminish with a relatively minor BSE outbreak. The term-debt coverage ratio decreases from 1.75 to 1.37.

A massive BSE outbreak during the expansionary phase of the cattle cycle (PF1, S13) results in not only short-term concerns but also diminished credit quality that extends into the long-term operations of the producers. The farm-only ROE percentage decreased from 0.02 to -0.18, when comparing the base case scenario with the model's worst-case BSE outbreak scenario. The term-debt coverage ratio also decreased dramatically from 1.75 to 1.00, when comparing the base case with the worst-case BSE outbreak scenario. Another short-term concern is the lack of sufficient cash balance. The average ending cash balance reported by producers decreased from $30,770 to $11,157 or approximately 64

percent. Drastic short-term losses and the inability to continue meeting term debt obligations can have a significant impact on producers' abilities to continue their operations and receive additional operating and term loan funds.

Long-term indicators of financial performance, such as the net farm income from operations ratio and equity/asset ratio, also experience decreases; however, they are considerably less than those previously mentioned. The net farm income from operations ratio decreases from 0.17 to 0.05, when comparing the base case with the worst-case scenario. The farm only equity/asset ratio decreases from 0.45 to 0.41. Although they remain at acceptable levels, these long-term indicators of financial performance represent fairly significant decreases. The net farm income from operations ratio remains positive. The equity/asset ratio of 0.41 indicates that a considerable amount of equity remains in the operation.

The scenario of an extensive BSE outbreak during the liquidation phase of the cattle cycle (i.e., PF7, S13), or period of high prices, has a much less adverse effect on agricultural producers. The financial ratios in Table 4.3 indicate comparable values between the base case and PF7, S13. However, the profitability level of firms, on average, still reaches a negative level. The term-debt coverage ratio also decreases from 1.75 to 1.45, which illustrates a diminished ability to withstand further losses attributed to a catastrophic event such as a BSE outbreak. Tables 4.4 to 4.7 illustrate the financial impacts experienced by individual producer classifications derived in this study.

Beef Producers

The financial performance results for the beef producer classification illustrated in Table 4.4 indicate serious short-term financial difficulty given an extensive BSE outbreak

Table 4.4. Key Indicators of Beef Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values)

Financial Performance Measurements	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Current Ratio*	1.33	1.24	1.23	1.18	1.56	1.44	1.43	1.37	1.70	1.55	1.54	1.47
E/A Ratio	0.35	0.32	0.32	0.31	0.42	0.40	0.40	0.38	0.45	0.43	0.43	0.41
Farm ROE	-0.20	-0.42	-0.87	-0.89	-0.10	-0.10	-0.12	-0.30	0.06	-0.10	-0.11	-0.18
NFI from Operations Ratio	-0.15	-0.29	-0.30	-0.39	0.11	0.00	-0.01	-0.09	0.21	0.10	0.09	0.02
Term-Debt Cov. Ratio*	0.16	-0.25	-0.27	-0.48	1.25	0.68	0.64	0.34	1.87	1.21	1.17	0.82
Ending Equity	$210,677	$191,316	$190,109	$179,858	$278,845	$251,698	$250,005	$235,640	$312,703	$281,539	$279,596	$263,112
Ending Cash Balance	-$27,311	-$42,719	-$43,678	-$51,781	$13,640	-$7,851	-$9,188	-$20,477	$37,343	$12,321	$10,764	-$2,373
Farm & Non-Farm												
E/A Ratio	0.39	0.37	0.37	0.35	0.46	0.43	0.43	0.42	0.48	0.46	0.46	0.44
ROE	-0.14	-0.21	-0.22	-0.28	0.06	-0.06	-0.07	-0.16	0.17	0.05	0.04	0.00
NI from Operations Ratio	0.31	0.23	0.22	0.05	0.47	0.39	0.30	0.25	0.52	0.46	0.45	0.33
Ending Equity	$283,157	$263,796	$262,589	$252,338	$351,325	$324,178	$322,485	$308,120	$385,183	$354,019	$352,076	$335,592
Ending Cash Balance	-$18,685	-$34,094	-$35,053	-$43,155	$22,819	$774	-$563	-$11,852	$45,968	$20,947	$19,390	$6,253

*Ratios are the same for farm-only, and farm and non-farm.

Table 4.5. Key Indicators of Crop Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values)

Financial Performance Measurements	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Current Ratio*	1.94	1.92	1.83	1.80	2.04	1.95	1.82	1.82	2.06	2.00	1.96	1.95
E/A Ratio	0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.48	0.49	0.49	0.49	0.49
Farm ROE	0.02	0.00	-0.02	-0.02	0.03	0.02	0.02	0.02	0.08	0.03	0.03	0.02
NFI from Operations Ratio	0.22	0.21	0.21	0.21	0.23	0.23	0.22	0.22	0.23	0.23	0.23	0.23
Term-Debt Cov. Ratio*	1.76	1.76	1.73	1.71	2.18	1.75	1.75	1.73	2.20	1.91	1.86	1.76
Ending Equity	$443,731	$441,662	$441,533	$440,436	$451,409	$448,505	$448,324	$446,785	$455,129	$451,805	$451,598	$449,837
Ending Cash Balance	$35,922	$35,121	$35,071	$34,651	$37,813	$36,698	$36,628	$36,044	$38,986	$37,681	$37,600	$36,917
Farm & Non-Farm												
E/A Ratio	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.53	0.54	0.53	0.53	0.53
ROE	0.07	0.06	0.06	0.06	0.08	0.08	0.08	0.07	0.09	0.08	0.08	0.08
NI from Operations Ratio	0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Ending Equity	$554,719	$552,650	$552,521	$551,423	$562,397	$559,493	$559,312	$557,772	$566,117	$562,793	$562,585	$560,824
Ending Cash Balance	$35,421	$34,620	$34,570	$34,150	$37,312	$36,197	$36,128	$35,543	$38,486	$37,181	$37,099	$36,416

*Ratios are the same for farm-only, and farm and non-farm.

Table 4.6. Key Indicators of Crop and Beef Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values)

Financial Performance Measurements	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Current Ratio*	1.52	1.43	1.33	1.33	1.83	1.74	1.66	1.61	1.92	1.82	1.82	1.76
E/A Ratio	0.42	0.41	0.41	0.40	0.47	0.45	0.45	0.44	0.49	0.47	0.47	0.46
Farm ROE	-0.14	-0.36	-0.36	-0.36	0.05	-0.12	-0.13	-0.30	0.06	0.05	0.04	-0.03
NFI from Operations Ratio	0.04	0.00	0.00	-0.03	0.15	0.10	0.09	0.06	0.19	0.14	0.14	0.11
Term-Debt Cov. Ratio*	0.87	0.54	0.52	0.35	1.57	1.16	1.15	1.02	2.00	1.54	1.51	1.27
Ending Equity	$355,475	$341,372	$340,492	$333,026	$404,819	$385,049	$383,816	$373,356	$429,417	$406,713	$405,297	$393,290
Ending Cash Balance	-$1,547	-$11,990	-$12,640	-$18,131	$26,099	$11,533	$10,627	$2,977	$42,137	$25,176	$24,121	$15,217
Farm & Non-Farm												
E/A Ratio	0.46	0.45	0.45	0.45	0.50	0.49	0.49	0.48	0.52	0.50	0.50	0.49
ROE	-0.09	-0.18	-0.19	-0.33	0.14	0.07	0.07	-0.08	0.14	0.14	0.07	0.03
NI from Operations Ratio	0.21	0.18	0.17	0.15	0.29	0.25	0.25	0.23	0.33	0.29	0.29	0.26
Ending Equity	$422,208	$408,104	$407,225	$399,759	$471,552	$451,781	$450,548	$440,089	$496,150	$473,446	$472,030	$460,023
Ending Cash Balance	-$10,015	-$20,458	-$21,108	-$26,599	$18,063	$3,065	$2,159	-$5,491	$33,669	$16,708	$15,653	$6,749

*Ratios are the same for farm-only, and farm and non-farm.

Table 4.7. Key Indicators of Other Producers' Financial Conditions Given Various BSE Outbreak Scenarios (Mean Values)

Financial Performance Measurements	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Current Ratio*	1.48	1.45	1.36	1.33	1.57	1.52	1.52	1.40	1.62	1.57	1.56	1.53
E/A Ratio	0.36	0.35	0.35	0.34	0.39	0.38	0.38	0.37	0.41	0.40	0.40	0.39
Farm ROE	0.01	-0.01	-0.01	-0.08	0.01	0.01	-0.02	-0.03	0.04	0.03	-0.02	-0.02
NFI from Operations Ratio	0.06	0.04	0.04	0.03	0.11	0.09	0.09	0.07	0.14	0.11	0.11	0.11
Term-Debt Cov. Ratio*	1.16	1.07	1.01	0.96	1.40	1.21	1.21	1.14	1.53	1.39	1.38	1.37
Ending Equity	$223,195	$216,876	$216,481	$213,126	$247,603	$238,725	$238,170	$233,459	$259,181	$249,045	$248,413	$243,036
Ending Cash Balance	$23,342	$20,978	$20,831	$19,590	$29,152	$25,859	$25,654	$23,927	$32,672	$28,826	$28,586	$26,570
Farm & Non-Farm												
E/A Ratio	0.39	0.38	0.38	0.37	0.42	0.41	0.41	0.40	0.43	0.42	0.42	0.41
ROE	-0.01	-0.01	-0.01	-0.01	0.02	-0.02	-0.03	-0.04	0.09	0.07	0.06	0.03
NI from Operations Ratio	0.32	0.31	0.31	0.30	0.35	0.33	0.33	0.32	0.36	0.33	0.33	0.33
Ending Equity	$276,292	$269,973	$269,579	$266,224	$300,701	$291,822	$291,268	$286,556	$312,278	$302,143	$301,510	$296,133
Ending Cash Balance	$15,703	$13,339	$13,192	$11,951	$21,801	$18,219	$18,015	$16,288	$25,033	$21,186	$20,947	$18,931

*Ratios are the same for farm-only, and farm and non-farm.

occurring during all phases of the cattle cycle. The results also indicate serious long-term impacts to producers' financial condition for BSE outbreaks during the expansion phase and middle of the cattle cycle. Short-term financial ratios of concern to the all producer classification, such as the ROE and term-debt coverage ratio, are also relevant to the beef producer classification. Other indicators of short-term financial performance, including the current ratio and ending cash balance, are of concern. The equity/asset ratio remains acceptable as a long-term indicator of financial condition. However, the net income from operations ratio becomes a concern, because it is an indicator of the long-term success or failure of business operations.

Beef producers are significantly, adversely affected by even a minimal BSE outbreak given average beef cattle prices over the past 9 years (PF4, S4). Profitability (i.e., ROE) remains at -0.10. However, the financial efficiency measurement (i.e., net farm income from operations ratio) decreases from 0.11 to 0.00, indicating that beef producers did not receive revenues that adequately covered operating expenses. The term-debt coverage ratio also decreased dramatically from 1.25 to 0.68. This value indicates that beef producers, on average, are unable to meet all term-debt obligations as they come due. The average ending cash balance reported decreases from $13,640 to -$7,851 (a reduction of $21,491). The average negative cash balance is an indicator of a weak short-term financial condition. The current ratio and equity positions of beef producers are not significantly affected given a minimal BSE outbreak and 9-year average prices.

An extensive BSE outbreak, provided 9-year average prices (PF4, S13) results in massive losses to beef producers in terms of profitability and credit quality. The farm-only ROE decreases to -0.30 and indicates a large negative net income. The term-debt coverage

ratio also decreases to 0.34, which indicates that only 34 percent of term-debt obligations can be satisfied. The ending cash balance decreases further to -$20,477.

A single case of BSE discovered during the liquidation phase of the cattle cycle (PF7, S4) best illustrates the U.S. occurrence on December 23, 2003. The simulation results indicate minimal, short-term damage to beef producers' financial conditions. The current ratio of 1.55 remains at an acceptable level, down only slightly from 1.70 pre-outbreak. The equity/asset ratio remains almost unchanged at 0.43. Areas of short-term concern do however exist, such as profitability and repayment capacity. The farm-only ROE decreases from 0.06 to -0.10. The term-debt coverage ratio decreases from 1.87 to 1.21, representing a fairly dramatic decrease. However, the average beef producer remains able to satisfy term-debt obligations. The ending cash balance decreases from $37,343 to $12,321 (approximately $25,000). This 67 percent loss in available cash is dramatic, although the balance remains positive and the market price impacts are short-lived. The long-term stability of most beef production enterprises remains strong. This is illustrated by wealth or equity measurements such as the equity/asset ratio and net farm income from operations ratio.

An extensive BSE outbreak occurring during the liquidation phase of the cattle cycle (PF7, S13) would be more problematic to the U.S. cattle industry. The farm-only ROE further decreases to -0.18, indicating a decline in farm income. The term-debt coverage ratio decreases to 0.82, which illustrates beef producers' inability to cover all term-debt obligations in the short-term. The simulations also suggest a cash balance of -$2,373. This scenario further illustrates short-term concerns for beef producers and

financial institutions that provide financial capital. However, the long-term success or failure of beef enterprises should not be altered given this BSE outbreak scenario.

The worst-case scenario of an extensive BSE outbreak and 9-year low prices (PF1, S13) results in extremely difficult financial positions for a majority of North Dakota's beef producers. The current ratio of 1.18 remains above 1.00, indicating that the average beef producer maintains a liquid financial position (i.e., current assets are greater than current liabilities). The ratio does, however, fall short of the 1.50-2.00 range defined by Oltmans et al. (1998). All other financial performance measurements indicate extremely poor financial conditions. The ROE, net income from operations, term-debt coverage ratio, and ending cash balance are all negative. The financial performance results for this scenario indicate serious short- and long-term financial difficulty and numerous potential loan foreclosures.

Crop Producers

The crop producer classification results indicate minimal adverse effects given a BSE outbreak, because the production of beef cattle represents a small portion of revenues (see Table 4.5). The farm-only profitability of crop producers becomes negative only at the 9-year low for beef cattle prices and a moderate BSE outbreak (PF1, S8). All other financial performance indicators remain quite strong throughout all BSE outbreak scenarios and price factor fluctuations.

Crop and Beef Producers

As expected, the crop and beef producer classification financially performed between that of the crop producer and beef producer categories (see Table 4.6). Losses attributable to a potential BSE outbreak have been partially offset by the more profitable,

liquid, and solvent crop production portion of the farming operations. However, difficult financial conditions may arise given a BSE outbreak of sufficient magnitude and corresponding beef cattle price reductions.

The 9-year average price factor (PF4) and an extensive BSE outbreak (S13) have the potential to cause profitability concerns. The farm-only ROE decreases from 0.05 in the base case to -0.30 in the PF4, S13 scenario, indicating short-term losses to the operation. The term-debt coverage ratio remains at 1.02, which indicates that the average crop and beef producer barely has the ability to pay all term-debt obligations as they come due. The ending cash balance inclusive of personal assets becomes negative at this point.

The scenario incorporating an extensive outbreak with 9-year low prices (PF1, S13) has the potential to cause serious short-term difficulty for some of North Dakota's crop and beef producers. The farm-only ROE and net farm income from operations ratio decrease to -0.36 and -0.03, respectively, which indicates a large loss generated by agricultural production operations. The term-debt coverage ratio decreases to 0.35, indicating that not all term-debt obligations can be satisfied. The ending cash balance for farm-only operations decreases to -$18,131. According to the simulations, crop and beef production enterprises do not experience significant long-term damage, as is the case with beef producers.

"Other" Producers

The "other" producer classification has the potential to incur some short-term profitability and repayment capacity concerns provided large beef price reductions resulting from a BSE outbreak (see Table 4.7). The term-debt coverage ratio decreases to below 1.00 only at the worst-case scenario outbreak with 9-year low prices (PF1, S13).

The ROE becomes slightly negative in extensive BSE outbreak scenarios occurring in the expansion phase and middle of the cattle cycle (i.e., PF1 and PF4). The "other" producer category does not experience any significant long-term effects due to BSE outbreaks.

Credit-Scoring Results

The results of the credit-scoring models for both the farm-only, and farm and non-farm scenarios are presented in the same format as the tables for the producer financial performance results (see Tables 4.8-4.12). Beef producers consistently performed at a higher credit-score (i.e., greater credit risk) than all other producer classifications both in the base case (Table 4.2) and throughout all BSE outbreak scenarios and price factor fluctuations (Table 4.9). Crop producers had the highest credit quality of all producers both in the base case (Table 4.2) and throughout all BSE outbreak scenarios and price factor fluctuations (Table 4.10). The crop and beef producer credit-scores reflect benefits obtained from diversification efforts (Table 4.11). Crop and beef producers' financial conditions may not be as well established as the crop producer category; however, they are better able to maintain a consistent degree of financial performance during periods of time when low grain prices or poor weather conditions persist. They are also subject to a lower level of financial risk in the event of a BSE outbreak in comparison to the beef producer category due to crop revenues.

