AN ANALYSIS OF KANSAS FARM STRUCTURE, 1973-2007

by

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Abstract

This thesis will determine if economies of size are present in production agriculture or the farming sector and if convergence or divergence is occurring. Change in the farming sector was analyzed using five-year moving averages from 1973 to 2007. Six key variables were analyzed; value of farm production, total acres, economic total expense ratio, operating profit margin ratio, asset turnover ratio, and percent of livestock income.

Data from the Kansas Farm Management Association were used in this study. To be included in the study, a farm had to have five years of continuous, usable data for a five-year period between 1973 and 2007. Moving five-year averages were calculated for the farms that met this qualification. Data were sorted by value of farm production and broken down by quartiles and deciles.

Trend regressions were used to calculate growth rates of the key variables and the difference between the top and bottom quartiles of the variables. Results suggested that acreage per farm is increasing, farms are doing better at covering their total economic costs, profit margin per farm has decreased, farms are utilizing their assets better, and the percent of livestock income per farm has decreased. When regressing the difference between the top and bottom quartiles to determine growth rates, it was evident that the gaps between the top and bottom quartiles of five of the six variables have widened. The differences in the percent of livestock income between farm quartiles and deciles were not significant. Convergence analysis confirmed the results of the trend regressions and

suggested that divergence is evident in the Kansas farming sector. Graphical representation supports the findings of this thesis.

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CHAPTER 1 - Introduction

1.1 Introduction

"Without change there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable" (Pollard).

Change is inevitable, especially in the agricultural world and must be fostered if farming is to remain dynamic and attractive as a business enterprise. In the 1970's there were generally good times in agriculture. This abruptly changed in the early 1980's as a strong dollar and reduced domestic demand hurt the agricultural market. Farm numbers have been on the decline in the last several decades. The shift toward fewer, larger farms is continuing. The traditional one-family farm is being phased out by larger, multi-family farms and corporations. One of the basic objectives in studying farm structure is to understand more fully how and why the sector of the U.S. economy that produces agricultural products is changing, and what such change may mean in the future (Stanton, 1993b). The presence or absence of economies of size in the agricultural industry may help predict the changing structure of U.S. agriculture. The existence of economies of size has broad implications for industry structure, growth, and change (Hallam, 1991). Hallam (1991) points out that significant increasing returns to size in the production of a particular output may lead to consolidation of farms, making it an interesting topic for economists to examine. He gives three other reasons why it is important to study economies of size: they can affect international competitiveness and changes in the terms of trade, the viability of the family farm is indirectly related to economies of size, and the direct relationship between economies of size and structural change in agriculture.

In this thesis, the structure of Kansas farms will be studied. Several factors are identified that might have an overall effect on farm financial performance and efficiency. This will be done to determine if economies of size are present in Kansas farms. Factors identified in this thesis will help determine the extent to which farm structure is changing and why it might be happening.

1.2 Objectives

Today, people are seeing change in the farming industry and this thesis will help to document that change. The first objective in studying farm structure is to determine if economies of size are present in production agriculture or the farming sector. Economies of size are studied using the economic total expense ratio and five-year moving averages from 1973-2007. The second objective is to examine changes in several key variables since 1973. Key variables analyzed include value of farm production, total acres, the operating profit margin ratio, the asset turnover ratio, and percent of livestock income. The third objective is to determine if convergence or divergence is occurring in the agricultural sector. Convergence analysis will help answer the question, "Are small farms catching up to larger farms?" Two different tests of convergence are going to be examined, β-convergence and σ-convergence. To study convergence, farms will be categorized into value of farm production deciles. The same six key variables listed above will be used in convergence analysis. The final objective is to document changes in Kansas farm structure beginning in 1973 to the present.

To accomplish the objectives listed above, several methods will be used. In order to calculate the growth rates of the key variables and determine if economies of size are present during each five-year period, exponential trend regressions will be performed.

First, a regression over time on the average values for each five-year snapshot will be ran to determine if the variables are increasing or decreasing over time. Second, a regression on the difference between the top and bottom quartiles of the key variables will be ran to see if the difference between the top and bottom quartiles is widening or narrowing over time. To analyze β-convergence, the growth rates of the six key variables will be used as dependent variables with the initial level of value of farm production representing the independent variable. If the relationship between the growth rate and the initial level of value of farm production is significant and negative, smaller farms are growing faster or performing relatively better compared to larger farms, evidence of convergence. If the relationship is significant and positive, larger farms are growing faster or performing relatively better compared to smaller farms, evidence of divergence. The second type of convergence is σ-convergence, where σ represents the standard deviation of each key variable in each five-year period. If a significant and positive relationship exists between the standard deviation of each key variable and time, the standard deviation between the deciles is getting larger, providing evidence of divergence. If the opposite is true, convergence is evident.

1.3 Outline of Study

The remainder of this thesis will be organized as follows. Chapter two will present a review of relevant literature related to the topic. This review will provide the reader with a broader understanding of farm structure and economies of size. Chapter three will describe the empirical model. Chapter four will provide a detailed discussion of the data used and how it was calculated. Chapter five will be comprised of tables and charts that

present the results and Chapter six will discuss conclusions and summarize the entire thesis.

CHAPTER 2 - Literature Review

2.1 Introduction

Today, fewer farms account for a larger share of total farm production than in the 1970's. U.S. agriculture has been transformed from diversified, labor intensive farming to a specialized, technology driven production environment. Structural changes in the agricultural sector are happening rapidly. The primary goals of this chapter are to examine previous work pertaining to changes the farm sector has seen beginning in the 1970's and to grasp a better understanding of economies of size.