Results of the Agricultural Financial Institution Model

The results of the agricultural financial institution model are dependent on the producers' financial conditions (i.e., credit-scores) contained in the simulated agricultural loan portfolios. The fluctuations in producer credit-scores, given BSE outbreak scenarios and price factor changes, alters the asset quality of representative banks, thereby driving

Table 4.8. Average Credit Scores of All Producers Given Various BSE Outbreak Scenarios

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
Credit Scoring Models	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Operating Credit	4.30	4.43	4.44	4.54	3.86	4.10	4.11	4.23	3.56	3.88	3.90	4.05
Term Credit	4.12	4.26	4.27	4.38	3.73	3.93	3.94	4.05	3.51	3.74	3.76	3.87
Farm & Non-Farm												
Operating Credit	3.86	4.00	4.01	4.14	3.37	3.65	3.64	3.77	3.09	3.38	3.40	3.56
Term Credit	3.77	3.90	3.91	4.00	3.40	3.58	3.58	3.70	3.18	3.41	3.42	3.51

Table 4.9. Average Credit Scores of Beef Producers Given Various BSE Outbreak Scenarios

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
Credit Scoring Models	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Operating Credit	6.05	6.42	6.42	6.65	4.70	5.54	5.56	5.88	3.74	4.74	4.84	5.35
Term Credit	5.54	6.04	6.07	6.33	4.46	5.05	5.07	5.32	3.65	4.49	4.58	4.90
Farm & Non-Farm												
Operating Credit	5.37	5.74	5.77	6.11	3.88	4.74	4.74	5.05	1.98	3.91	4.00	4.54
Term Credit	4.97	5.39	5.40	5.61	3.82	4.39	4.40	4.75	3.21	3.84	3.88	4.21

Table 4.10. Average Credit Scores of Crop Producers Given Various BSE Outbreak Scenarios

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
Credit Scoring Models	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Operating Credit	3.50	3.52	3.53	3.55	3.41	3.47	3.47	3.48	3.38	3.42	3.43	3.47
Term Credit	3.41	3.43	3.43	3.44	3.31	3.36	3.36	3.39	3.27	3.32	3.32	3.35
Farm & Non-Farm												
Operating Credit	3.07	3.10	3.10	3.13	1.97	3.02	3.02	3.05	1.91	1.97	1.97	3.00
Term Credit	3.15	3.17	3.17	3.19	3.06	3.10	3.10	3.13	3.03	3.06	3.06	3.08

Table 4.11. Average Credit Scores of Crop and Beef Producers Given Various BSE Outbreak Scenarios

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
Credit Scoring Models	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Operating Credit	4.72	5.06	5.10	5.32	3.78	4.31	4.33	4.63	3.17	3.81	3.85	4.16
Term Credit	4.44	4.72	4.74	4.98	3.65	4.08	4.09	4.34	3.24	3.66	3.68	3.91
Farm & Non-Farm												
Operating Credit	4.31	4.66	4.67	5.00	3.36	3.83	3.84	4.17	1.74	3.38	3.42	3.68
Term Credit	4.11	4.36	4.38	4.60	3.36	3.74	3.75	3.99	1.86	3.40	3.43	3.65

Table 4.12. Average Credit Scores of Other Producers Given Various BSE Outbreak Scenarios

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
Credit Scoring Models	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only												
Operating Credit	4.56	4.62	4.62	4.71	4.26	4.37	4.37	4.44	4.04	4.30	4.30	4.37
Term Credit	4.44	4.52	4.53	4.62	4.12	4.27	4.29	4.37	4.00	4.13	4.14	4.24
Farm & Non-Farm												
Operating Credit	4.16	4.25	4.26	4.33	3.78	4.03	4.00	4.10	3.64	3.78	3.78	3.93
Term Credit	4.04	4.10	4.13	4.17	3.75	3.87	3.88	3.96	3.59	3.76	3.76	3.81

the financial institution model results. The results of the agricultural financial institution model are divided into three sections. First, examples of the fluctuations in asset quality for the representative banks in response to the BSE outbreak scenarios and price factor changes will be illustrated. Second, the allowance for agricultural loan losses will be addressed to measure how the fluctuations in asset quality ratings affect the overall quality of the agricultural loan portfolios. Third, the collateral quality of financial institutions will be addressed to determine how the collateral available to banks is affected by the BSE outbreak scenarios and price factor fluctuations.

Fluctuations in Asset Quality

Numerous combinations of bank size, agricultural concentration, BSE outbreak scenarios, and price factor fluctuations are possible. Therefore, a limited number of graphical representations were selected to illustrate the fluctuations in asset quality resulting from the outlined variables. Graphical representations of the composition of farm-only loan volume by asset quality rating for bank size 1, with either LP1 or LP2 (i.e., beef or crop concentrated agricultural loan portfolios), are displayed. These figures illustrate how the distribution of loan volume fluctuates given selected BSE outbreak scenarios and price factor changes. Three price factor changes are used for the graphical representations. They include PF4 (i.e., 9-year average prices), PF1 (i.e., 9-year low prices), and PF7 (i.e., 9-year high prices). BSE outbreak scenarios 1, 4, 8, and 13 are applied to each graphical representation. Bank size 1 was selected for the graphical representation, because it is the smallest bank category (i.e., less than $25 million) utilized in this study. It averages $18.7 million in total assets and $11.3 million in total loans

outstanding. Furthermore, agricultural loans represent, on average, 59 percent of total outstanding loans.

Graphical representations also are provided for the remaining representative banks to illustrate the differences in asset quality of agricultural portfolios for banks of varying asset sizes. These banks will be illustrated using only the 9-year average price factor (i.e., PF4) and beef-concentrated agricultural loan portfolio (LP1), however, over the same BSE outbreak scenarios. These graphical representations provide an understanding of how the asset qualities of the representative banks fluctuate given various scenarios of BSE outbreaks during the middle of the cattle cycle (PF4) where 9-year average prices exist.

Figure 4.1 illustrates the simulated farm-only loan volume by asset quality rating (AQR) for bank size 1 that has a beef producer concentrated agricultural loan portfolio (i.e., 50 percent beef producers, 20 percent crop producers, 20 percent beef and crop producers, 10 percent "other" producers) given 9-year average beef prices.

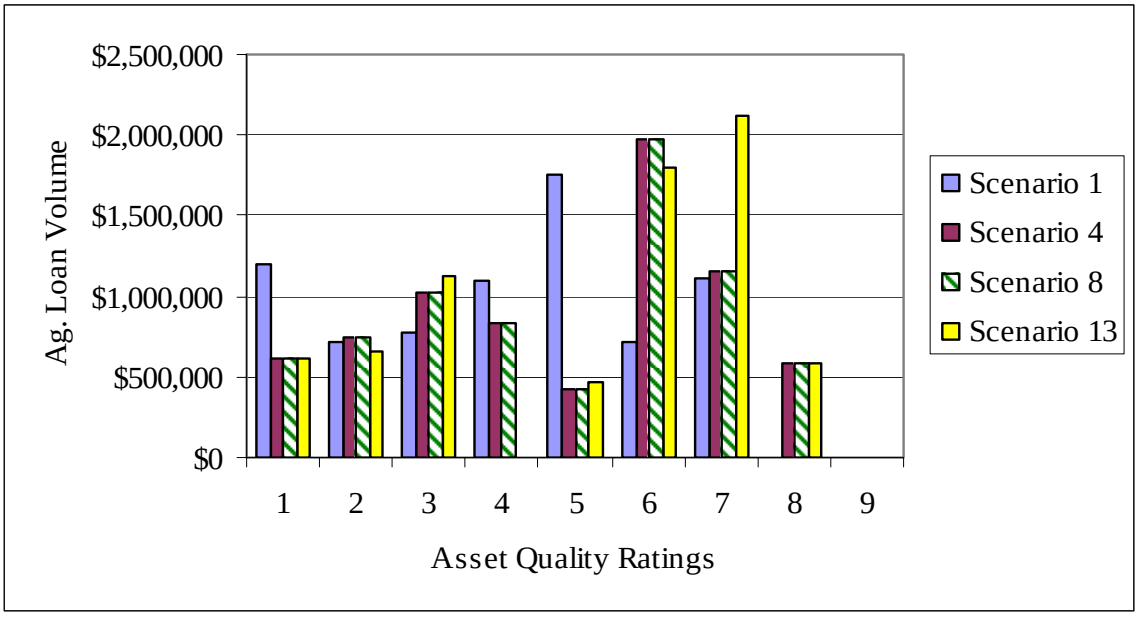

Figure 4.1. Agricultural loan volume by AQR for bank size 1, LP1, PF4.

As the magnitude of the price impacts increase, the asset quality of the loans decrease. In the base case, asset quality ranges from AQR 1-7 and indicates that no producers have a credit-score in the doubtful or loss categories. However, the BSE outbreak scenario 4 results in loan volume under the AQR-8 category. The increased credit risk of the agricultural loan portfolio can be seen by a shift in loan volume from the lowest credit risk, highest asset quality rating 1 to the higher-risk category 8.

Figure 4.2 represents the distribution of agricultural loan volume by AQR for the same representative bank with the same loan portfolio composition. The only difference is the change in price factor.

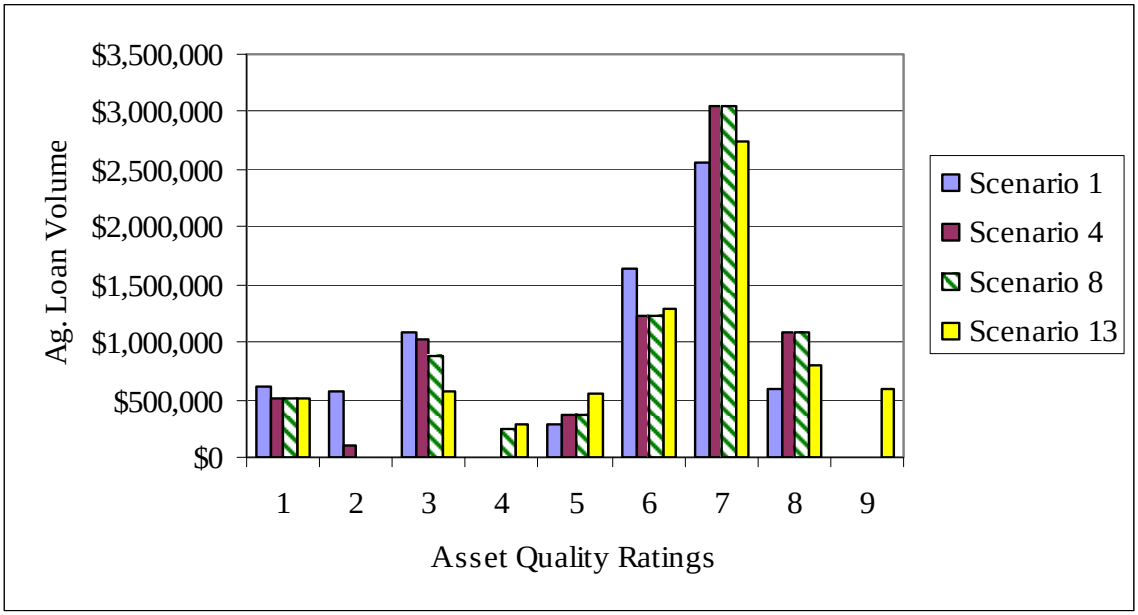

Figure 4.2. Agricultural loan volume by AQR for bank size 1, LP1, PF1.

The figure illustrates the farm-only loan volume distribution given BSE outbreak scenarios and 9-year low beef prices for producers. Therefore, it represents the worst-case scenario utilized in this study. This figure shows a drastic change in asset quality structure

by a large shift in loan volume in comparison to Figure 4.1. A majority of the loan volume is classified as risk class 6 or 7 throughout all scenarios, with a portion of the loan volume falling under the AQR-9 category in the most extensive BSE outbreak scenario. This scenario would have a dramatic effect on financial institutions' loan portfolio quality due to higher percentage requirements for the allowance for agricultural loan losses.

Figure 4.3 illustrates a drastic improvement in the asset quality ratings of the agricultural loan portfolio. This figure exhibits many similarities to the previous two figures; however, the prices received by producers with this simulation are at the 9-year high (PF7).

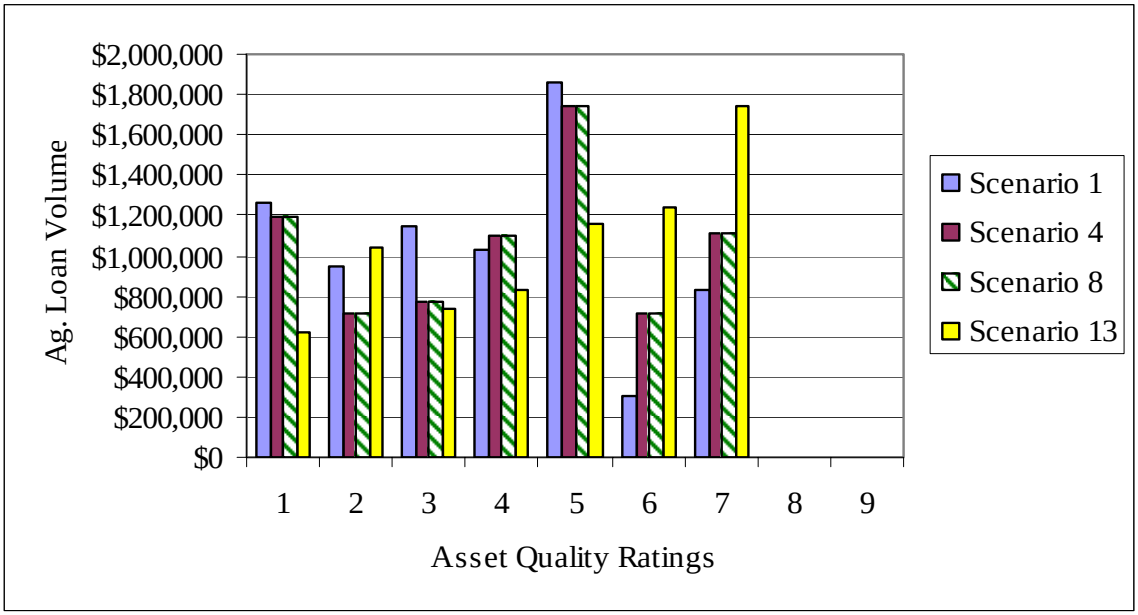

Figure 4.3. Agricultural loan volume by AQR for bank size 1, LP1, PF7.

BSE outbreak scenario 4 is the most representative scenario utilized in this study of the decrease in asset quality that a bank of this size and loan structure may have experienced after the discovery of BSE in the state of Washington on December 23, 2003.

Minimal decreases in asset quality may have resulted, temporarily increasing the allowance for loan losses and diminishing the value of potential collateral used to secure loans.

The following three figures (Figures 4.4 - 4.6) illustrate fluctuations in AQR for the same representative bank; however, an agricultural loan portfolio consisting primarily of outstanding crop production loans, as defined in this study, is analyzed. Figure 4.4 represents the base case beef prices (i.e., 9-year average) received by North Dakota agricultural producers.

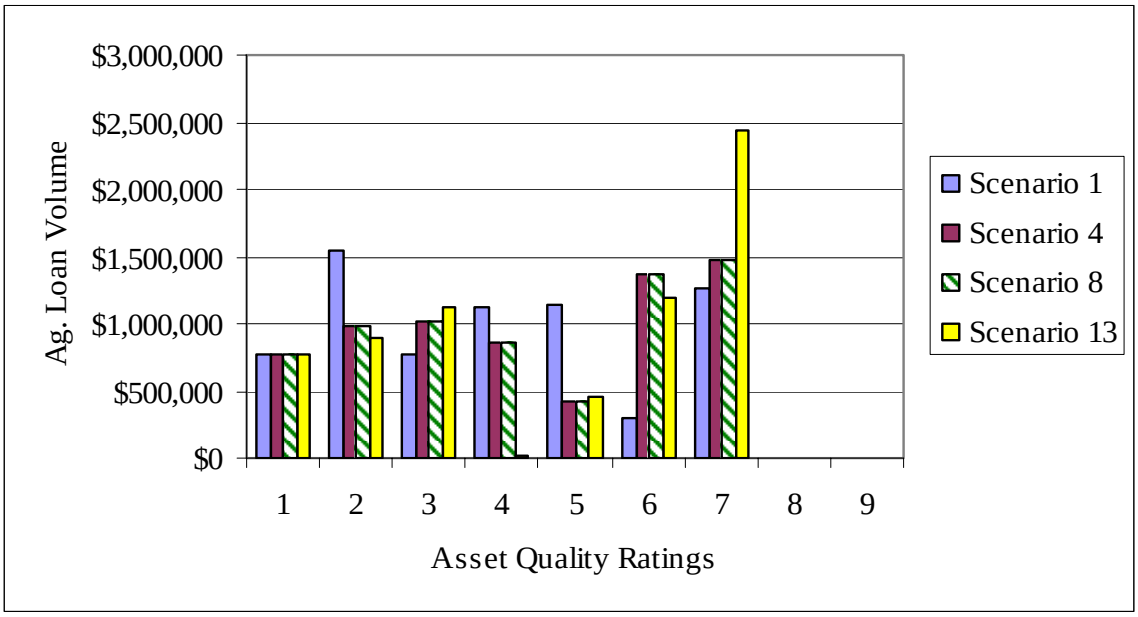

Figure 4.4. Agricultural loan volume by AQR for bank size 1, LP2, PF4.

In this study, representative financial institutions of all asset sizes with a more concentrated crop producer loan portfolio have more favorable asset quality structures than banks of equal size that are more heavily involved with beef production loans (see Figure 4.1 for comparison). Only minimal fluctuations or losses in asset quality are reported as the severity of market price impacts to producers increase. Therefore, a BSE outbreak

would have a less dramatic impact on the funding necessary to provide for a sufficient allowance for agricultural loan losses and collateral available to secure loans.

Figure 4.5 illustrates the asset quality composition of the agricultural loan portfolio given 9-year low prices (PF1). There is some variation in asset quality in comparison to Figure 4.4, especially with a large amount of loan volume diminishing to AQR-7. However, there is a significant amount of variation when comparing the crop and beef concentrated loan portfolios. The representative financial institution with a crop concentrated loan portfolio (Figure 4.5) has a much stronger asset quality position, when compared to the beef concentrated loan portfolio (Figure 4.2). This relationship will be further illustrated in the allowance for agricultural loan losses section.

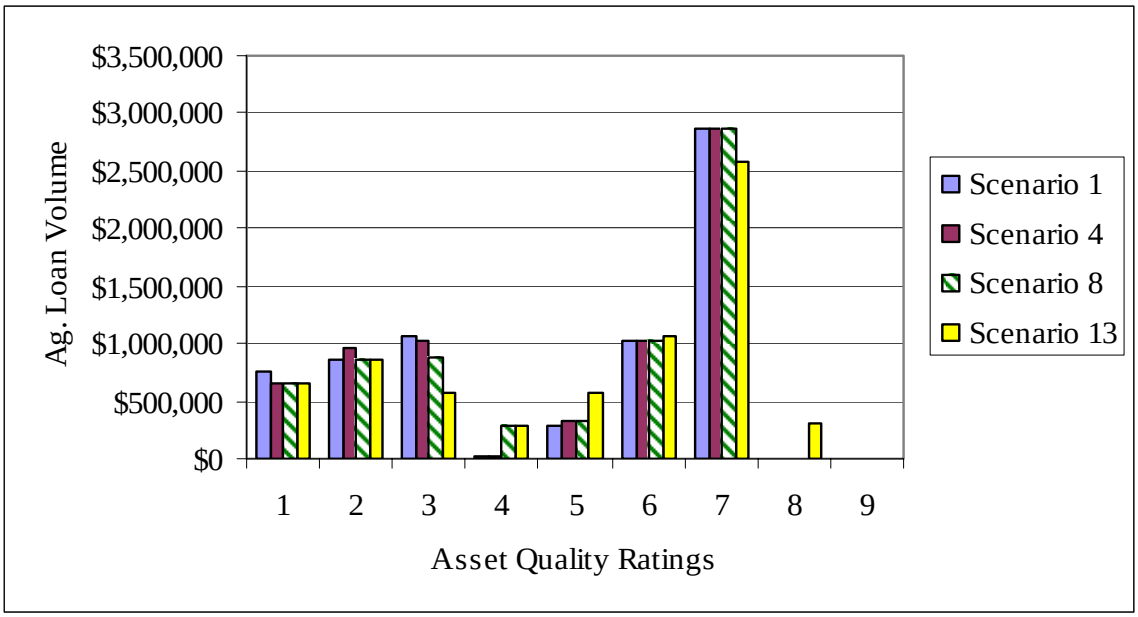

Figure 4.5. Agricultural loan volume by AQR for bank size 1, LP2, PF1.

Figure 4.6 illustrates varying magnitudes of price reductions resulting from BSE outbreaks occurring during the liquidation phase of the cattle cycle where 9-year high

prices exist. This scenario indicates a very favorable asset quality for financial institutions specializing in providing agricultural production loans to crop producers. However, extensive BSE outbreaks still have the potential to decrease asset quality as can be seen in scenario 13.

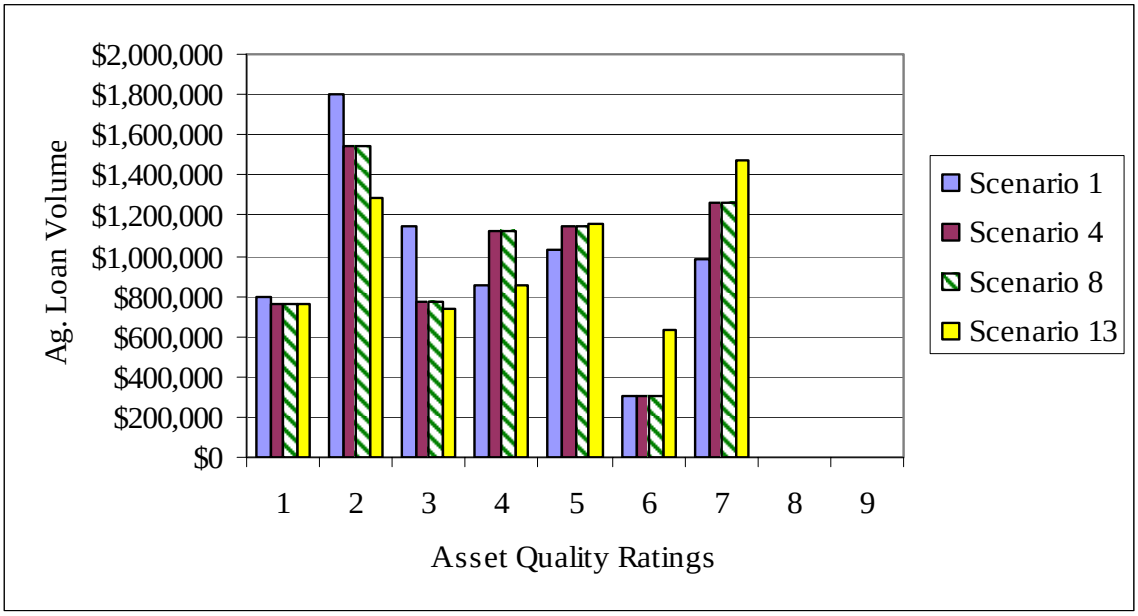

Figure 4.6. Agricultural loan volume by AQR for bank size 1, LP2, PF7.

Figure 4.7 illustrates how the simulated farm-only loan volume by AQR for representative bank size 2 with a beef-concentrated agricultural loan portfolio is affected by various scenarios of BSE outbreaks. This figure can be compared to the smaller representative bank size 1 under the same set of conditions (LP1, PF4) (see Table 4.1). A greater percentage of farm-only loan volume for bank size 2 is designated as AQR-2 (i.e., performing loan category) as compared to the smaller representative bank. Therefore, a smaller bank may be more susceptible to losses associated with increased credit risk of borrowers due to a limited borrower base.

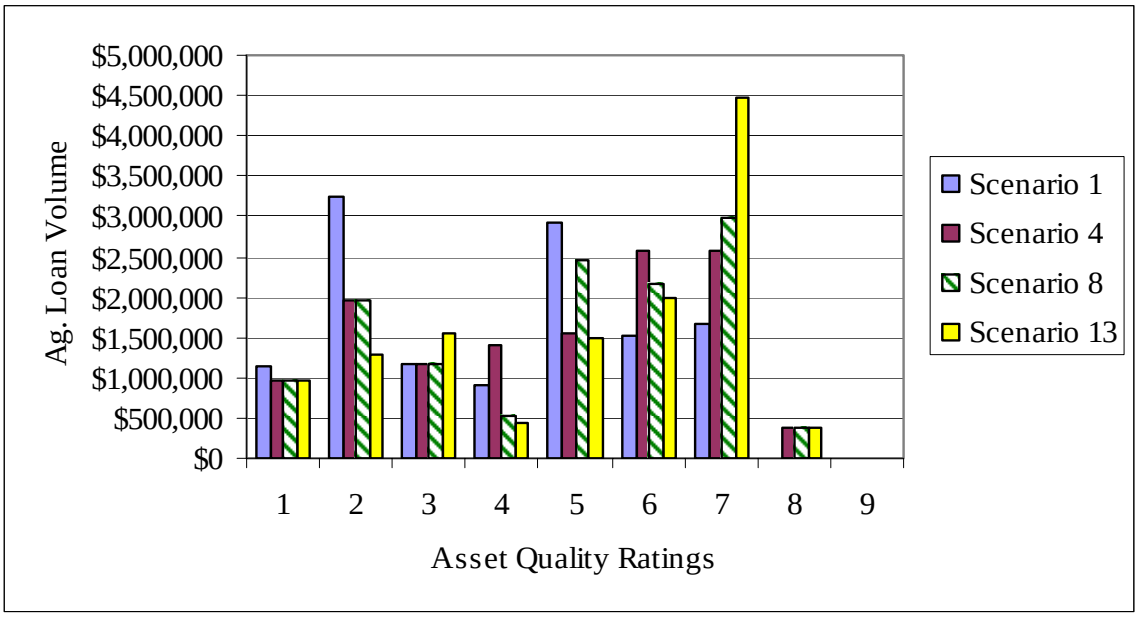

Figure 4.7. Agricultural loan volume by AQR for bank size 2, LP1, PF4.

Figure 4.8 is representative of the simulated farm-only agricultural portfolio of bank size 3. The average asset quality continues to improve as illustrated when comparing Figures 4.7 and 4.8. Figure 4.7 indicates that a large percentage of agricultural loan volume is designated AQR-6; whereas, Figure 4.8 contains a greater amount of agricultural loan volume in AQR 1-4 (i.e., performing loan classifications). The improvement in the average agricultural asset quality can be seen in Table 4.13, where the required allowance for agricultural loan loss reserve account decreases from representative bank size 2 to 3.

Figure 4.9 represents the fluctuation in farm-only loan volume by AQR for bank size 4 under the same conditions as Figure 4.8. The average asset quality diminishes when comparing representative bank size 3 and 4. This is illustrated in Figure 4.9 by the sharp increase in loan volume that is considered high-risk when compared to Figure 4.8.

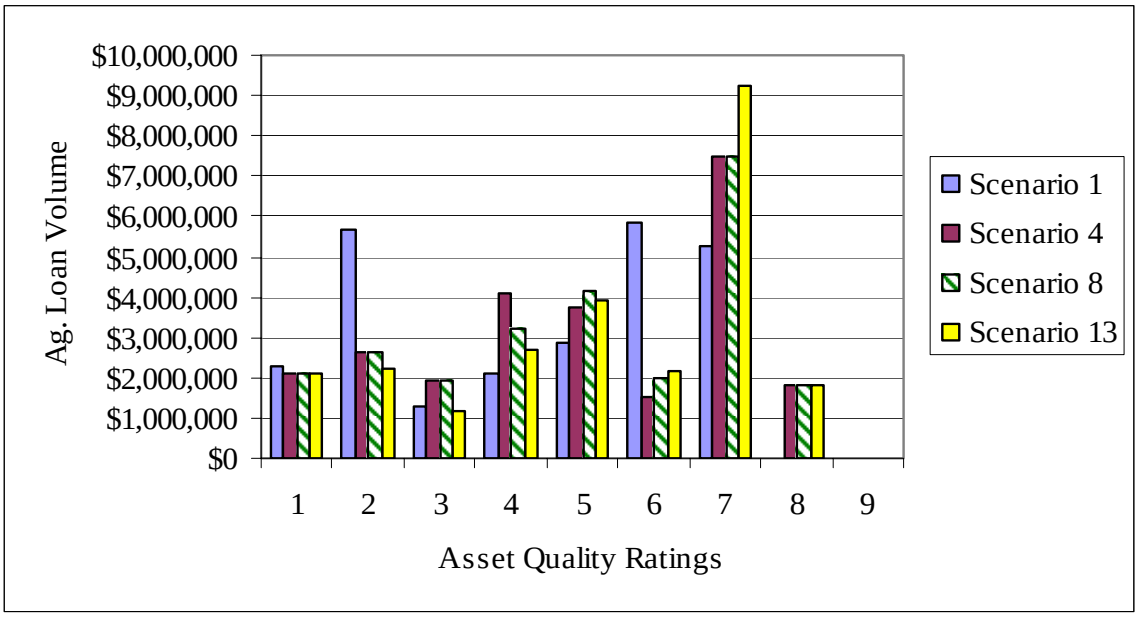

Figure 4.8. Agricultural loan volume by AQR for bank size 3, LP1, PF4.

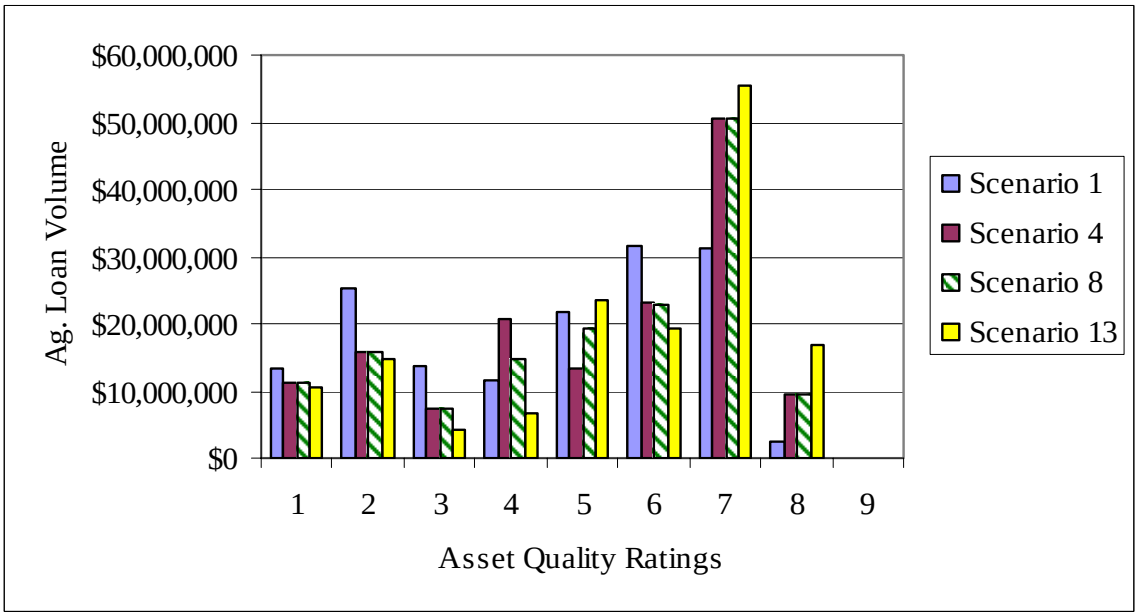

Figure 4.9. Agricultural loan volume by AQR for bank size 4, LP1, PF4.

Agricultural Asset Quality Results

In this study, the allowance for agricultural loan losses represents the dollar amount necessary to set aside in reserve for the possibility of agricultural loan loss. The reserve account must be increased as the credit risk of producers increases (i.e., fluctuates from credit risk 1 to credit risk 9). A riskier portfolio is the result of diminished AQRs derived by incorporating BSE outbreak scenarios and price factor fluctuations described in the previous section. The methodology for calculating the allowance for agricultural loan losses was described in Chapter 3. The results of the scenarios are shown in Table 4.13, which provides the allowance for agricultural loan losses as a percentage of the simulated farm-only, and farm and non-farm portfolios. Additional figures illustrate how the asset quality of representative banks of varying asset sizes and locations in North Dakota could be impacted by a BSE outbreak.

The base case results indicate that the farm-only financial condition of producers is riskier (i.e., higher average AQR) than the model inclusive of non-farm assets, thus warranting a higher allowance for loan losses. This result demonstrates the importance of non-farm income and equity for lenders as a method of decreasing risk exposure to farm-only operations. However, emphasis is placed on the farm-only model throughout this section to determine how the agricultural loan portfolios of financial institutions could be impacted by a BSE outbreak.