To aide the reader in understanding this review, it has been broken down into three additional sections. Section 2.2 summarizes literature relating to the theory and measurement of economies of size in agriculture and demonstrates industries where economies of size are prevalent. Section 2.3 reviews literature on financial performance and measuring financial ratios over time. Finally, Section 2.4 entails the theory and measurement of trends and will include a discussion of convergence and divergence.

2.2 Empirical Studies of Structural Change in the Farming Sector

Hallam (1991) summarizes much of the economies of size literature up until the late 1980's in a historical and interpretive fashion. Hallam (1991) indicates that the long literature on economies of size has brought no strong consensus on either appropriateness of alternative measuring techniques or overall empirical conclusions relating to economies of size. Hallam (1991) then goes on to present definitions and different methods used to measure economies of size. Economies of size are directly related to

the elasticity of cost with respect to output, so the cost function seems a natural candidate for the estimation of economies of size (Hallam, 1991). In agriculture, multiple outputs are normally produced. Difficulty arises in measuring economies of size with multiple outputs because they are typically defined as the change in a scalar valued function with respect to some measure of quantity. Therefore, a decision must be made as to what to do with the other outputs. Aggregation of outputs has an impact on measures of economies of size. Gross revenue has historically been used to represent output with multi-output firms.

Hallam (1991) discusses several normative studies relating to economies of size. He found the most commonly used method for examining economies of size is the firm model in which budgets are constructed using actual firm data. By varying output levels, the average cost curve would be obtained and the shape would give you some information on size economies. Another common method in measuring size economies is by comparing average costs of production for firms producing different levels of output (Hallam, 1993b). By analyzing multi-output crop farm studies, Hallam found the cost curve to be a sagging "L" shape with the right turn at fairly low output levels. This implies that the number of crop farms should remain fairly stable but as we have seen, there has been a large decline in the number of crop producers. Studies have shown that crop farms don't deviate much from this sagging "L" shape which may be the result of using gross revenue as the output measure resulting in crop specific economies being blurred in optimal enterprise choices (Hallam, 1993b).

According to Hallam (1991), another way to analyze economies of size is by direct estimation of the cost function using cross section or time series data. Using cross

sectional data, Moschini (1988) analyzed the structure of Ontario dairy farms using a hybrid-translog multi-product cost function. His results showed increasing returns to scale for a wide range of output levels. Average cost for milk production was "L" shaped but found that most firms are still not capturing significant economies of size. An advantage of using a cost function to estimate economies of size is that size measures are easily computed from parameters of the cost function and any objective function consistent with cost minimizing behavior could have generated the data (Hallam, 1993a). A drawback to using cost functions with cross section data is there may not be enough variation in input prices to obtain accurate parameter estimates (Hallam, 1993a).

In addition to using cross section data, time series data can be used in estimating economies of size. Time series studies usually assume some type of technical progress in the underlying technology and size measures will represent short run returns to size since observations are from points on a short run production, cost, or profit function (Hallam, 1991). Ray (1982) conducted a study estimating a two output cost function for U.S. agriculture using annual data from 1939-1977. The method used was a translog approximation to the cost function. Crops and livestock were treated as two distinct outputs instead of being lumped together in one group. The size economies computed from the cost function tell us that U.S. agriculture operated under diminishing returns but that returns to size have increased over time. Again using time series data, Weaver (1983) measured technical and economic relationships characterizing agricultural production in North and South Dakota in the years 1950-1970. In contrast to using a cost function, Weaver (1983) used a multi-product translog profit function allowing for non-

homotheticity and biased technical change. The results were consistent with Ray (1982) in that they both found decreasing economies of size over the sample period.

While calculating economies of size has its benefits, it also has its limitations. Hallam (1991) points out that cross sectional studies are limited because of the lack of homogeneous technologies across firms. Another potential problem in using cross sectional data is that equilibrium tends to force many firms to produce at the point of minimum average cost. This results in little to no observations in the upward sloping section of the curve and a masking of any size economies present (Hallam, 1991). A possible solution, according to Hallam, would be the use of panel data or combined cross section, time series data. Hallam indicates that data should be aggregated in a way that doesn't mask the economies or diseconomies of size. The aggregation must be consistent with the true underlying technologies or the results may be biased.

Hallam (1991) summarizes his review of economies of size by drawing on two general conclusions: (1) mixed crop farms seem to not exhibit significant economies of size and (2) the cost curve does resemble an "L" shape but remains rather flat over the average farm size measured in acres. This sagging "L" shaped cost curve found in the literature in the 1970's and 1980's, implies that firm size in production agriculture should have been relatively constant with very little entry and exit. However, with farm numbers decreasing and farm size increasing, this work is not in accordance with the current phenomenon. While many factors can be causing these results, one explanation is that economies of size really do exist at moderate levels of output and that the growth in firm size is just a natural consequence of that fact (Hallam, 1991).

Schroeder (1992) estimated the economies of scale and scope for multi-product agricultural supply and marketing cooperatives. Data was obtained from the Cooperative Finance Association, a subsidiary of Farmland Industries. He studied a 10-year period (1979-88) for 29 local farm supply and marketing cooperatives. All prices and costs in his study were deflated to constant 1982 dollars. A translog cost function, along with a bootstrapping regression, was used to estimate confidence intervals for the economies of scale and scope. Results imply the average farm cooperative has too much invested in fixed assets. Because of the seasonal demand of farm products, over-investment in fixed assets is not surprising. Support was found for firm–wide economies of scale. Grain, petroleum, feed, other merchandise sales, and to some extent fertilizer, were found to have product specific economies of scale. Chemical sales were not found to exhibit economies of scale. All six products had economies of scope present where economies of scope refers to total cost decreasing as a result of increasing the number of different goods produced or sold.