Figure 4.10 illustrates the allowance for farm-only loan losses for bank size 1 for the three representative agricultural loan portfolios (beef-concentrated, crop-concentrated, and mixed). Financial institutions that have a beef-concentrated or mixed agricultural loan portfolio are more susceptible to diminished asset quality resulting from a BSE outbreak as

Table 4.13. Average Allowance for Agricultural Loan Losses as a Percentage of Total Agricultural Loans

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4,S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Bank size1, LP1												
Farm-only	5.77%	7.73%	7.74%	8.38%	1.53%	3.48%	3.59%	5.49%	1.05%	1.53%	1.54%	2.12%
Farm & Non-farm	4.81%	5.91%	5.93%	6.67%	1.06%	3.64%	3.65%	4.38%	0.79%	1.06%	1.06%	1.24%
Bank size1, LP2												
Farm-only	2.99%	3.01%	3.01%	3.54%	1.34%	1.77%	1.85%	2.69%	1.08%	1.34%	1.34%	1.61%
Farm & Non-farm	1.94%	2.01%	2.03%	2.18%	0.74%	0.88%	0.89%	1.59%	0.69%	0.74%	0.74%	0.77%
Bank size1, LP3												
Farm-only	5.98%	7.04%	7.05%	7.91%	2.48%	4.59%	4.83%	5.94%	2.29%	2.48%	2.48%	2.88%
Farm & Non-farm	5.76%	6.05%	6.05%	8.39%	2.29%	5.42%	5.42%	5.64%	1.96%	2.29%	2.29%	3.10%
Bank size2, LP1												
Farm-only	4.21%	5.98%	5.99%	6.62%	1.55%	2.83%	3.06%	3.72%	1.21%	1.55%	1.62%	2.81%
Farm & Non-farm	3.58%	4.14%	4.14%	5.26%	1.13%	2.51%	2.51%	3.03%	0.93%	1.14%	1.31%	2.28%
Bank size2, LP2												
Farm-only	2.64%	3.07%	3.07%	3.07%	1.33%	1.49%	1.50%	2.19%	1.15%	1.33%	1.33%	1.48%
Farm & Non-farm	2.29%	3.52%	3.52%	3.57%	1.27%	1.44%	1.44%	1.93%	1.18%	1.27%	1.35%	1.43%
Bank size2, LP3												
Farm-only	2.70%	3.59%	3.59%	3.59%	1.31%	1.75%	1.79%	2.23%	1.08%	1.45%	1.45%	1.72%
Farm & Non-farm	2.11%	3.80%	3.80%	3.89%	1.14%	1.46%	1.46%	1.84%	1.04%	1.15%	1.23%	1.36%
Bank size3, LP1												
Farm-only	4.11%	6.52%	6.57%	6.77%	1.95%	3.70%	3.75%	4.79%	1.29%	2.33%	2.52%	3.32%
Farm & Non-farm	3.50%	4.63%	4.71%	5.75%	1.46%	3.23%	3.23%	3.87%	0.94%	1.73%	1.85%	2.59%
Bank size3, LP2												
Farm-only	2.85%	4.30%	4.30%	4.73%	1.60%	2.87%	2.90%	3.77%	1.13%	1.97%	2.10%	2.41%
Farm & Non-farm	2.31%	3.19%	3.27%	4.11%	1.09%	2.19%	2.19%	2.95%	0.79%	1.37%	1.38%	1.60%
Bank size3, LP3												
Farm-only	3.97%	4.89%	4.95%	5.02%	1.81%	2.47%	2.51%	3.26%	1.44%	1.82%	1.90%	2.42%
Farm & Non-farm	3.17%	3.41%	3.64%	4.44%	1.37%	2.36%	2.36%	2.81%	1.07%	1.37%	1.51%	2.21%
Bank size4, LP1												
Farm-only	5.81%	7.76%	7.82%	8.89%	2.50%	4.10%	4.10%	6.02%	1.81%	2.75%	3.01%	3.61%
Farm & Non-farm	5.26%	6.23%	6.30%	7.69%	2.20%	3.75%	3.59%	5.28%	1.52%	2.37%	2.43%	3.15%
Bank size4, LP2												

Table 4.13. (continued)

	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4,S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only	4.11%	5.34%	5.39%	6.00%	2.43%	3.21%	3.21%	4.05%	1.98%	2.52%	2.66%	3.03%
Farm & Non-farm	3.77%	4.47%	4.49%	5.26%	2.26%	3.13%	2.98%	3.71%	1.76%	2.31%	2.34%	2.75%
Bank size4, LP3												
Farm-only	4.29%	5.37%	5.43%	6.32%	2.51%	3.17%	3.17%	4.25%	1.89%	2.62%	2.75%	3.11%
Farm & Non-farm	4.06%	4.91%	5.05%	5.87%	2.44%	3.32%	3.00%	4.00%	1.84%	2.53%	2.55%	2.95%

indicated by the higher reserve requirements. Financial institutions with a crop-concentrated portfolio are better able to maintain a positively performing portfolio in the event of a BSE outbreak as indicated by the comparatively lower allowance for agricultural loan losses. Financial institutions in areas of crop concentration may find it necessary to increase the reserve account up to 3.5 percent if an extensive BSE outbreak occurred during the expansion phase of the cattle cycle. It also may be necessary to increase the reserve account up to 8.4 percent when financial institutions have a beef-concentrated agricultural loan portfolio (PF1, S13).

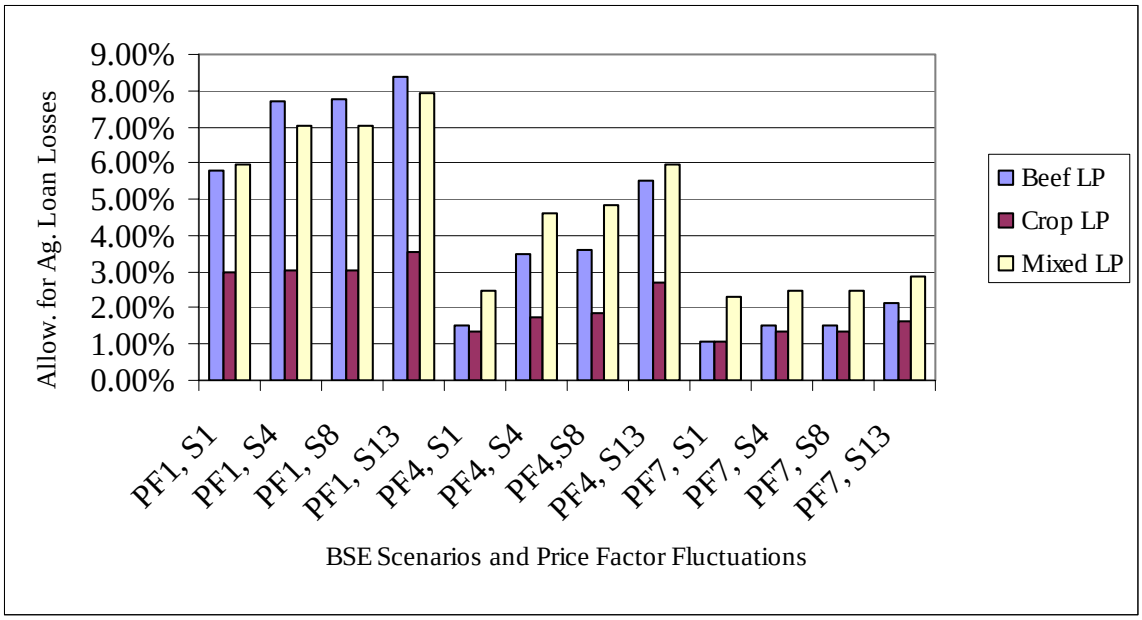

Figure 4.10. Allowance for agricultural loan losses for bank size 1, LP1-LP3.

Figure 4.11 illustrates the asset quality impacts of BSE outbreak scenarios and price factor fluctuations on all representative bank sizes that have a beef-concentrated agricultural loan portfolio. The allowance for agricultural loan losses as a percentage of agricultural loan volume is similar across all classifications of representative banks due to

the similarity in agricultural loan portfolio composition. However, the allowance for agricultural loan losses as a percentage of total outstanding loans differs significantly due to the total loan volume and the overall loan portfolio composition of the representative banks. Representative bank size 4 has a much larger asset base to offset potential loan losses attributed to the agricultural loan portfolio. This is illustrated in Figure 4.12 where the allowance for agricultural loan losses as a percentage of total loans outstanding is displayed for each representative bank size given crop-concentrated agricultural loan portfolios.

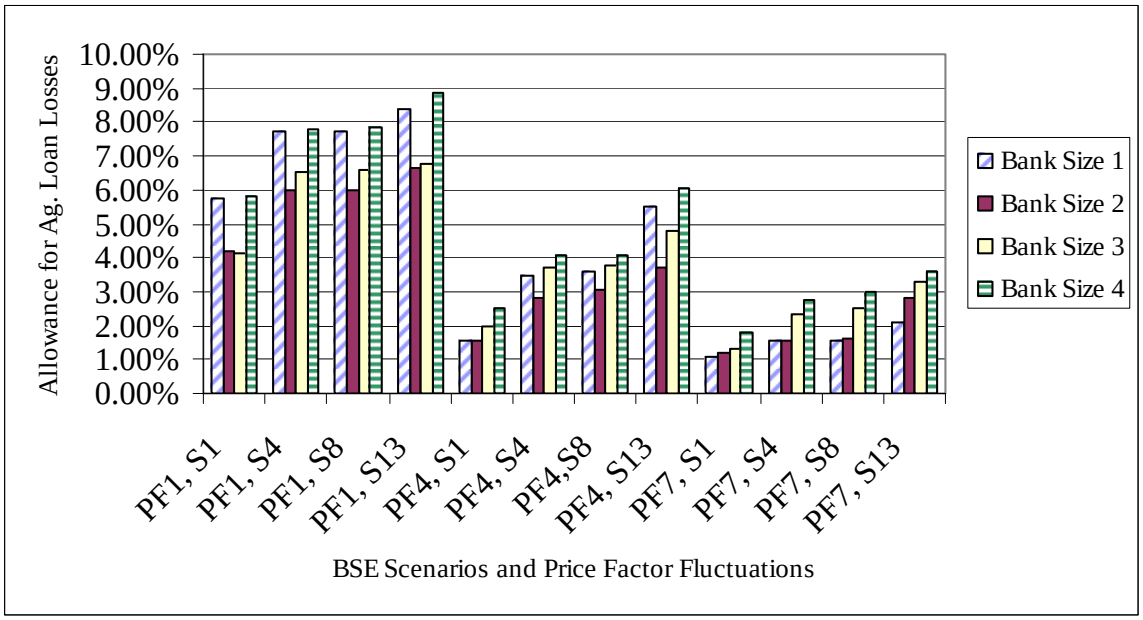

Figure 4.11. Allowance for agricultural loan losses for all bank sizes with a beef-concentrated agricultural loan portfolio.

Representative bank sizes 1-3 must allocate a similar percentage of total loans outstanding to the reserve account in anticipation of loan loss. The greatest amount of variation in percentage requirements among these three representative banks occurs when

there is an extensive BSE outbreak during the middle of the cattle cycle (PF4, S13). This scenario indicates a 0.69 percent difference in the reserve requirements for bank size 2 and 3. Representative bank size 4 indicates a large difference in the reserve requirements when compared to representative bank sizes 1-3. This difference is attributed to agricultural loans representing only a small portion of the total loan portfolio.

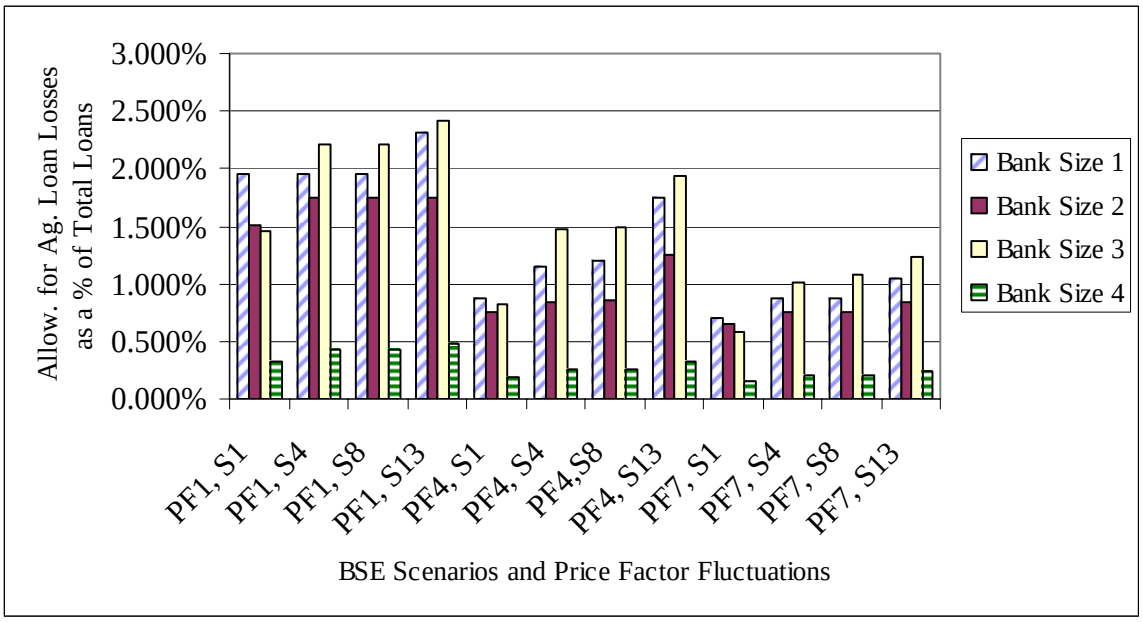

Figure 4.12. Allowance for agricultural loan losses as a percentage of total outstanding loans for all bank sizes with a crop-concentrated agricultural loan portfolio.

The allowance for agricultural loan loss as a percentage of total loans outstanding for representative bank size 4 indicates minimal variation across all BSE outbreak scenarios and price factor fluctuations. In fact, the percentage requirement fluctuates by only 0.32 percent and reaches a maximum allowance requirement of 0.48 percent provided an extensive BSE outbreak during the expansion phase of the cattle cycle (PF1, S13). The same scenario results in a reserve requirement of 2.43 percent for bank size 3, which is

approximately 7.6 times greater than representative bank size 4. This increase in necessary reserve requirements illustrates the reliance on agricultural loan performance by financial institutions with a relatively small asset structure.

Figure 4.13 illustrates the allowance for agricultural loan losses as a percentage of total loans outstanding for representative banks that have a beef-concentrated agricultural loan portfolio. This figure indicates that representative bank size 1 may experience the most severe asset quality impacts of a BSE outbreak due to specialization in agricultural loans and small asset structure (i.e., less than $25 million in total assets). Representative bank size 1 may find it necessary to increase the allowance account up to 5.46 percent of total loans outstanding when an extensive BSE outbreak occurs during the expansion phase of the cattle cycle. The largest representative bank size (i.e., bank size 4) indicates that agricultural loans compose a small percentage of the total loan portfolio and, consequently,

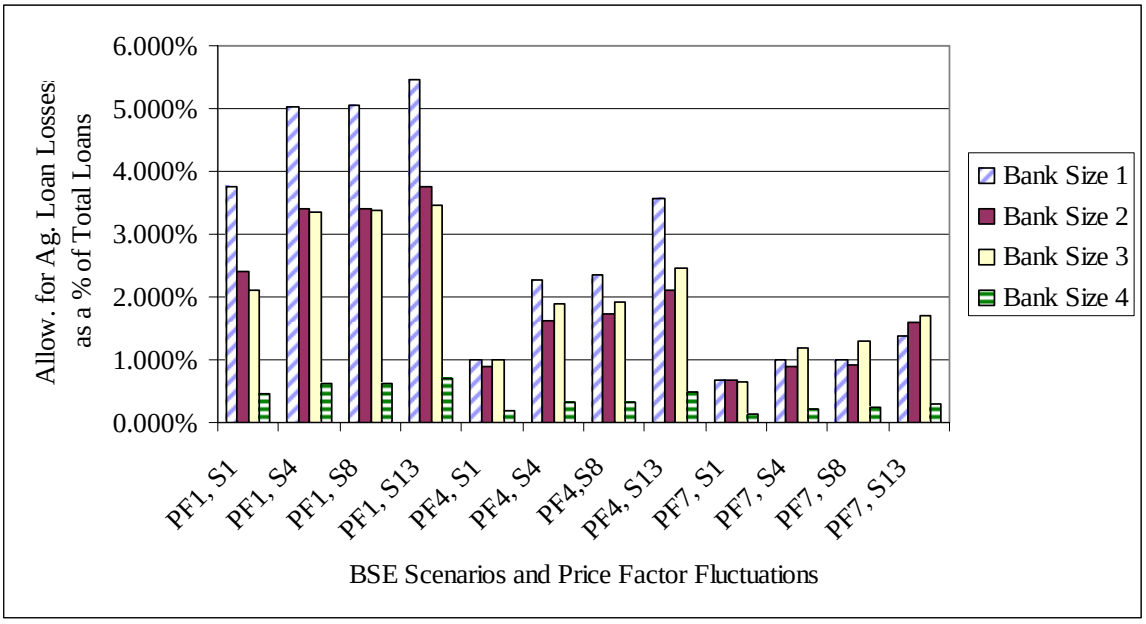

Figure 4.13. Allowance for agricultural loan losses as a percentage of total outstanding loans for all bank sizes with a beef-concentrated agricultural loan portfolio.

experience only minimal fluctuations in asset quality in the event of a BSE outbreak ranging from 0.15 percent (PF7, S1) to 0.71 percent (PF1, S13). The differences in reserve requirements clearly indicate that small agricultural financial institutions in North Dakota rely more on the financial performance of production agriculture when compared to large, diversified financial institutions.

The results of the BSE outbreak scenarios and price factor fluctuations for all representative banks are illustrated in Table 4.13. Key BSE outbreak scenarios are analyzed to determine how the asset quality of all classifications of representative financial institutions potentially could be impacted. The scenarios selected to discuss in further detail include the discovery of BSE in the United States (PF7, S4), the scenario addressing what could have resulted from the discovery of additional cases of BSE (PF7, S13), and an extensive outbreak occurring during the expansion phase of the cattle cycle (PF1, S13).

The scenario best illustrating the discovery of BSE in the state of Washington for agricultural financial institutions is the liquidation phase of the cattle cycle and BSE outbreak scenario 4 (PF7, S4). The representative banks report minimal increases in the reserve account, ranging from 0.05 percent (i.e., bank size 1, LP2, farm and non-farm) to 1.04 percent (i.e., bank size 3, LP1, farm-only). The asset quality impacts of the representative banks would have been more significant if additional cases of BSE were discovered (PF7, S8), which could potentially double the agricultural allowance for loan losses from 0.94 percent to 1.73 percent (i.e., bank size 3, LP1, farm and non-farm). An extensive outbreak occurring during the liquidation phase of the cattle cycle (PF7, S13) could have resulted in necessary increases in funding requirements for the allowance for

agricultural loan losses ranging from 0.08 percent (i.e., bank size 1, LP2, farm and non-farm) to 2.03 percent (i.e., bank size 3, LP1, farm-only).

An extensive BSE outbreak during the expansionary phase of the cattle cycle (PF1, S13) could have extremely damaging effects with respect to agricultural asset quality. The representative banks located in the middle and western portions of the state, where cattle are heavily concentrated, will be most affected and find it necessary to allocate a greater amount of capital to the reserve account. The reserve account given this scenario ranges from 5.26 percent (i.e., approximately 5 times the base case) for the farm and non-farm portfolio of bank size 2, LP1 to 8.89 percent (i.e., approximately 3.5 times the base case) for the farm-only agricultural portfolio of bank size 4, LP1. The smallest representative bank utilized in this study, with a beef-concentrated agricultural loan portfolio, indicates that the allowance for agricultural loan losses could reach 8.4 percent. This is approximately 5.5 times greater than the base case scenario.

Representative banks located in the Red River Valley with heavily crop-concentrated agricultural loan portfolios also found it necessary to increase their allowance accounts due to diminished asset quality. However, the necessary increases are less dramatic when compared to beef or "other" concentrated agricultural loan portfolios. The reserve account for this type of representative bank ranges from 2.18 percent (i.e., approximately 2.5 times the base case) for the farm and non-farm portfolio of bank size 1, LP2 to 6.0 percent (i.e., approximately 2.5 times the base case) for the farm-only portfolio of bank size 4, LP2. The largest representative bank size indicates a farm-only allowance for agricultural loan losses of 6.0 percent in comparison to the beef-concentrated portfolio of 8.9 percent. Financial institutions similar in composition to representative bank size 2

and 3 with a crop-concentrated portfolio might expect to increase their allowance for agricultural loan losses by as much as 2.30 percent and 3.13 percent, respectively, when compared to the base case scenario.

In this study, the required increases in the agricultural allowance reserve accounts are a result of a one-time impact to the financial conditions of producers. The simulated BSE outbreak scenarios and price factor fluctuations were applied to the end of year 2002 financial conditions of North Dakota producers. Therefore, the simulated financial impacts assume that percentage price reductions remain constant for a period of one year. Leistritz et al. (1988) researched the consequences of farm liquidations in North Dakota over time and determined that losses attributed to poor asset quality can be more dramatic. They also determined that producers left approximately 28 percent of loans unpaid when they quit farming during the 1980s.

Collateral Risk Results

The value of available collateral diminishes given BSE outbreak scenarios and price factor fluctuations. The change in the valuation of collateral is of concern to lenders, because it diminishes their abilities to recoup loan losses in the event of foreclosure. It was not possible to determine which assets were pledged as security in a loan transaction due to data limitations. Therefore, all producer assets were considered available as collateral for securing loans (see Chapter 3).

The ratio of available collateral to base case collateral was developed to model the fluctuations in collateral valuation given the BSE outbreak scenarios and price factor fluctuations (see Table 4.14). The base case collateral for each scenario represents all available farm assets for the farm-only model and all available farm and personal assets for

Table 4.14. Average Fluctuations in Available Collateral as a Percentage of Base Case Collateral

	Animal Disease Outbreak Scenarios w/ Price Factor Fluctuations											
	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Bank size1, LP1												
Farm-only	-7.30%	-9.01%	-9.01%	-10.30%	100.00%	-2.58%	-3.00%	-4.29%	3.43%	0.43%	0.43%	-1.72%
Farm & Non-farm	-6.46%	-7.98%	-7.98%	-9.13%	100.00%	-2.66%	-2.66%	-3.80%	3.04%	0.38%	0.00%	-1.52%
Bank size1, LP2												
Farm-only	-4.00%	-5.20%	-5.20%	-5.60%	100.00%	-1.60%	-1.60%	-2.40%	2.00%	0.00%	0.00%	-0.80%
Farm & Non-farm	-3.19%	-4.26%	-4.26%	-4.61%	100.00%	-1.06%	-1.42%	-1.77%	1.77%	0.35%	0.00%	-0.71%
Bank size1, LP3												
Farm-only	-5.05%	-6.57%	-6.57%	-7.07%	100.00%	-1.52%	-2.02%	-3.03%	3.03%	0.51%	0.51%	-1.01%
Farm & Non-farm	-4.76%	-6.19%	-6.19%	-7.14%	100.00%	-1.90%	-1.90%	-3.33%	2.38%	0.00%	0.00%	-1.43%
Bank size2, LP1												
Farm-only	-6.17%	-7.82%	-7.82%	-9.05%	100.00%	-2.47%	-2.88%	-4.12%	2.88%	0.00%	0.00%	-1.65%
Farm & Non-farm	-5.15%	-6.62%	-6.99%	-7.72%	100.00%	-2.21%	-2.21%	-3.68%	2.21%	0.00%	0.00%	-1.47%
Bank size2, LP2												
Farm-only	-3.13%	-4.02%	-4.02%	-4.46%	100.00%	-1.34%	-1.34%	-1.79%	1.34%	0.00%	0.00%	-0.89%
Farm & Non-farm	-2.46%	-2.87%	-2.87%	-3.28%	100.00%	-0.82%	-0.82%	-1.23%	1.23%	0.41%	0.00%	-0.41%
Bank size2, LP3												
Farm-only	-5.21%	-6.16%	-6.16%	-7.11%	100.00%	-1.90%	-1.90%	-2.84%	2.37%	0.00%	0.00%	-0.95%
Farm & Non-farm	-4.29%	-5.58%	-5.58%	-6.01%	100.00%	-1.72%	-1.72%	-2.58%	1.72%	0.00%	0.00%	-0.86%
Bank size3, LP1												
Farm-only	-6.53%	-8.54%	-8.54%	-9.55%	100.00%	-3.02%	-3.02%	-4.52%	3.02%	0.00%	0.00%	-1.51%
Farm & Non-farm	-5.56%	-7.41%	-7.41%	-7.87%	100.00%	-2.31%	-2.31%	-3.70%	2.78%	0.00%	0.00%	-1.39%
Bank size3, LP2												
Farm-only	-4.02%	-4.91%	-4.91%	-5.80%	100.00%	-1.79%	-1.79%	-2.68%	1.79%	0.00%	0.00%	-0.89%
Farm & Non-farm	-3.35%	-4.18%	-4.60%	-5.02%	100.00%	-1.26%	-1.26%	-2.09%	1.67%	0.00%	0.00%	-0.84%
Bank size3, LP3												
Farm-only	-4.95%	-5.94%	-5.94%	-6.93%	100.00%	-1.98%	-1.98%	-2.97%	2.48%	0.50%	0.50%	-0.99%
Farm & Non-farm	-4.13%	-5.05%	-5.50%	-5.96%	100.00%	-1.38%	-1.38%	-2.29%	2.29%	0.46%	0.46%	-0.92%
Bank size4, LP1												
Farm-only	-6.73%	-9.13%	-9.13%	-10.10%	100.00%	-2.88%	-2.88%	-4.33%	3.85%	0.48%	0.48%	-1.44%
Farm & Non-farm	-6.55%	-8.30%	-8.30%	-9.17%	100.00%	-2.62%	-2.62%	-3.93%	3.06%	0.00%	0.00%	-1.75%
Bank size4, LP2												

Table 4.14. (continued)

	PF1, S1	PF1, S4	PF1, S8	PF1, S13	PF4, S1	PF4, S4	PF4, S8	PF4, S13	PF7, S1	PF7, S4	PF7, S8	PF7, S13
Farm-only	-4.61%	-5.53%	-5.99%	-6.45%	100.00%	-1.84%	-1.84%	-2.76%	1.84%	0.00%	0.00%	-1.38%
Farm & Non-farm	-3.81%	-5.08%	-5.08%	-5.51%	100.00%	-1.69%	-1.69%	-2.54%	1.69%	0.00%	0.00%	-0.85%
Bank size4, LP3												
Farm-only	-5.00%	-6.50%	-6.50%	-7.50%	100.00%	-2.00%	-2.00%	-3.00%	3.00%	0.50%	0.00%	-1.00%
Farm & Non-farm	-4.59%	-5.96%	-5.96%	-6.88%	100.00%	-1.83%	-1.83%	-2.75%	2.29%	0.46%	0.46%	-0.92%

the farm and non-farm model. The total valuation of the collateral in the base case is considered to be 100 percent in the analysis. The fluctuations in collateral value are calculated using the BSE outbreak scenarios and price factor fluctuations. A percentage change then was derived to enable comparability among representative banks of varying asset sizes. Additional figures are provided that illustrate the increased collateral risk of financial institutions with beef-concentrated agricultural loan portfolios.

The farm-only model results indicate a greater percentage decrease in collateral value as compared to the farm and non-farm model. This relationship can be attributed to the changes impacting only farm assets such as market livestock, breeding livestock, pastureland, and hay land. The farm and non-farm model also accounts for non-farm assets, such as residences and automobiles, increasing the collateral available to lenders while maintaining the same financial impacts experienced by the farm operations. This indicates that lenders have decreased collateral risk if they are able to secure personal assets that remain unaffected by an animal disease outbreak as collateral on farm loans. It also indicates that relatively larger financial institutions are at an advantage to small, community banks, because they are better able to develop a more diversified portfolio that is not as dependent on the agricultural sector.

Figure 4.14 illustrates the relationship between collateral value fluctuations of beef-concentrated, crop-concentrated, and mixed agricultural loan portfolios for representative bank size 1. North Dakota financial institutions similar to representative bank size 1 with a beef-concentrated loan portfolio are at the greatest risk of diminished collateral due to a BSE outbreak. Collateral value potentially could diminish by as much as 10.3 percent for the most extensive BSE outbreak occurring during the expansion phase of the cattle cycle

when compared to the base case. The scenario best illustrating the recent discovery of BSE in the state of Washington (PF7, S4) resulted in a reduction in the value of available collateral of approximately 3.0 percent (i.e., difference between PF7, S1 and PF7, S4 for beef-concentrated loan portfolio). However, if additional cases of BSE were discovered or if there was a larger decline in consumer demand, the value of available collateral could have decreased by up to 5.2 percent (i.e., difference between PF7, S1 and PF7, S13 for beef-concentrated loan portfolio).

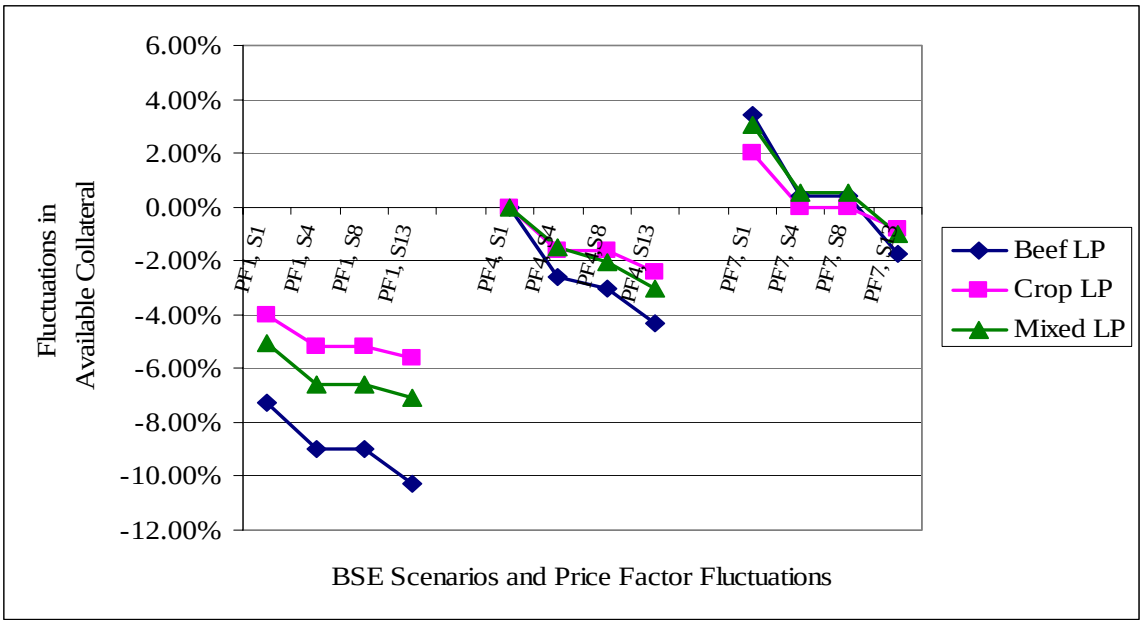

Figure 4.14. Fluctuations in available collateral for bank size 1, LP1-LP3.

Bank size 4 demonstrates a comparable decline in collateral value of 10.1 percent (i.e., farm-only) given a similar BSE outbreak (Figure 4.15). In fact, all representative banks experience fluctuations in collateral value regardless of agricultural loan portfolio composition, provided an extensive BSE outbreak and low beef cattle prices. Financial institutions did not experience long-term reductions in collateral value when the single case

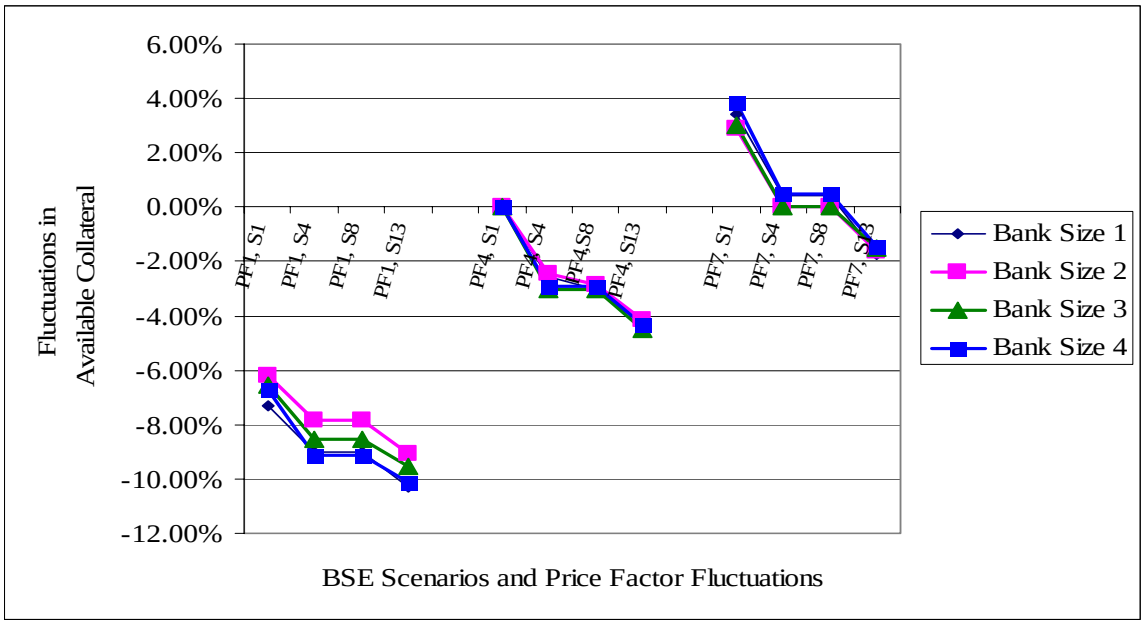

Figure 4.15. Fluctuations in available collateral for all representative bank classifications with a beef-concentrated agricultural loan portfolio.

of BSE was discovered in the state of Washington. This was primarily due to its occurrence during the liquidation phase of the cattle cycle (i.e., favorable prices) and the rapid USDA response in preventing further cases. The model indicates that collateral available to lenders in securing loans may have diminished by as much as 3 percent (i.e., the difference between PF7, S1 and PF7, S4); however, market prices quickly recovered and negated the short-term increase in collateral risk. The potential discovery of additional cases of BSE may have magnified the collateral risk experienced by lenders. The model suggests that the value of the available collateral could have decreased by as much as 4.5 percent (the difference between PF7, S1 and PF7, S13). This scenario is more problematic to lenders as compared to the discovery of a single case of BSE because market prices take longer to recover. The resulting effect for financial institutions would be diminished ability to recover loan losses in the event of foreclosure.

Summary

The base case results of the producer model indicate that beef production operations are the greatest credit risk to banks when compared to the remaining producer classifications investigated in this study. However, all producer classifications experienced diminished financial conditions as the magnitude of the potential BSE outbreak increased. Financial institutions that have a heavily beef-concentrated agricultural loan portfolio, as is the case with small banks located in the central and western portions of North Dakota, are at the greatest risk of loss due to diminished asset quality and collateral risk.

The financial risks to agricultural producers and financial institutions in North Dakota are magnified by the distinct possibility that an extensive BSE outbreak may occur in the United States. On December 23, 2003, a single case of BSE was discovered in the state of Washington. The financial impacts of this incident were relatively short-lived due to the discovery of only one case of BSE, the rapid response by USDA-APHIS, and the current liquidation phase of the U.S. cattle cycle. This discovery resulted in decreased short-term profitability and repayment capacity for producers, while financial institutions may have experienced little change.