In another chapter of the book "Size, Structure, and the Changing Face of American Agriculture," Fox et al. (1993) poses the question, "why are some farms more successful than others?" Broken down into three time periods, the authors selected various empirical studies to illustrate the evolution of procedures and to assess the consistency of results obtained in defining and measuring farm success. Farm success has been defined in terms of profitability or viability. Profitability relates to the ability of the farm to generate returns to operator labor and equity, and viability means the ability of the farm to meet current and future financial obligations (Fox et al., 1993). Because

this study only covers two of the time periods evaluated, literature from 1948-1980 and from 1980-1990 will be discussed.

Luckham (1976) conducted a study focusing on indentifying financial ratios associated with the profitability of Virginia dairy farms. The empirical method used was discriminant analysis using farm financial records. Many factors were evaluated as to whether they could be related to successful farm operations. Those factors included: financial structure, cost control, farm size, and financial performance. His results indicated that cost control remains one of the farm manager's most important means of increasing profitability, thus success. Focusing on viability, Osburn (1978) evaluated personal and business characteristics of U.S. farmers who had defaulted on loans in the year 1971. In his study, he used a generalized analysis of variance method and found that defaulted loan losses increased with increased total debt, debt to collateral ratio, education, experience, and outside business interests (Fox et al., 1993).

Several studies were summarized during the 1980-1990 period. Cunningham (1982) evaluated New York egg farms and studied the effects of five production and twelve business management factors on labor and management income per operator. He used a regression analysis that identified farm size, income per hen, and investment per hen as significant factors in determining income per operator. Korth (1984) studied the financial success of Nebraska beef-hog, grain, and dairy farms between 1978 and 1982. Using a variety of statistical techniques, he considered seventy-one variables to be related to success and found that two-thirds of the statistically significant variables were in the categories of volume of production, efficiency, and expense structure. In his study, return on investment was used as the main measure of success. Burton and Abderrezak

(1988) used Kansas farms to identify characteristics related to expected profit. They used 1985 production and financial plans obtained from farm management data to run a linear regression. Success factors that were evaluated were farm size, financial structure, organizational structure, enterprise type, off-farm factors, and personal characteristics. Factors related to success and expected profits were found to be increased farm size, financial efficiency, and decreased ownership of real estate and machinery.

Turning to viability studies, Ellinger and Barry (1987) used cross classification and regression analyses on Illinois farm records. Their goal was to assess the relationship between land tenure and solvency and profitability. Their results indicated that as the proportion of leased land increased, the debt-to-asset ratio, and the rates of return to assets or equity increased (Fox et al., 1993).

When examining the results presented by Fox et al. (1993), it is important to remember that different farmers have different definitions of success and those definitions can change over time. There is still much that is unknown about the reasons some farms are more successful than others, which creates a great opportunity for further research.

Reimund and Gale (1992) discuss the structural changes that happened to the farm sector between 1974 and 1987 in the 13th Annual Family Farm Report to Congress. The farm sector is known to be quite volatile, and the 70's and 80's were no exception. The 1970's were categorized as mainly good times in farming. According to the authors, there was strong worldwide demand for U.S. farm products which boosted farm incomes during this period. Farm land was seen as a good investment, thus land values rose rapidly encouraging farmers to borrow more money. Farm numbers were stabilized and

some years even saw the entry of new farmers enticed by favorable economic conditions. The early 1980's witnessed a recession in farming that strained the financial status of many farmers. The authors state that restrictive monetary policy aimed at curbing inflation drove interest rates up and brought inflation down, resulting in much higher real interest rates and raising the cost of borrowing money for farmers. The 1980's also witnessed a stronger dollar, reduced domestic demand, and greater competition overseas that shrank U.S. farm exports. Farm numbers and land in farms declined in the 1980's while farm size increased (Brooks et al., 1990). From 1982 to 1987 there was a 6.8 percent drop in the number of farms nationwide, a 2.3 percent drop in the amount of farm land, and farm size increased from 440 to 462 acres (Brooks et al., 1990). The authors also state that historical comparisons of rates of change in farm numbers and size suggest that the long-term trends may be converging toward equilibrium, as the rates have slowed in recent decades.

The volatile economy of the 1970-80's brought about many changes to a farmer's balance sheet and income statement. In this time period, nominal farm asset values nearly doubled from $508.8 billion to $1,101.6 billion (Reimund and Gale, 1992). Net farm income was highly unstable throughout this period as well. Government payments rose rapidly from less than $1 billion to $11.9 billion from 1974 to 1988 (Reimund and Gale, 1992). Off-farm income was very important during this period and provided some stability during the very violate times.

The trend towards fewer, larger farms sparks the concern that midsize farms will disappear. Measured by value of products sold in nominal dollars, the changes in distribution of farms between 1974 and 1987 showed substantial increases in the number

and proportion of farms with product sales of $100,000 or more and decreases in the number and proportion selling products worth less than $100,000 (Reimund and Gale, 1992). The authors point out that one fallback to using nominal prices is that it tends to overstate the increase in farm size during periods of general inflation when farm commodity prices are rising and understates the increase when prices are falling. The authors also used average acres as a measure of farm size and came up with similar conclusions. Farm number declines were concentrated in the middle with farmers farming 50-499 acres. As a proportion of all farms, this group of farms fell from 62 percent in 1974 to 53 percent in 1987 (Reimund and Gale, 1992). It is important to remember that net decline in farm numbers can be brought about by reduced entry as well as increased exits (Reimund and Gale, 1992). Farm distribution was also examined by tenure status. Results indicated that the distribution changed very little between 1974 and 1987. There was a slight drop in the number of full time farmers. The authors believe this might reflect a long-term trend toward a higher proportion of part-owner farms.