The results of this study also indicate that an extensive BSE outbreak occurring during the expansion phase of the cattle cycle would inflict longer-term damage to beef producers through extended losses, the inability to repay term-debt obligations, and liquidity and solvency concerns. This scenario would create problems for small banks that have heavily beef-concentrated loan portfolios, because they would have to increase their reserve account by as much as 7.0 percent. In the event of foreclosure, banks' abilities to recoup losses through collateral sales also may diminish by as much as 10.3 percent.

CHAPTER 5. CONCLUSIONS

Review of Problem

An extensive BSE outbreak in the United States would present a number of problems for North Dakota's agricultural producers and financial institutions that provide capital to farm operations. BSE outbreaks have occurred in countries throughout the world, resulting in a wide range of financial consequences that are dependent on the number of discovered cases of BSE and the extent of domestic consumption and export reduction. It is important to anticipate the potential economic impacts of an outbreak given the dependence on beef production in the central and western regions of North Dakota.

Agricultural Producers

North Dakota's agricultural producers may experience financial difficulty in the event of a BSE outbreak due to reductions in prices received for market cattle and the devaluation of breeding stock, pastureland, and hay land. The discovery of a single case of BSE in the state of Washington resulted in short-term decreases in beef cattle prices and minimal reductions in profitability and repayment capacity. Additional cases of BSE may have led to more significant reductions in profitability and repayment capacity, as well as long-term impacts to the solvency and financial efficiency of the agricultural operations.

Financial Institutions

North Dakota financial institutions are characterized as having a relatively small asset base with a loan portfolio heavily concentrated in the agricultural sector, which indicates their reliance on the financial performance of agricultural operations. Reductions in beef cattle prices may diminish the overall financial conditions of producers and result in a diminished asset quality of the agricultural loan portfolio. The reduction in asset quality

indicates that a bank must increase its allowance for agricultural loan losses (i.e., reserve account) in anticipation of increased loan loss. Banks located in the central and western portions of the state, where livestock are concentrated, may also be more susceptible to a BSE outbreak than a bank located in the Red River Valley.

Review of Objectives

The main objectives of this study were to determine how various BSE outbreak scenarios would affect North Dakota agricultural producers' overall financial condition (i.e., credit-score) so that the impacts to representative financial institutions' agricultural loan portfolio and collateral quality could be effectively analyzed. Specific objectives included: (1) identifying the financial impacts that a BSE outbreak would have on North Dakota's beef producers and their repayment capacity; (2) simulating representative agricultural loan portfolios that reflect the composition of North Dakota banks; (3) developing a series of feeder, slaughter, and breeding cattle price factors that allowed the one-period model to exhibit dynamic modeling properties; (4) adapting existing term credit and operating credit-scoring models to determine changes in credit quality of representative producer categories; and (5) incorporating the effects of BSE outbreak scenarios on representative banks' allowance for loan loss reserve accounts and collateral quality.

Review of Methodology

Producer financial statements, including the balance sheet, income statement, and statement of cash flows, were developed for the representative producer categories. Operating and term credit-scoring models were adapted from Splett et al. (1994) to derive a comprehensive risk rating that represented the producers' well-being as indicated on their financial statements. Agricultural loan portfolios were simulated using GAMS for banks

selected to represent the financial intermediation structure in North Dakota. The BSE outbreak scenarios and price factor fluctuations then were applied to the producer financial statements to determine changes in financial condition. The alterations in producer financial conditions were reflected in the resulting credit-scores and the diminished asset quality of financial institutions.

BSE Outbreak Scenarios and Price Factor Fluctuations

The BSE outbreak scenarios utilized in the model were estimated by Jin et al. (2004) in response to the discovery of a single case of BSE in the United States. While the actual price declines in response to the discovery of BSE were less than those estimated by Jin et al. (2004), the scenarios represented in their study are indicative of potential economic consequences. The corresponding price reductions resulting from the BSE outbreaks reflect scenarios ranging from a decrease in demand of 5 percent and a reduction in exports of 50 percent to a decrease in demand of 20 percent and a reduction in exports of 100 percent. The price factor fluctuations are representative of beef cattle prices ranging from low prices received during the expansion phase to high prices received during the current liquidation phase of the cattle cycle.

Review of Results

The results of the model indicate that a BSE outbreak and corresponding reductions in beef cattle prices could create short-term financial difficulty for producers, such as profitability and repayment capacity concerns, as well as longer-term damage if the BSE outbreak were extensive (i.e., discovery of additional cases of BSE). The results also indicate that financial institutions in areas of high cattle concentration, such as the central and western portions of North Dakota, are susceptible to the greatest amount of loss given

producers' inabilities to repay principal and interest on outstanding operating and term loans. The asset quality ratings of financial institutions diminish as the producer (i.e., borrower) experiences a decrease in credit risk-rating (i.e., credit-score) that results from reductions in beef cattle prices due to a BSE outbreak. The diminished asset quality ratings require the financial institutions to increase their allowance for agricultural loan loss in anticipation of diminished probability of collecting the entire loan balance. In the event of foreclosure, financial institutions may not be able to collect the entire loan amount due to diminished values of producer collateral that was potentially used to secure the loan.

Base Case Results

Crop producers exhibited the best credit risk-rating of all representative producer classifications. Their average base case credit scores indicated a Risk Class 3 rating, which is a performing loan category as defined by AgCountry Farm Credit Services (2004). Risk Class 3 is indicative of "borrowers with satisfactory asset quality and liquidity, adequate debt capacity and coverage, and good management in critical positions." This indicates that financial institutions located in areas of concentrated crop production likely will experience only modest financial concerns due to a BSE outbreak. Banks with a crop producer-concentrated agricultural loan portfolio indicated an average initial allowance for loan losses ranging from 1.33 to 2.43 percent.

Beef producers exhibited the highest credit risk rating of all representative producer classifications derived in this study. Their average credit-scores for the farm-only operating and term models were 4.70 and 4.46, respectively. These averages represent a credit risk-rating near Risk Class 5 (OAEM), which is a non-performing or high-risk classification. According to the Risk-Rating Definitions and Guidelines provided by

AgCountry Farm Credit Services (2004), assets classified as Risk Class 5 are "currently protected, but potentially weak and constitute an undue and unwarranted credit risk." The increased credit risk of beef producers in comparison to the other representative producer categories indicates that financial institutions located in the central and western portions of North Dakota, where livestock are heavily concentrated and pastureland and hay land are prevalent, are at a financial disadvantage pre-BSE outbreak. Financial institutions with a beef-concentrated agricultural loan portfolio reported an average initial allowance for agricultural loan losses ranging from 1.53 to 2.50 percent.

Scenario Analysis Results

The scenario that most accurately reflects the recent discovery of BSE in the state of Washington resulted in minimal adverse effects to agricultural producers in North Dakota (i.e, comparing PF7, S1 to PF7, S4). The beef producer classification indicated short-term, temporary reductions in profitability (i.e., ROE) and repayment capacity (i.e., term-debt coverage ratio). The farm-only ROE decreased from 6.0 percent to -10.0 percent, which indicates a short-term loss to farm operations. The term-debt coverage ratio decreased from 1.87 to 1.21, indicating that the producer is less able to withstand further adverse economic conditions. In this study, there were no long-term effects to the financial conditions of beef producers or any other producer classification. This scenario also resulted in minimal impacts to the agricultural loan portfolios of representative banks located in the central and western portions of North Dakota. The reserve account for agricultural loan losses was increased by as little as 0.34 percent for representative bank size 2 up to 1.04 percent for representative bank size 3. The quality of available producer

collateral also decreased by as little as 2.88 percent for representative bank size 2 up to 3.37 percent for representative bank size 4.

The scenario best illustrating what may have happened if additional cases of BSE were discovered (i.e., prolonged BSE outbreak) or a stronger decline in consumer confidence in the beef supply was experienced would have resulted in more significant impacts to both producers and financial institutions (i.e, comparing PF7, S1 to PF7, S13). The beef producer classification could have seen more significant, longer-lived reductions in profitability and repayment capacity. The farm-only ROE would have decreased further to -18.0 percent, which indicates more substantial losses to farm operations. The term-debt coverage ratio could have decreased to 0.82, indicating that beef producers, on average, no longer have the ability to meet all term-debt obligations as they come due. The net farm income from operations ratio also diminished from 0.21 to 0.02. This indicates that revenues received from farm operations have decreased to the point where they are barely able to cover operating expenses. The substantial reductions in beef producers' financial performance are also indicated by the change in the farm-only average credit-score from 3.74 to 5.35. The resulting effects on financial institutions with heavily beef-concentrated agricultural loan portfolios are more substantial. The amount of funds set aside for the allowance for agricultural loan losses increased by as little as 1.07 percent for representative bank size 1 up to 2.03 percent for representative bank size 2. The quality of available collateral decreased by as little as 4.53 percent for representative bank sizes 2 and 3, and up to 5.29 percent for representative bank size 4.

The scenario having the most adverse effect on producers and agricultural financial institutions was an extensive BSE outbreak (i.e., numerous discovered cases of BSE)

occurring during the expansion phase of the cattle cycle (PF1, S13). This scenario resulted in extremely poor financial conditions of beef producers due to low beef cattle prices for an extended period of time (see Table 4.4). The resulting average credit risk-rating of beef producers for the farm-only operating and term credit-scoring models were 6.65 and 6.33, respectively. Risk Class 6, Substandard Viable, is defined by AgCountry Farm Credit Services (2004) as "assets that are inadequately protected by the borrower's current sound worth and paying capacity or the collateral pledged, if any, but the operation is still viable." According to the reserve requirements for the allowance for agricultural loan losses, financial institutions that have a beef-concentrated agricultural loan portfolio must set aside up to 8.89 percent of the total agricultural loan volume. The quality of available producer collateral also could diminish by up to 10.30 percent, which indicates a further loss to banks in the event of foreclosure.

The results indicated that banks with a higher proportion of cattle loans are impacted more by a BSE outbreak. Therefore, the summarized results of the various scenarios highlight impacts to beef producers and financial institutions located in areas of concentrated beef production (i.e., limited opportunities for diversification efforts). However, financial institutions that are located in other areas of North Dakota are also affected because beef production represents at least a portion of their loan portfolio.

Implication of Results

Animal disease outbreaks, such as BSE, have the potential to create significant adverse effects for North Dakota's beef producers as well as financial institutions that provide capital to beef operations. Since the first discovery of BSE in the United States on December 23, 2003, issues regarding the credit risk exposure of agricultural producers and

asset quality risk exposure of agricultural financial institutions have become increasingly important. In this study, the financial impacts of twelve BSE outbreak scenarios and price factor fluctuations have been analyzed in detail. The implications for agricultural producers and agricultural financial institutions are presented in the following sections.

Agricultural Producer Implications

This research has provided North Dakota's beef producers with a better understanding of how significantly they may be impacted financially in the event of a catastrophic event such as a BSE outbreak and what actions can be taken to help limit overall economic losses. Currently, there is not an insurance program that protects producers from losses, such as diminished values of breeding cattle herds, pastureland, and hay land, that have the potential to diminish their credit qualities. However, a livestock insurance pilot program known as the "Livestock Risk Protection Insurance Pilot Program" has been developed to provide relatively small beef cattle producers (i.e., limit of 2,000 head insured) a risk management tool to protect a percentage of expected feeder and fed cattle returns (USDA-RMA, 2004).

Agricultural producers can select an insurance coverage level between 70-95 percent of the expected ending returns. If, at the end of the insurance period, the actual ending value is less than the coverage value, the producer is paid an indemnity for the difference between the coverage price and actual ending value multiplied by the selected coverage percentage. Daily livestock risk protection coverage prices, rates, and actual ending values can be obtained from the Risk Management Agency (RMA) Internet site. Relatively small beef operations may find this risk management tool especially attractive

due to the credit risk reduction benefits and, consequently, the ability to maintain more favorable loan pricing agreements with agricultural lenders.

Adjusted Gross Revenue (AGR), or "whole-farm" insurance, is another risk management tool administered by the RMA division of the USDA. This insurance plan guarantees a percentage of the gross farm revenue derived from the sale of agricultural commodities. It protects producers against a decline in farm revenues due to unavoidable natural disasters and market fluctuations and is designed to insure multiple agricultural commodities under one insurance contract (USDA-RMA, 2004). This insurance product may benefit producers that earn revenues from a variety of agricultural commodities.

Financial Institution Implications

Financial institutions of varying asset sizes and locations in the state can select which representative bank derived in this study most accurately reflects their asset quality risk exposure to a BSE outbreak. Agricultural banks may find diversification of loan portfolios infeasible due to small asset sizes and a limited borrowing pool. Therefore, based on banks' financial structure (i.e., asset size, agricultural loans as a percentage of total loans, and beef producer loans as a percentage of total loans), it may be advantageous to utilize risk management tools.

Some of these tools include adopting risk-adjusted loan pricing, initiating loan participations, securing additional collateral, participating in guaranteed loan programs through the Bank of North Dakota or Farm Service Agency, allocating additional resources to monitoring beef production loans, providing further training for lenders and borrowers on the importance of risk management tools, and requiring beef producers to purchase risk protection insurance to help protect against downside price risk.

Specialized agricultural banks located in areas of high cattle concentration also may find it beneficial to diversify or invest a percentage of their asset portfolio in securities such as stocks, bonds, or treasuries. However, this risk management strategy may limit banks' abilities to satisfy the credit requirements of borrowers depending on the asset structures of the financial institutions and, consequently, may not be feasible.

Limitations of Study

The first limitation of this study is that the results are largely dependent on the percentage reductions in beef cattle prices estimated by Jin et al. (2004). Their research was conducted in response to the United State's first and only discovery of BSE to date. Therefore, assumptions were made regarding domestic consumption and the degree of export reduction. They indicated that exports could decrease between 50-100 percent. According to the USDA-ERS (2004b), beef and veal exports did decrease by 96 percent from December 2003 to January 2004. However, Jin et al. (2004) also indicated that the domestic consumption of beef products likely would decrease between 5-20 percent. The domestic consumption of beef only decreased by 0.62 percent from the fourth quarter of 2003 to the first quarter of 2004 (Virginia Polytechnic Institute and State University [VPISU], 2004). The domestic consumption of beef was estimated to increase by 1.53 percent from the first quarter of 2004 to the second quarter of 2004 (VPISU, 2004). The variation in actual and estimated reduction in domestic consumption may have caused the estimated price reductions in beef cattle to be overstated. However, more prolonged cases may be more representative of the BSE outbreak scenarios derived by Jin et al. (2004).

A second limitation of the study was the inability to determine what the profitability impacts to financial institutions might be. The FDIC Call Reports available on the Internet

do not distinguish interest earned by the type of outstanding loan. Other necessary data regarding interest rates charged on individual loans and producer collateral used to secure loans was not available. Therefore, profitability impacts to financial institutions could not be established due to limited data and the number of decisive assumptions that would have been required to conduct such an analysis.

Third, the effects of a BSE outbreak on dairy production operations in the United States were not available and, consequently, no dairy impacts were applied to the model. Minimal financial impacts to banks may have resulted, because dairy receipts comprise only $3.4 million or 2.7 percent of total gross cash farm income in the data sample utilized in the analysis. In 2004, only 47,000 head or 2.7 percent of the total cattle and calves inventory in North Dakota was dairy cattle (USDA-NASS, 2004b).

A fourth limitation of the study was the inability to conduct statistical analyses to determine the significance of the model results. The simulation methodology utilized in this study allows financial institutions to select the representative bank and agricultural portfolio that most accurately reflects their financial structure. Multiple random draws of the producer data set would have been required to conduct a statistical analysis, which would distort the total agricultural loan volume and composition of the agricultural loan portfolios of the representative banks. These distortions would have resulted in the inability to obtain results with respect to representative banks derived in this study.

Need for Further Research

Additional research regarding BSE outbreak quarantine zones, eradication policies enforced by the USDA-APHIS, and indemnification payment schedules would allow a

more comprehensive analysis of the total impacts or shocks incurred by beef producers and agricultural financial institutions.

Research addressing the design of further livestock insurance products to mitigate longer-term wealth impacts (i.e., diminished values of breeding herds, pastureland, and hay land) of catastrophic disease outbreaks also would contribute to an improved understanding of the risk management strategies of producers and financial institutions.

This study could be extended to account for financial impacts to rural communities that rely on the successful operations of agricultural producers. Leistritz et al. (2002) concluded that agriculture is vital to the North Dakota economy, directly employing 10.9 percent of the state's total workforce as farmers, ranchers, and farm wage and salary employees and accounting for 7.9 percent of the gross state product.

A study incorporating potential losses over time would be a further enhancement. Currently, a one-period framework incorporating a one-time shock to the short-term financial conditions of producers and financial institutions is utilized. The one-period framework estimates losses for one year; whereas, a dynamic framework would allow losses in subsequent years to be calculated. A dynamic framework may be more beneficial in situations where an extensive BSE outbreak occurs and financial impacts are experienced in subsequent years.

Summary

This study has addressed the financial impacts that agricultural producers and financial institutions in North Dakota might expect given various scenarios of BSE outbreaks occurring throughout all phases of the cattle cycle. Results of model simulations have shown that producers and financial institutions would experience only short-term

adverse effects when a single case of BSE is discovered. A prolonged BSE outbreak occurring during the expansion phase of the cattle cycle could have both short- and long-term effects on beef producers and financial institutions that provide capital to affected beef operations. Producers and financial institutions in areas of North Dakota with concentrated beef production should consider risk mitigation strategies to limit risk exposure to a BSE outbreak.

REFERENCES

AgCountry Farm Credit Services. (2004, July). Exhibit 1 – Risk rating definitions and guidelines (Credit Procedures 4.7.16). Moorhead, MN: Author.

Albright, J.W. (n.d.). Using simulation to estimate loan portfolio funding requirements. *Financial Engineering News*. Retrieved May 19, 2004, from http://www.fenews .com/fen34/siminfinancialengfiles/siminfinancialeng.html

Andrews, N.J. (2004). *Incidence of variant creutzfeldt-jakob disease onsets and deaths in the UK, January 1994 – June 2004.* Statistics Unit, CDSC, Health Protection Agency. Retrieved September 30, 2004, from http://www.cjd.ed.ac.uk/vcjdq.htm

Barry, P.J., & Ellinger, P.N. (1989). Credit scoring, loan pricing, and farm business performance. *Western Journal of Agricultural Economics, 14*(1), 45-55.

Barry, P.J., Ellinger, P.N., Hopkin, J. A., & Baker, C. B. (2000). *Financial management in agriculture.* Danville, IL: Interstate Publisher's, Inc.

Bervejillo, J.E., & Jarvis, L.S. (2003). Bovine Spongiform Encephalopathy: Lessons from the United Kingdom. In D. A. Sumner (Ed.), *Exotic pests & diseases: Biology and economics for biosecurity* (pp. 71-84). Ames: Iowa State Press.

Board of Governors of the Federal Reserve System. (2002). *Agricultural finance databook* (Federal Reserve Statistical Release E.15-125). Retrieved April 10, 2004, from http://www.federalreserve.gov/../releases/e15/20021231/ pdf/databook.pdf

Burton, M.P., & Young, T. (1996). The impact of BSE on the demand for beef and other meats in Great Britain. *Applied Economics, 28,* 687-693.

Canadian Animal Health Coalition. (2003). *BSE economic impact assessment.* Retrieved

December 2, 2003, from http://www.animalhealth.ca/BSEFinal-June262003.pdf

Davidson, P. (2004, January 2). Beef processors ease production, lay off workers. *USA Today.* Retrieved May 26, 2004, from http://www.usatoday.com/money/industries/food/2004-01-02-exporters_x.htm

Ellinger, P.N., & Barry, P.J. (n.d.). *A farmer's guide to agricultural credit.* University of Illinois at Urbana-Champaign, The Center for Farm and Rural Business Finance. Retrieved August 17, 2004, from http://www.farmdoc.uiuc.edu/finance/FarmersGuidetoCreditBody.htm

Ellinger, P.N., Splett, N.S., & Barry, P.J. (1992). Consistency of credit evaluation procedures at agricultural banks. *Agribusiness-An International Journal,* 8, 517-36.

Federal Deposit Insurance Corporation. (2003). *The reports of condition and income and thrift financial report.* Retrieved November 14, 2003, from http://www2.fdic.gov/Call_TFR_Rpts/search.asp

Francl, T. (2003). The economic impact of BSE. American Farm Bureau Federation. Retrieved May 18, 2004, from http://www.mdfarmbureau.com/2004/Files/Alerts/BSE.htm

Gallagher, R.L. (2002). Modeling agricultural loan portfolio risk in a stochastic environment. *Agricultural Finance Review, 62*(1), 25-39.

General Algebraic Modeling System. (1998). GAMS distribution 21.2. [Computer software]. Washington, DC: GAMS Development Corporation.

Green, J.W. (2003, October 2). Unpublished presentation for departmental seminar at North Dakota State University. "Economic policy, risk, and impact analysis."

Gustafson, C.R., Barry, P.J., & Sonka, S.T. (1988). Machinery investment decisions: A

simulated analysis for cash grain farms. *Western Journal of Agricultural Economics, 13*(2), 244-253.

Henson, S., & Mazzocchi, M. (2002). Impact of Bovine Spongiform Encephalopathy on agribusiness in the United Kingdom: Results of an event study of equity prices. *American Journal of Agricultural Economics, 84*(2), 370-386.

Jin, H.J., & Koo, W.W. (2003). *U.S. meat exports and food safety information.* Agribusiness and Applied Economics Report No. 514. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

Jin, H.J., Skripnitchenko, A., & Koo, W.W. (2004). *The effects of the BSE outbreak in the United States on the beef and cattle industry.* Agricultural Economics Special Report 03-4. Fargo: North Dakota State University, Department of Agricultural and Applied Economics.

Jin, H.J., Sun, C., & Koo, W.W. (2003). *The effect of food-safety related information on consumer preference: The case of the BSE outbreak in Japan.* Agribusiness and Applied Economics Report No. 506. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

Kim, C.S., & Lewandrowski, J. (2003). Economics of managing invasive pest species: Exclusion and control. *American Agricultural Economics Association.* Retrieved January 15, 2003, from http://agecon.lib.umn.edu/cgi-bin/pdf_view .pl?paperid=8700&ftype=.pdf

Koo, W.W. (2003). *Applied Econometrics*. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

Kunkle, W.E., Sand, R.S., & Garces-Yepez, P. (2002). *Strategies for successful*

development of beef heifers. (SS-ANS-15). Department of Animal Sciences, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.

Latouche, K., Rainelli, P., & Vermersch, D. (1998). Food safety issues and the BSE scare: Some lessons from the French case. *Food Policy, 23*(5), 347-356.

Lawrence, J.D., Strohbehn, D., Loy, D., & Clause, R. (2003). L*essons learned from the Canadian cattle industry: National animal identification and the Mad Cow.* Midwest Agribusiness Trade Research and Information Center Research Paper 03-MRP7, MATRIC, Iowa State University, Ames.

Leistritz, F.L., Ekstrom, B.L., Leholm, A.G., & Wanzek, J. (1988). Farm liquidations in North Dakota: Consequences for Operators and Lenders. *Agricultural Finance Review, 48*, 75-85.

Leistritz, F.L., Lambert, D.K., & Coon, R.C. (2002). *The role of agriculture in the North Dakota economy.* Agribusiness and Applied Economics Statistical Series Report No. 57-S. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

Lins, D.A., Ellinger, P.N., & Lattz, D.H. (1987). Measurement of financial stress in agriculture. *Agricultural Finance Review*, 47, 53-61.

Miller, L.H., Barry, P.J., & Ellinger, P.N. (1993). Credit risk management. *Journal of Agricultural Lending*, 6, 22-27.

Miller, L.H., Ellinger, P.N., Barry, P.J., & Lajili, K. (1993). Price and nonprice management of agricultural credit risk. *Agricultural Finance Review,* 53, 28-41.

National Cattlemen's Beef Association. (n.d.). *Economic impact of the United States beef*

industry. Retrieved September 24, 2004, from http://www.beef.org/documents/Econ%20Impact%20Beef%20v2.doc

Office of the Comptroller of the Currency Handbook. Retrieved August 24, 2004, from http://www.occ.treas.gov/handbook

Oltmans, A.W., Klinefelter, D.A., & Frey, T.L. (1998). *Agricultural financial reporting and analysis*. St. Louis: Doane Agricultural Services Company.

Peart, R.M., Ogilvie, J.R., Barrett, J.R., & Bender, D.A. (1985). Some examples of the use of simulation in U.S. and Canadian agriculture. *The Journal of the Operational Research Society, 36*(2), 109-115.

Pederson, G.D., & Chellappan, R.R. (1991). *Use of credit evaluation procedures at agricultural banks in Minnesota: 1991 survey results*. Staff Paper 91-48. St. Paul: University of Minnesota, Department of Agricultural and Applied Economics.

Pennings, M.E., Wansink, B., & Meulenberg, M.T.G. (2002). A note on modeling consumer reactions to a crisis: The case of the mad-cow disease. *International Journal of Research in Marketing, 19*(1), 91-100.

Price, B. (2003). What happened to cattle cycles? Texas Cattle Feeders Asscociation. Retrieved June 29, 2004, from http://www.tcfa.org/Annual03/Cycles.PDF

Schmiesing, B.H., Edelman, M.A., Swinson, C., & Kolmer, D. (1985). Differential pricing of agricultural loans by commercial banks. *Western Journal of Agricultural Economics, 10*(2), 192-203.

Schnitkey, G.D., Barry, P.J., & Ellinger, P.N. (1987). A microcomputer analysis of farm financial performance. *Southern Journal of Agricultural Economics, 19*(2), 203-09.

Schnitkey, G.D., Taylor, C.R., & Barry, P.J. (1989). Evaluating farmland investments

considering dynamic stochastic returns and farmland prices. *Western Journal of Agricultural Economics, 14*(1), 143-156.

Sherrick, B.J., & Lins, D.A. (2000). *Time value of money and investment analysis: Explanations and spreadsheet applications for agricultural and agribusiness firms.* (V 1.1). University of Illinois, Urbana-Champaign, The Center for Farm and Rural Business Finance.

Shields, D.A., & Matthews, K.H. (2003). *Interstate livestock movements*. (LDP-M-108-01). United States Department of Agriculture, Electronic Outlook Report from the Economic Research Service.

Splett, N.S., Barry, P.J., Dixon, B.L., & Ellinger, P.N. (1994). A joint experience and statistical approach to credit scoring. *Agricultural Finance Review,* 54, 39-54.

Stokes, J.R. (n.d.). Using simulation to determine bank capital adequacy. Financial Engineering News. Retrieved May 19, 2004, fromhttp://fenews.com/fen28/siminfe.html

Swenson, A.L. (2003). *Financial characteristics of North Dakota farms 2000-2002.* Agribusiness and Applied Economics Report No. 522. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

Taylor, R.D., Koo, W.W., & Swenson, A.L. (2003). *2003 North Dakota agricultural outlook: Representative farms, 2003-2012.* Agribusiness and Applied Economics Report No. 523. Fargo: North Dakota State University, Department of Agribusiness and Applied Economics.

United States Census Bureau. (2002). *2002 NAICS matched to 1987 SIC – finance and insurance*. Retrieved April 10, 2004, from http://www.census.gov/epcd/naics02/

N2SIC52.HTM

United States Department of Agriculture. (2003, December 23). *USDA makes preliminary diagnosis of BSE.* (News Release No. 0432.03). Retrieved January 12, 2004, from http://www.usda.gov/Newsroom/0432.03.html

United States Department of Agriculture. (2004, January 5). *BSE update.* (News Release No. 0460.04). Retrieved January 12, 2004, from http://www.usda.gov/Newsroom/0460.04.html

United States Department of Agriculture – Animal and Plant Health Inspection Service, Federal Inter-agency Working Group. (2003). *Animal disease risk assessment, prevention, and control act of 2001.* (Publication No. PL 107-9). Retrieved February 18, 2004, from http://www.aphis.usda.gov/lpa/pubs/pubs/PL107-9_1-03.pdf

United States Department of Agriculture – Economic Research Service. (2001). *Interstate livestock movements: state-to-state flows.* Retrieved June 14, 2004, from http://www.ers.usda.gov/Data/InterstateLivestockMovements/view.asp?Geog=North+Dakota&Species=All&Flow=In

United States Department of Agriculture – Economic Research Service. (2004a, April 14). *Livestock, dairy, and poultry outlook.* (Publication No. LDP-M-118). Retrieved June 14, 2004, from http://www.ers.usda.gov/Publications/LDP/apr04ldpm118t.pdf

United States Department of Agriculture – Economic Research Service. (2004b). *Monthly U.S. meat and livestock trade.* Retrieved October 1, 2004, from http://www.ers.usda.gov/Briefing/AnimalProducts/Data/MonthlyLivestockTable.xls

United States Department of Agriculture – Economic Research Service. (2004c). *North*

Dakota state fact sheet. Retrieved October 22, 2004, from http://www.ers.usda .gov/StateFacts/ND.htm.

United States Department of Agriculture – Farm Service Agency. (2004). *Farm loans – guaranteed loans*. Retrieved October 11, 2004, from http://www.fsa.usda.gov/ DAFL/Guaranteed.htm

United States Department of Agriculture – Food Safety and Inspection Service. (2004, January 8). *USDA issues new regulations to address BSE.* Retrieved April 10, 2004, from http://www.fsis.usda.gov/oa/news/2004/bseregs.htm

United States Department of Agriculture – North Dakota Agricultural Statistics Service. (2004a). *Land values and farm numbers.* Retrieved May 10, 2004, from http://www.nass.usda.gov/nd/land.htm

United States Department of Agriculture – North Dakota Agricultural Statistics Service. (2004b). *North Dakota agricultural statistics annual bulletin.* Retrieved May 10, 2004, from http://www.nass.usda.gov/nd/abindex.htm

United States Department of Agriculture – North Dakota Agricultural Statistics Service. (2004c, January 30). *North Dakota cattle numbers decline*. Retrieved October 10, 2004, from http://www.nass.usda.gov/nd/jancttl.pdf

United States Department of Agriculture – Risk Management Agency. (2004). *Livestock risk protection insurance pilot program LRP-fed cattle*. Retrieved October 4, 2004, from http://www2.rma.usda.gov/pubs/2003/PAN-1667-10.pdf

Virginia Polytechnic Institute and State University, Research Institute on Livestock Pricing. (2004, July). *Beef and pork demand indexes.* Retrieved October 1, 2004, from http://www.aaec.vt.edu/rilp/demand.html

Walraven, N., & Barry, P. (2003). *Bank risk ratings and the pricing of agricultural loans*. Unpublished manuscript. Retrieved March 8, 2004, from http://www.federalreserve.gov/pubs/feds/2003/200353/200353pap.pdf

APPENDIX A. PRODUCER FINANCIAL STATEMENTS

Income Statement

For the Year Ended December 31, 2002

Net Non-Farm Income
Cash Farm Income
Crop income
Dairy income
Hog income
Beef income
Sheep income
Other income

Gross Cash Income

Apparent Family Living Expense
Cash Farm Expense
Total cash operating expense

Net Income from Operations

Market livestock inventory change
Breeding livestock capital adjustment
Other inventory changes and depreciation and other capital adjustments

Net Income

Balance Sheet at Cost Values

December 31, 2002

ASSETS

Current Farm Assets
Cash and checking balance
Crops held for sale or feed
Market livestock held for sale
Other current assets
Total current assets

Intermediate Farm Assets
Breeding livestock
Other intermediate assets
Total intermediate assets

Long-Term Farm Assets
Total long-term farm assets

Non-Farm Assets
Non-farm savings
Non-farm stocks and bonds
Other non-farm assets
Total non-farm assets
Total Assets

LIABILITIES

Current Farm Liabilities
Current notes
Principal due on term debt
Other current liabilities
Total current farm liabilities

Intermediate Farm Liabilities
Total intermediate farm liabilities

Long-Term Farm Liabilities
Total long-term farm liabilities

Non-farm Liabilities
Total non-farm liabilities
Total Liabilities

NET WORTH (farm & non-farm)
Total Liabilities and Net Worth

Statement of Cash Flows

For the Year Ended December 31, 2002

Beginning cash and checking
Beginning non-farm savings
Beginning non-farm stocks and bonds
Total beginning cash (farm & non-farm)

Cash From Operating Activities
Gross cash farm income
Net non-farm income
Cash operating expense
Apparent family living expense
Income and social security tax
Cash from operations

Cash from Investing Activities
Sale of breeding livestock
Sale of machinery and equipment
Sale of titled vehicles
Sale of other intermediate assets
Sale of farm land
Sale of farm buildings
Sale of other long-term assets
Purchase of breeding livestock
Purchase of machinery and equipment
Purchase of titled vehicles
Purchase of other intermediate assets
Purchase of farm land
Purchase of buildings
Purchase of other long-term assets
Cash from investing activities

Money borrowed
Borrowed -current farm
Borrowed - intermediate farm
Borrowed -long-term farm
Cash Gifts and Inheritances
Principal Payments
Paid -current farm
Paid -intermediate farm
Paid -long-term farm
Gifts Given
Cash from financing activities
Net change in cash balance
Ending cash (farm & non-farm)