The authors went on to break down the farming sector into cash grain farms and beef cattle farms. Between 1974 and 1987, the number of cash grain farms dropped 21 percent and the average farm size increased from 485 acres to 540 acres (Reimund and Gale, 1992). Changes in technology and cultural practices have been attributed to this shift. This time period for cash grain farms also revealed a high dependence on government programs. In 1987, there were nearly 650,000 beef cattle farms or ranches with 85 percent of them having annual product sales of less than $25,000 (Reimund and Gale, 1992). The authors point out that cattle raising lends itself well to small-scale production and no known major economies of size exist in raising cattle.

The authors end their report by pointing out that during their study farmers as a group were no worse off than non-farmers and their households. To address the issue of the survival of the family farm, it was pointed out that when nonfarm businesses were compared to farming operations in the United States, farms were generally much smaller and played a smaller direct role in the economy; even the largest farms are tiny compared with the average U.S. corporation.

Farm size has been discussed by many economists since the beginning of the agricultural economics profession. Taylor (1905) stated, "While there is no one proper size for farms in general, there is always a proper size of farm for a given man, at a given stage of his own development, on a given type of soil in a given line of production with given labor and market conditions" (p. 155). Peterson and Brooks (1993), and Stanton (1978, 1993a, 1993b) discuss the relevance of farm size and how it can be measured. According to Stanton (1978), farm size has continued to be of interest for so long because of four main reasons; poverty and low income in rural areas, business management, maximizing efficiency given a bundle of resources, and distribution. Efforts have been made, unsuccessfully, by various units of government to develop a systematic way to measure and classify farms into meaningful groups. Size is usually measured using output or input measures. Some common input measures include land and labor. An advantage of using land (acres) to measure size is that it is not subject to inflation or deflation but a major disadvantage is that an acre one place may not be equivalent to an acre another place. It is also very hard to compare physical quantities, such as acreage, because of the problems of aggregation across different types of farming (Stanton, 1993b). Land is also only one production input and not necessarily the most vital or most

limiting (Peterson and Brooks, 1993). Turning to outputs, gross sales is a very common way to measure size. It allows producers to make comparisons across farm types and with other non-farm businesses. It has its disadvantages as well. Some problems that need addressing when using gross sales is the effects of changing price levels, changes in crop or livestock inventories, and making sure government payments are included (Stanton, 1993a). According to Peterson and Brooks (1993), the monetary value of output is the most satisfactory method of combining diverse products into a single measure because value is easily indexed for any number of years and can describe production of any number of diverse products.

Barry et al. (2001) analyzed the variability of net farm income and determined whether it is significantly influenced by farm size. They use two approaches to estimate their models. The first is a cross-sectional model that estimates acres and value of farm production variables using the coefficient of variation and mean values of the explanatory variables during the period of 1980-1996. The second is a combined time-series/cross-section model that is estimated using three-year moving averages of the variables over the 17 year period. Independent variables included farm size, relative prices and yields, farm type, life cycle, financial structure, and location. Data for the 213 farms used in this study were obtained from Illinois Farm Business Farm Management Association.

Ordinary least squares regression was used in the first model to determine whether economic risk was significantly influenced by farm size. Results of this model concluded that almost all of the size variables were highly insignificant. When the time-series/cross-section model was ran, autocorrelation was found. To correct for this, the Parks method in SAS was used. This method estimates a covariance matrix under a two-

stage procedure that leads to the estimation of the model regression parameters by generalized least squares (Barry et al., 2001). All size variables were now highly significant, contrary to the initial results using only cross-section data. The coefficient estimates for both size measures (value of farm production and acres) had an inverse relationship with farm income variability thus larger farms had lower net farm income variability. There was also a negative relationship between yield and crop prices, and income variability. In summary, results suggested that not only is variability in net farm income influenced by farm size, it is also influenced by other structural and demographic variables.

Short (2001) discussed the characteristics and production costs specifically related to the cow-calf enterprise. Data were obtained from the 1996 Agricultural Resource Management Study (ARMS). Short (2001) found that cow-calf production costs were primarily influenced by regional factors. Forty-nine percent of cow-calf operations were located in the Southern and Northern Plains combined and accounted for 51 percent of the total number of weaned calves (Short, 2001). Cow-calf operators in the West and Southern Plains had significant cost advantages over operators in other regions because, with a longer grazing season, their herds require less supplemental forage during the winter. Farmers and ranchers in these two regions can also take advantage of economies of size because they have a larger acreage base, thus can spread their fixed costs over more units of production. Also indicative of economies of size; operating costs declined with increased enterprise size.

Ali (2002) studied the characteristics and production costs of U.S. wheat farms. Mirroring cow-calf producers, regional differences in production practices and growing

conditions were major influences on production costs and yields among wheat producers. ARMS data for 1998 were used in the study. Production costs differed by region due to differences in production practices, input use, and irrigation. The study showed that operating costs ranged from $50 per acre in the Prairie Gateway to $115 per acre in the Fruitful Rim region with fertilizer, chemicals, and fuel accounting for 50-60 percent of the operating costs in all regions. Enterprise size often effects the cost of production. In the case of wheat, costs decrease as acreage increases. The smallest size farms, in terms of wheat acreage, spent on average $200 per acre which is $40 more per acre than larger size farms. On a per bushel basis, in 1998, farms with 50-199 wheat acres had the highest costs at $4.41, compared with $3.75 per bushel for farms with 800 or more wheat acres (Ali, 2002).

Nehring et al. (2002) studied off-farm labor and the structure of U.S. agriculture using corn and soybean farms. Their emphasis was on including off-farm income as an output, along with corn, soybeans, livestock, and other crops. The objective of the study was to examine labor allocation decisions and the productivity and efficiency of farm operator households at the state level. Data were obtained from the Agricultural Resource Management Survey. The author's methods were twofold. First, they wanted to setup a multi-activity cost function to analyze labor allocation decisions and to estimate returns to scale and scope for the year 2000. Second, using 1996-2000 data, they set up an input distance function to estimate returns to scale, technical progress, cost economies, and technical efficiency.

Results obtained were not directly comparable to other studies conducted because of the inclusion of off-farm labor. Substantial economies of scope existed

between traditional farm products and off-farm labor. The authors found that holding everything else constant, the higher the scope economies the more likely that the firm is diversified. Results showed that size economies were a primary factor impacting farm size and lack of competitiveness of small farms. The cost function results suggest that off-farm outputs and inputs can be modeled in a multi-activity framework and used to identify economies of size and scope (Nehring et al., 2002). The main conclusion was when off-farm income was accounted for in small farms, they achieved efficiency levels comparable to that of larger farms.

Morrison-Paul et al. (2004) studied structural change on family farms. Structural changes are thought to be the result of economies of size, meaning that larger, more diversified farms are increasingly more productive or efficient than small farms. The objective of this research was to assess the performance of small and large farms in terms of size economies, and size and technical efficiency. Data were obtained from an Agricultural Resource Management Study (ARMS) for the years 1996-2001. The data set contained 780 annual observations. An input distance function approach was used to represent farms' technological structure. To estimate their model, the authors used two methods, the deterministic data envelope analysis (DEA) and the stochastic production frontier (SPF) procedure. As in the above study, off-farm income was treated as an output because it is a revenue generating activity that uses measured inputs and affects farm family economic performance. Other outputs, measured in dollars per farm, included corn, soybeans, other crops, and livestock. Inputs used were land, labor, capital, energy (fuel), fertilizer, feed, seed, other crop specific materials, other animal specific materials, and all other operating expenses.

Both the DEA and SPF methods revealed that size economies were present. While there were some differences between the DEA and SPF models, overall they were pretty consistent with each other. Results implied that the inability of small farms to improve cost efficiency by expanding their size of operations and diversity is a primary factor inhibiting their competitiveness. Morrison-Paul et al. (2004) also found that small family farms are generally less efficient in terms of both their size of operations and technical aspects of production than are large farms. In order for small family farms to enhance their competitiveness, they must either expand or diversify.

Langemeier and Bradford (2006) examined the relationship between overall inefficiency and numerous farm characteristics such as farm size, years of farm experience, percent of time devoted to farming, educational level, record keeping system, percent acres owned, organizational structure, and farm type for a sample of Kansas farms. Inefficiency was estimated using an overall inefficiency index, computed using linear programming. Indexes ranged from zero to one with zero representing the farms that are producing on the cost frontier and at the most efficient scale of operation. Inefficiency estimates were summarized two different ways. The first way sorted the data by inefficiency levels to develop quartiles. The second way utilized an ordinary least squares regression to examine the relationship between inefficiency and farm characteristics. Data were obtained from two different sources. The Kansas Farm Management Association provided financial and production data for the 1999-2001 period. The second source was a survey administrated to the Kansas Farm Management members in 2000. After the two sources of data were combined, there were 516 useable farms.

Results indicated the average level of inefficiency was 0.322. This means that on average, costs per unit would be 32.2 percent lower if all farms were overall efficient. Gross farm income was significantly related to inefficiency with a negative relationship. Results indicated that inefficiency was very sensitive to changes in gross farm income. According to the authors, this suggests that there are strong economies of size in the sample of farms.

Mosheim and Lovell (2006) analyzed economic efficiency and size economies across regions in the U.S. dairy sector in 2000. A total of 620 dairy farms were obtained from the Agricultural Resource Management Survey. Size economies have been found in the dairy industry. According to the authors, correlation analysis provides some evidence that size economies are important determinants of productivity. It was hypothesized that size economies exist for small farms and that there was a wide range of constant size economies. Specifically for the dairy industry, size economies were expected to be exhausted quickly. A shadow cost function was used to estimate and decompose economic efficiency. It was found that small farms have lower variable costs than other farms and that increased specialization increases variable costs. Results also imply that as dairy farms get larger, cost inefficiency and its components increase as well. Ending conclusions state that surviving small farms are more economically efficient, on average, with no indication of decreasing returns to scale. The results of the study contradict many previous studies.

Hoppe et al. (2007) summarized the structure and finances of U.S. farms in the 2007 Family Farm Report. The authors showed that the decline in farm numbers slowed

in the 1980's and nearly stopped in the 1990's. By 2005, nearly 2.1 million farms remained in operation, 98 percent of them being family farms.

Financial performance was evaluated between the different size classes in the year 2004. The study primarily used the Agricultural Resource Management Survey (ARMS) for its data. It was noted that profitability measures were strongly associated with farm size. The average operating profit margin and average rates of return on assets and equity were negative for small farms, but positive for large-scale and nonfamily farms (Hoppe et al., 2007). Overall, net farm income averaged $25,000 per farm in 2004, up 37 percent from the previous year. The debt to asset ratio ranged from 2.5 percent (retirement farms) to 16.7 percent (very large family farms). Limited-resource and residential/lifestyle farms both had operating expense ratios greater than 100 percent. This means that operating expenses exceeded gross cash farm income in the year 2004. It was noted that vulnerable farms – farms with negative net income and a debt/asset ratio above 40 percent – were rare in all farm types and amounted to less than 3 percent of all farms in the study.

Hoppe et al. (2007) next discussed the shift towards larger farms. In order to track the changing structure of agricultural farms, the latest five censuses of agriculture were used; 1982, 1987, 1992, 1997, and 2002. When measuring trends over time, the authors pointed out that it was important to adjust for changes in agricultural prices, the Producer Price Index (PPI) was used to make adjustments. The number of farms with sales of at least $250,000 grew steadily from 1982 to 2002, increasing from 85,000 to 152,000 and the number of farms with sales between $500,000 and $999,999 more than doubled with the number of million-dollar farms more than tripling (Hoppe et al., 2007).