APPENDIX B. BASE CASE CREDIT-SCORE DISTRIBUTIONS

	Credit Scores									
	Sc1	**Sc2**	**Sc3**	**Sc4**	**Sc5**	**Sc6**	**Sc7**	**Sc8**	**Sc9**	**Total Producers**
Bsize 1, Loan Port 1										
O-Farm-only	5	5	3	3	7	5	3	0	0	31
O-Farm & Non-farm	7	5	6	5	5	1	2	0	0	31
T-Farm-only	5	2	5	10	3	5	1	0	0	31
T-Farm & Non-farm	6	4	8	9	1	2	1	0	0	31
Bsize 1, Loan Port 2										
O-Farm-only	6	6	3	4	5	3	4	0	0	31
O-Farm & Non-farm	8	7	5	5	0	4	2	0	0	31
T-Farm-only	6	5	4	8	3	5	0	0	0	31
T-Farm & Non-farm	8	5	7	7	2	2	0	0	0	31
Bsize 1, Loan Port 3										
O-Farm-only	4	4	2	4	4	2	3	1	0	24
O-Farm & Non-farm	6	3	3	4	2	3	2	1	0	24
T-Farm-only	2	4	3	6	2	5	2	0	0	24
T-Farm & Non-farm	4	4	3	6	0	5	2	0	0	24
Bsize 2, Loan Port 1										
O-Farm-only	8	11	5	4	11	8	6	0	0	53
O-Farm & Non-farm	11	13	7	4	10	4	4	0	0	53
T-Farm-only	8	6	9	12	5	11	2	0	0	53
T-Farm & Non-farm	10	8	14	9	2	9	1	0	0	53
Bsize 2, Loan Port 2										
O-Farm-only	14	8	3	3	4	7	5	0	0	44
O-Farm & Non-farm	16	8	4	3	4	5	4	0	0	44
T-Farm-only	8	12	4	6	5	9	0	0	0	44
T-Farm & Non-farm	11	10	6	7	2	7	1	0	0	44
Bsize 2, Loan Port 3										
O-Farm-only	10	11	3	3	9	11	4	0	0	51
O-Farm & Non-farm	13	11	7	3	9	5	3	0	0	51
T-Farm-only	6	9	7	12	7	10	0	0	0	51
T-Farm & Non-farm	8	10	12	10	4	6	1	0	0	51
Bsize 3, Loan Port 1										
O-Farm-only	14	15	4	7	9	20	15	0	0	84
O-Farm & Non-farm	17	15	9	10	15	6	12	0	0	84
T-Farm-only	11	14	8	14	11	23	3	0	0	84
T-Farm & Non-farm	14	14	11	21	4	18	2	0	0	84
Bsize 3, Loan Port 2										
O-Farm-only	20	18	5	5	8	16	11	0	0	83
O-Farm & Non-farm	23	17	9	9	15	2	8	0	0	83
T-Farm-only	17	15	9	13	10	17	2	0	0	83
T-Farm & Non-farm	18	17	13	18	6	10	1	0	0	83
Bsize 3, Loan Port 3										
O-Farm-only	16	17	5	14	9	11	17	1	0	90
O-Farm & Non-farm	22	19	6	10	12	9	11	1	0	90

T-Farm-only	14	14	12	14	9	22	4	1	0	90
T-Farm & Non-farm	19	14	14	13	9	19	1	1	0	90
Bsize 4, Loan Port 1										
O-Farm-only	72	68	39	43	68	75	72	4	0	441
O-Farm & Non-farm	95	85	37	67	53	40	56	8	0	441
T-Farm-only	57	57	75	72	47	109	22	2	0	441
T-Farm & Non-farm	76	68	88	67	53	62	25	2	0	441
Bsize 4, Loan Port 2										
O-Farm-only	89	73	39	45	61	60	65	6	0	438
O-Farm & Non-farm	113	88	38	48	60	34	46	9	2	438
T-Farm-only	70	65	76	67	43	93	21	3	0	438
T-Farm & Non-farm	84	79	86	56	49	56	23	5	0	438
Bsize 4, Loan Port 3										
O-Farm-only	82	72	37	47	69	56	65	9	0	437
O-Farm & Non-farm	97	91	49	46	48	48	42	16	0	437
T-Farm-only	53	73	75	73	39	96	26	2	0	437
T-Farm & Non-farm	73	76	91	59	49	57	30	2	0	437

APPENDIX C. BASE CASE LOAN VOLUME DISTRIBUTIONS

Asset Quality Ratings

	AQR1	AQR2	AQR3	AQR4	AQR5	AQR6	AQR7	AQR8	AQR9	Total Loan Volume
Bsize 1, Loan Port 1										
Farm-only-Loan Vol.	$1,198	$714	$775	$1,098	$1,747	$716	$1,111	$0	$0	$7,360
Farm & NF-Loan Vol.	$1,263	$741	$782	$1,131	$1,807	$732	$1,116	$0	$0	$7,572
Bsize 1, Loan Port 2										
Farm-only-Loan Vol.	$765	$1,538	$775	$1,121	$1,144	$298	$1,262	$0	$0	$6,903
Farm & NF-Loan Vol.	$832	$1,565	$782	$1,154	$1,184	$302	$1,353	$0	$0	$7,170
Bsize 1, Loan Port 3										
Farm-only-Loan Vol.	$1,377	$991	$737	$1,452	$1,049	$446	$1,057	$330	$0	$7,439
Farm & NF-Loan Vol.	$1,461	$1,000	$737	$1,498	$1,103	$447	$1,093	$341	$0	$7,679
Bsize 2, Loan Port 1										
Farm-only-Loan Vol.	$1,133	$3,236	$1,171	$921	$2,937	$1,506	$1,667	$0	$0	$12,570
Farm & NF-Loan Vol.	$1,239	$3,286	$1,191	$925	$3,153	$1,555	$1,828	$0	$0	$13,178
Bsize 2, Loan Port 2										
Farm-only-Loan Vol.	$2,763	$2,699	$739	$1,392	$1,389	$2,247	$1,613	$0	$0	$12,843
Farm & NF-Loan Vol.	$3,783	$2,759	$753	$1,420	$1,442	$2,376	$1,721	$0	$0	$14,254
Bsize 2, Loan Port 3										
Farm-only-Loan Vol.	$1,929	$2,621	$742	$1,392	$2,792	$2,751	$1,230	$0	$0	$13,457
Farm & NF-Loan Vol.	$2,106	$2,692	$749	$1,420	$2,996	$2,920	$1,337	$0	$0	$14,220
Bsize 3, Loan Port 1										
Farm-only-Loan Vol.	$2,296	$5,691	$1,306	$2,093	$2,862	$5,821	$5,259	$0	$0	$25,329
Farm & NF-Loan Vol.	$3,273	$5,834	$1,332	$2,151	$2,954	$6,108	$5,460	$0	$0	$27,113
Bsize 3, Loan Port 2										
Farm-only-Loan Vol.	$3,363	$6,647	$1,633	$1,551	$2,351	$5,628	$3,948	$0	$0	$25,121
Farm & NF-Loan Vol.	$4,358	$6,886	$1,711	$1,594	$2,476	$5,875	$4,080	$0	$0	$26,982
Bsize 3, Loan Port 3										
Farm-only-Loan Vol.	$2,593	$5,023	$1,182	$4,617	$3,168	$3,409	$4,641	$118	$0	$24,751
Farm & NF-Loan Vol.	$3,580	$5,351	$1,198	$4,720	$3,310	$3,538	$5,052	$121	$0	$26,870
Bsize 4, Loan Port 1										
Farm-only-Loan Vol.	$13,352	$25,100	$13,783	$11,695	$21,693	$31,744	$31,290	$2,325	$0	$150,982
Farm & NF-Loan Vol.	$15,281	$25,902	$14,565	$12,564	$22,456	$32,668	$32,150	$2,380	$0	$157,965
Bsize 4, Loan Port 2										
Farm-only-Loan Vol.	$16,624	$27,865	$12,686	$15,109	$21,238	$24,038	$28,762	$3,246	$0	$149,567
Farm & NF-Loan Vol.	$19,456	$28,946	$13,064	$16,222	$22,250	$24,797	$29,835	$3,317	$0	$157,888
Bsize 4, Loan Port 3										
Farm-only-Loan Vol.	$17,036	$27,190	$13,228	$16,248	$23,979	$23,967	$23,220	$5,058	$0	$149,926
Farm & NF-Loan Vol.	$19,158	$28,232	$13,881	$16,847	$25,137	$24,628	$24,578	$5,318	$0	$157,778

Note. Loan volumes are in thousands of dollars.

APPENDIX D. RISK RATING DEFINITIONS[1]

AgCountry Farm Credit Services

Document: Credit Procedures 4.7.16

Print date: 07/20/2004 09:17

User Name: ANONYMOUS

Exhibit 1 - Risk Rating Definitions and Guidelines

Loans will be risk rated according to the following guidelines. It is important to remember that criteria not meeting the noted standards can be offset by strengths in others, i.e. lower OE% but strong CDRC and/or WC/AGI. A key element is the overall trend of the unit, i.e. is the financial trend improving (I), stable (S) or deteriorating (D). That should be indicated with each risk rating assigned. Other factors can and should be considered in the overall assignment of the risk rating, such as how the equity was obtained, total amount of equity, length of time until unit transition or retirement, etc. Historical earnings should be considered as to whether they are representative of future earnings (plus or minus). If anyone questions an existing risk rating, the issue needs to be brought to the attention of the loan officer for review. Credit analysts and credit vice presidents as well as the CCO may also provide assistance and direction.

1. **Acceptable**

Owner Equity	>70%
CDRC (3 yr avg)	>150%
WC/AGI	>20%

Borrowers of the highest quality. Cash flows and earnings over at least three years demonstrate stability and substantial margins. Balance sheets are conservative and relatively strong with liquid assets. Projected cash flow, including anticipated credit extensions, exhibit excellent debt service coverage and margins of protection. Asset quality is excellent and management is highly regarded. The operation is stable and has ready access to alternative financing. **Working capital can absorb 2 or 3 years of losses.**

2. **Acceptable**

Owner Equity	55% - 70%
CDRC (3 yr avg)	125% - 150%
WC/AGI	>15%

[1] Source: AgCountry Farm Credit Services. (2004, July). Exhibit 1 – Risk Rating Definitions and Guidelines (Credit Procedures 4.7.16). Moorhead, MN.

Borrowers with a modest degree of risk. The margin of protection is good. Elements of strength are present in such areas as liquidity, stability of margins and cash flows, diversity of assets, and lack of dependence on one type of enterprise or commodity. Reasonable access to alternative financing is present and borrowers can obtain favorable rates and terms. These are well-established, stable operations. Management and owners have unquestioned character, as demonstrated by repeat performance. Working capital can absorb 1 or 2 years of losses.

3. **Acceptable**

Owner Equity	45% - 55%
CDRC (3 yr avg)	110% - 125%
WC/AGI	~ 10%

Borrowers with smaller margins of debt service coverage and some elements of reduced strength. Borrowers have satisfactory asset quality and liquidity, adequate debt capacity and coverage, and good management in critical positions. These operations have adequate margins of protection and definitely qualify as attractive borrowers. These borrowers may have some limitations on their ability to obtain similar financing from other financial institutions, but can generally borrow at reasonable rates and terms. A loss year or a somewhat declining earning trend may occur, but borrowers have sufficient strength and financial flexibility to offset these events. These operations are somewhat vulnerable to adverse conditions. Management and owners have unquestioned character. Working capital can absorb 1 year of loss.

4. **Acceptable**

Owner Equity	< 45%
CDRC (3 yr avg)	100% - 110%
WC/AGI	0% - 10%

Borrowers with marginal or declining earnings, strained cash flow, high or increasing leverage and/or weakening market fundamentals that indicate above average risk. These borrowers generally have limited additional debt capacity and modest coverage and average or below average asset quality and margins of protection. Some management weaknesses may exist. These borrowers may have some limited ability to obtain similar financing with comparable terms from other banks, but that ability may diminish in difficult economic times. Also, the borrower is currently performing as agreed but could be adversely affected by such developing factors as deteriorating industry conditions, operations problems, pending legislation of a significant nature, or declining collateral quality/adequacy. Management and owners have good character with no basis for questions.

5. **OAEM**

Other Assets Especially Mentioned - Assets in this category are currently protected, but potentially weak. These assets constitute an undue and unwarranted credit risk, but not to the point of justifying a classification of substandard. The credit risk may be relatively

minor, yet constitutes an unwarranted risk in light of the circumstances surrounding a specific asset.

A special mention classification should not be used as a compromise between adversely classified and nonadversely classified. It should be used as a transition classification only for deteriorating loans and not for loans being upgraded to acceptable classification. A special mention classification should not be used to avoid difficult decisions.

Special mention loans have potential weaknesses that may, if not checked or corrected, weaken the loan or inadequately protect the institution's position at some future date. Loans that might be detailed in this category include those that have any deviations from prudent lending practices, including those subject to economic or market conditions that may, in the future, affect the borrower. An adverse trend in the borrower's operations or an imbalanced may best be handled by this classification. This category should not be used to list loans that bear risks usually associated with the particular type of financing. Any type of loan, regardless of collateral, financial stability, and responsibility of the borrower involves certain risks. A secured loan has a certain risk, but to criticize such a loan it must be evident that the risk is increasing beyond that at which the loan originally would have been granted. A rapid increase in assets or liabilities without the lender's knowing the cause, concentrations that lack proper credit support, lack of on-site collateral evaluations or inspections, or other similar matters could lead the examiner to question the loan quality and possibly classify the loan as special mention. Chronically delinquent rural residence loans are classified special mention. Loans in which actual, not potential weaknesses are evident and significant should be considered for more serious classification. These are loans that have been delinquent 30 days or more, but less than 90 days, at least three times in the past 12 months.

6. **Substandard Viable**

Substandard viable assets are inadequately protected by the borrower's current sound worth and paying capacity or the collateral pledged, if any, but the operation is still considered viable (see definition of viable at the end of this category).

Assets so classified must have a well-defined weakness or weaknesses that jeopardize debt liquidation.

These assets are characterized by the distinct possibility that the lender will sustain some loss if the deficiencies are not corrected. Loss potential, while existing in the aggregate amount of substandard loan assets, does not have to exist in individual loan assets, typically representing the secured adverse assets or portions of assets in a portfolio. Substandard assets may or may not be placed in nonaccrual status, depending on the loan's viability and the asset's performance. Very weak substandard assets sometimes have specific reserves established that represent holding costs or the difference between net realizable value and collateral value for loss loan accounting. Characteristics of a substandard asset include:

Not performing as agreed, but currently adequately collateralized.

Pledged collateral marginally supports the credit, but collateral value is declining. Operation marginally provides funds required for debt service, and current position analysis indicates a declining trend.

Credit weaknesses usually are described as being either significant or serious. Because circumstances vary widely, much of the difference between significant and serious credit weakness depends on the loan officer's sound judgment. Significant weaknesses have the potential to become serious and thereby impact the loan's performance. Serious weakness exists because one credit factor is inadequate, or several factors are weak and have affected the loan and/or the borrower's ability to perform in the future. Substandard assets have serious weaknesses, whereas special mention assets have potential weaknesses. Poor credit administration does not justify substandard classification.

Rural residence loans that are delinquent 90 days or more are classified substandard.

A viable loan is a loan to a borrower whose business operation is reasonably expected to be able to meet all operating expenses (including depreciation and/or a reasonable allowance for capital expenditures necessary to operations), to service all debt on a timely basis and to provide for personal living expenses. Dependable non-farm income and third-party guarantees may not be included if the borrower and/or the guarantor have demonstrated a willingness to use such resources to meet outstanding obligations. Additionally, analysis should consider whether existing debt service requirements provide for a reasonable amortization of principal (based on the nature of underlying collateral and/or the purpose of the loan).

7. **Substandard Nonviable**

Substandard assets as defined above but for which it is probable that ultimate payment in full can be accomplished only through liquidation, forced or otherwise, of assets other than that converted to cash in the normal course of business.

8. **Doubtful**

An asset classified doubtful has all the weaknesses inherent in one classified substandard with the added characteristic that the weaknesses make collection in full, on the basis of currently existing facts, conditions, and values, highly questionable and improbable. The possibility of a loss is extremely high, but because of certain important and reasonable specific pending factors that may work to the advantage and strengthening of the asset, its classification as an estimated loss is deferred until its more exact status can be determined. Pending factors include proposed merger, acquisition, or liquidation procedures; capital injection; perfecting liens on additional collateral; and refinancing plans.

Doubtful assets generally are not performing as agreed and/or involve a nonviable operation. High probability of loss exists on these assets, but the exact amount is not determinable. (Substandard classification would not communicate the severity of the situation.)

Underlying collateral pledged cannot be assigned specific value because the asset has limited purpose, salability and/or market, or is involved in pending litigation with unknown outcome.

Doubtful classification occurs most frequently for un-restructured nonaccrual and nonaccrual non-cash basis restructured assets. Poor credit administration does not justify doubtful classification.

9. **Loss**

Technically risk rated 9 but being charged off, it is no longer considered an asset. This classification is defined as:

Assets classified loss are considered uncollectible and of such little value that their continuance as book able assets is not warranted. This classification does not mean the loan or asset has absolutely no recovery or salvage value, but rather, it is practical or desireable to defer writing off this basically worthless asset even though partial recovery may be affected in the future. Losses should be taken in the period in which they surface as uncollectible.

Charge offs are recognized and booked when the loss becomes known, not necessarily synonymous with liquidation of the asset. When determining the amount of loss, consider unpaid principal, accrued interest, accounts receivable, borrower stock and amounts recoverable from secured assets.

Trend Definitions – Used with 1 through 8, the trend indicator should reflect the trend in the operation, considering history, present and near future expectations. Trend of earned net worth may be most appropriate gauge. The trend indicator will not be used to indicate a high, medium or low subdivision of the numeric trend.

Trend is likely to be more subjective than the numeric rating. Since trend indicators became available on 5 through 8 with the 6/16/00 systems release, it may take a year to populate the trends on customers with these risk ratings.

Improving (I) – financial progress is positive. Historical earnings have been strong. Generally, any losses have been isolated and offset by strong earnings. CDRC meets and exceeds standard by +10%. Unit is viable and financial growth is on the upturn.
Stable (S) – financial progress is static. Historical earnings have shown some smaller losses mixed with modest earnings. CDRC generally meets standards with an occasional +/- 10% variation. Generally, unit is viable, but financial growth is stable.
Deteriorating (D) – financial progress is declining. Historical earnings are generally break even or loss. Trend of losses likely exceed earnings. CDRC generally does not meet standard. Long term viability may be challenged if trend does not stabilize or reverse.