The number of farms in all of the other sales classes declined, except sales of less than $10,000. The distribution of total agricultural sales also changed. Farms with sales of $250,000 or more increased from 47 percent in 1982 to 76 percent in 2002 (Hoppe et al., 2007).

2.3 Empirical Studies Examining Financial Performance

Purdy et al. (1997) examined the impact of risk and specialization on mean financial performance. They hypothesized that mean financial performance was influenced by farm size, among other things. The authors state that mean financial performance depends on how important economies of size and scope are. If economies of size are important, specializing in the production of a specific enterprise would result in increased overall financial performance. Previous literature suggested that farm size can be measured several different ways. The authors chose to use total acres operated as the size measure. A three-stage least squares and E-V model were used to generate results. Data were obtained from the Kansas Farm Management Association. Specifically, 320 farms with continuous data from 1985-1994 were used in the study.

Results suggested that strong overall economies of size existed for the sample of Kansas farms. Sensitivity to farm size was found to be elastic; a 10 percent increase in the mean total acres operated would result in an increase in the mean return on equity from 0.0395 to 0.0481, representing a 21.77 percent increase in financial performance. Results of the study suggested that there are large benefits associated with increasing farm size.

The question of why farms grow at different rates prompted Villatoro and Langemeier (2006) to study farm structure in Kansas. Factors affecting farm growth can

be categorized into internal and external factors. The study examined the relative importance of internal factors such as farm size, farm type, managerial ability, capital structure, operator age, family size, and off-farm income in explaining farm growth rates. The methods employed were simple comparisons of variables and two different regressions with the mathematical growth rate of total farm assets and the geometric growth rate of total farm assets used as dependent variables. Independent variables included farm size, percent of farm income derived from crop production, managerial ability, capital structure, operator age, family size, and off-farm income. Data were again supplied by the Kansas Farm Management Association. Specifically, whole-farm continuous data from 1983-2002 were obtained for 353 farms.

Results indicated that 73 farms had a negative growth rate and 280 farms had a positive growth rate over the study period. Pertinent to this literature review, the relationship between farm growth rate and farm size was not statistically significant. This implies that farm growth rate and size are independent of each other. Another result of interest was the economic total expense ratio being significant and negatively related to growth rates in total farm assets. This implies farms with above average managerial ability had lower economic total expense ratios and grew at a faster rate (Villatoro and Langemeier, 2006).

Langemeier (2007b) examined the persistence of financial efficiency and performance measures for a sample of Kansas farms. Financial performance was measured using the profit margin ratio, the asset turnover ratio, the total expense ratio, the adjusted total expense ratio, and the economic total expense ratio. Differences in financial performance have a direct relationship to benchmarking and competitive

advantage. The paper examined the performance of farms over a four-year period and put into perspective the importance of benchmarking financial ratios. Data for 1,255 farms in the Kansas Farm Management Association were used in the study. Data were broken down into quartiles according to the different ratios presented.

Summarizing the profit margin ratio results and the expense ratio results, it was concluded that it is hard for a farm to consistently be in the top quartile over time. On the other hand, it was easier for farms in the four-year period to never be in the bottom quartile. The performance between farms in the top and bottom quartiles was substantial. It is worth noting that economies of size were prevalent. In conclusion, the study stressed the importance of benchmarking financial performance using more than one year of data to obtain accurate results.

Financial stress has also been an important topic in the agricultural economics literature. Financial stress is defined as the absence of a normal profit or returns to factors (Jolly et al., 1985). Some stress is essential for farm firm growth and survival, but when too much occurs it can be detrimental. Jolly et al. (1985) measured financial stress for a group of farms in 1984-1985 using USDA data and a survey of Iowa farm operators. Ratios were used as measures of financial stress, indicating again the importance of benchmarking. The two measures of farm stress used were the debt to asset ratio and the existence of negative cash flow in 1984. Farms with a low debt to asset ratio and positive cash flow would be considered financially stable and farms with a high debt to asset ratio and negative cash flow would be considered financially stressed. Results indicated that approximately 50 percent of farm operators did not have a positive cash flow and 64 percent of debt was not fully serviced in 1984 (Jolly et al., 1985). The author stated that

of all U.S. farm debt, 62 percent is held by farm operators with debt to asset ratios over 40 percent.

2.4 Empirical Estimation of Trends and Convergence

Time series trends are a common way to analyze structural change. According to Allen et al. (2005), a trend is a relatively smooth long-term movement of a time series. Economic time series can be broken down into four parts; trend, seasonal variation, cyclical variation, and irregular movements. It can be assumed that the value of an economic variable at a certain time could be represented as the product of each of these four components (Allen et al., 2005). Trends can be upward or downward sloping, but are usually represented by a smooth line.

Literature on convergence is vast and has proceeded in many directions using several different definitions and methodologies. According to Islam (2003), convergence has been linked with the issue of validity of alternative growth theories. Thus, convergence research has provided the background for the formulation of stochastic growth models. There are two types of convergence; β - convergence and σ - convergence. β - convergence follows the law of diminishing returns and projects a negative correlation between the initial income level and the subsequent growth rate (Islam, 2003). Therefore, if the relationship between the growth rate and the initial level of value of farm production is significant and negative, convergence is evident. If the relationship is significant and positive, divergence is evident. When using σ – convergence, σ is the notation for standard deviation of the cross-sectional distribution of either income level or growth rate (Islam, 2003). If σ-convergence is present, there will be a negative relationship between σ and a time variable. If divergence is found, there

will be a positive relationship between σ and a time variable. β – convergence is a necessary but not sufficient condition of σ – convergence. One must also make a distinction between conditional and unconditional convergence. Unconditional convergence implies that all elements in a vector are the same for the economies considered (Islam, 2003). Conditional convergence emphasizes possible differences in the steady state and hence requires that appropriate variables be included on the right hand side of the growth-initial level regression in order to control for these differences (Islam, 2003).

McCunn and Huffman (2000) examined the implications of interstate research spillover for funding agricultural research. The objective of their research was to test for convergence in state agricultural total factor productivity (TFP) growth rates and to examine the contributions of public and private R&D relating to convergence. The data set contained the years 1950-82 and covered forty-two states. Regression analysis was conducted to obtain results. McCunn and Huffman (2000) made the distinction between conditional and unconditional convergence as it relates to TFP. If convergence is unconditional, then all states have the same steady state and TFP converges to the same level across all states (McCunn and Huffman, 2000). If convergence is conditional, then each state has in principle a unique steady state and it is converging to its own steady state (McCunn and Huffman, 2000).

The crop, livestock, and aggregate farm sectors were examined for evidence of convergence. Twenty-eight, five-year overlapping intervals between the years 1950-82 were used. σ – convergence was rejected in the study, but the authors failed to reject the hypothesis of β - convergence. According to the authors, the results showed that the rate

of conditional convergence is unlikely to be constant across states, and most likely to be variable depending on own and spill in public agricultural research stocks, private agricultural research stocks, and farmers' schooling (McCunn and Huffman, 2000).

CHAPTER 3 - Methodology

3.1 Introduction

Application of theory using the methods described here will help to determine the change in agriculture that is occurring. This section summarizes the methods used to document farm financial structure in Kansas from the years 1973 to 2007. Throughout this chapter, the modeling framework is developed and discussed. Section 3.2 defines and explains all the variables used to analyze farm characteristics and efficiency, liquidity, solvency, and profitability ratios. Section 3.3 discusses the categorization of farms. Section 3.4 describes the trend regressions used to examine growth rates pertaining to key farm characteristics and ratios. Section 3.5 concludes with a discussion of the models used to examine convergence and divergence of key farm characteristics and ratios.

3.2 Explanation of Variables

As the size of an operation increases and technology advances, the financial phase of management becomes more critical to the success of the operation (Langemeier, 2007a). Financial ratios have been used to help evaluate the condition of a farm business as a whole unit. Specifically, they can help to determine if economies of size are prevalent in the agricultural industry. Farm characteristics over time, such as value of farm production and total acres, can tell us how the structure of agriculture is changing and helps to explain why the change might be happening. Throughout this section,

numerous farm characteristics used in the development of documenting structural change are described along with efficiency, profitability, liquidity, and solvency ratios.

3.2.1 Farm Characteristics

Value of farm production equals the sum of livestock, crop, and other income computed on an accrual basis minus accrual feed purchased. It is a value added measure and can be used as a measure of farm size. Net farm income is the return to operator's labor, management, and net worth computed on an accrual basis. The percentage of time devoted to crops is obtained directly from the Kansas Farm Management Data Bank. This variable is computed using crop labor standards. This variable was not available for the years 1973-1981 (Langemeier, 2003).

The next group of characteristics are acres. Acres were broken down into harvested acres, total acres, total owned acres, and total crop acres. They were then separated further into specific crop acres; wheat, corn, sorghum, soybean, and hay and forage acres. Data for harvested acres were unavailable for the years 1973-1976 in the Kansas Farm Management Data Bank (Langemeier, 2003). Total acres are a summation of all crop and pasture acres, rented and owned. Percent of crop acres devoted to specific crops was obtained for wheat, feed grains (corn and sorghum), soybeans, and hay and forage by dividing the respective crop acres by total crop acres.

Income characteristics are described next. Income was broken down into grain income, wheat income, feed grain income (e.g., corn and grain sorghum), hay and forage income, oilseed income (e.g., soybeans and sunflowers), total crop income, beef income, dairy income, swine income, and total livestock income. Grain income is calculated as the sum of wheat income and feed grain income. Crop income includes grain, hay and

forage, and oilseed income. All income measures were calculated on an accrual basis and thus include inventory changes. The percentage of income from beef, dairy, and swine was computed by dividing the respective livestock enterprise income by the value of farm production. These values are used to illustrate how the proportion of different livestock enterprises is changing over time. Livestock numbers were also examined for beef cows, swine litters, dairy cows, beef feeders, and swine feeders.

Farm characteristics were next studied by looking at assets and liabilities. Specifically, crop inventories, livestock inventories, miscellaneous asset inventories, intermediate asset inventories, total assets, current liabilities, total liabilities, and net worth were calculated. Crop inventories are the sum of grain, hay and forage, and oilseed inventories. Livestock inventories included beef feeders, beef breeding stock, dairy breeding stock, sheep feeders, sheep breeding stock, swine feeders, swine breeding stock, poultry, and other livestock inventories. Miscellaneous asset inventories include feed, seed, fertilizer, fuel and oil, cash, and current accounts receivable. Non-current asset inventories include listed property, motor vehicles, machinery and equipment, buildings, long term accounts receivable, intermediate accounts receivable, and land. Machinery and equipment values were adjusted using Dumler et al. (2001). Land is valued every five years by Association Economists. Land values were interpolated between the five-year intervals using annual Kansas land values (Kansas Department of Agriculture). Total assets include current and noncurrent assets ranging from crop inventories to machinery and land. Total liabilities are also the culmination of current and noncurrent liabilities. Net worth is calculated as total assets minus total liabilities.

3.2.2 Efficiency and Profitability Ratios

Financial efficiency ratios are used to judge how efficiently a farm manager is utilizing their assets and their ability to manage costs. They measure the intensity with which a farm business uses its assets to generate value of farm production and the effectiveness of production, pricing, and marketing decisions (Langemeier, 2007a). Efficiency ratios are calculated from the balance sheet and income statement. Financial efficiency ratios discussed here include the total expense ratio, adjusted total expense ratio, economic total expense ratio, and the asset turnover ratio. The ratios are defined in Table 3.1.

The total expense ratio is calculated as total expenses divided by value of farm production. It takes into account operating expenses and depreciation. The adjusted total expense ratio accounts for operating expenses, depreciation, and unpaid family and operator labor. An adjusted total expense ratio below one indicates that the business is covering all operating expenses, depreciation, and unpaid labor charges. In order to calculate the economic total expense ratio, total economic cost must be determined. Total economic cost is the sum of labor cost, purchased input cost, and capital cost. Labor cost includes unpaid family and operator labor along with hired labor. Purchased inputs include gas/fuel/oil, seed expenses, fertilizer and lime, crop storage and marketing, herbicide, insecticide, veterinary expenses, livestock marketing and breeding, organization fees and publications, and utilities. In 1993, three more purchased inputs were added; crop insurance, irrigation energy, and dairy expenses. Feed is not included in purchased inputs because it is already subtracted out of value of farm production. Capital cost includes machinery and irrigation repairs, machine hire, auto expenses,

building repairs, conservation expense, cash interest, cash farm rent, real estate taxes, personal property taxes, general farm insurance, adjusted depreciation, and opportunity interest charge on equity. The original recorded depreciation values were adjusted using Dumler et al. (2001). The opportunity charge on equity was computed by multiplying net worth or equity by a five-year average interest rate (Federal Reserve Bank of Kansas City). An economic total expense ratio below one indicates that the business is covering labor, purchased inputs, and capital costs. Farms operating with a ratio value below one are earning an economic profit. The last efficiency ratio discussed in the asset turnover ratio. This ratio indicates how efficiently farmers are utilizing their assets to generate revenue. Although this ratio varies by farm type, a higher asset turnover ratio generally means greater asset utilization.

Profitability measures the extent to which a farm business generates a profit from the use of land, labor, management, and capital (Langemeier, 2007a). The operating profit margin ratio is one measure of profitability. It measures profit in terms of return per dollar of value of farm production. The higher the profit margin, the more profitable the farm.

3.2.3 Liquidity and Solvency Ratios

Liquidity ratios measure the ability of a farm business to meet financial obligations as they come due in the ordinary course of business (Langemeier, 2007a). Maintaining liquidity is vital to keeping the financial transactions of a farm business running smoothly. Liquidity measures are calculated using data from the balance sheet. The current ratio is the measure of liquidity used here. It measures the extent to which current farm assets, if liquidated, would cover current farm liabilities. Current

Table 3.1 Definitions of Efficiency, Profitability, Liquidity, and Solvency Ratios and Financial Stress

Efficiency Ratios

Total Economic Cost

The sum of labor cost plus purchased input cost plus capital cost. In addition to cash costs and depreciation, economic cost includes unpaid family and operator labor, and opportunity cost on equity.

Percent Labor

Labor cost divided by total economic cost

Percent Purchased Inputs

Purchased input cost divided by total economic cost

Percent Capital

Capital cost divided by total economic cost

Total Expense Ratio

Total expense divided by value of farm production

Adjusted Total Expense Ratio

Total expense plus unpaid family labor, and unpaid operator labor divided by value of farm production

Economic Total Expense Ratio

Total economic cost divided by value of farm production

Asset Turnover Ratio

Value of farm production divided by total assets

Profitability Ratio

Operating Profit Margin Ratio

Net farm income plus interest expense minus unpaid family and operator labor divided by value of farm production

Liquidity and Solvency Ratios

Current Ratio

Current assets divided by current liabilities

Table 3.1 Continued.

Debt to Asset Ratio Total debt divided by total assets
Financial Stress
Net Farm Income above Operator Labor (Earnings) Net farm income minus unpaid family and operator labor
Percent Negative Earnings Number of farms with negative earnings divided by total number of farms
Percent High Debt Number of farms with a debt to asset ratio above 0.70 divided by total number of farms
Percent of Farms Financially Stressed The sum of the total number of farms with high debt to asset ratios and negative earnings divided by total number of farms

assets include seed, fertilizer, and current accounts receivable, and current liabilities include current loans and accounts payable. Breeding livestock inventories are included in current assets. A current ratio around two is generally considered adequate.

Solvency measures the amount of debt and other expense obligations used in the farm business relative to the amount of owner equity invested in the business (Langemeier, 2007a). Solvency ratios provide an indication of the farm's ability to repay financial obligations if all assets were sold. Solvency ratios are also calculated using data from the balance sheet. The debt to asset ratio is one measure of solvency and measures the importance of borrowed funds in financing the farm's operation. It compares total farm liabilities to the value of total farm assets, and therefore measures financial position (Langemeier, 2007a). A lower debt to asset ratio means the farm owes less to its creditors and has less exposure to risk. This ratio is difficult to benchmark because everyone's risk preferences are different.

3.2.4 Financial Stress Indicators

Financial stress indicators are also defined in Table 3.1. Recording earnings from operation can identify if a farm is covering unpaid labor charges. A component of financial stress is negative earnings. Another component of financial stress is a high debt to asset ratio. Typically, a debt to asset ratio above 0.7 would be considered high. In this study, a farm with negative earnings and a debt to asset ratio above 0.7 is considered financially stressed. The percent of financially stressed farms is calculated as the total number of farms with both high debt to asset ratios and negative earnings divided by the total number of farms.

3.3 Categorization of Farms

To be included in this study, a farm had to have five years of continuous data during any continuous five-year period, from 1973 to 2007. Moving five-year averages were calculated for each farm that met this qualification. This created snapshots in time dating from 1973 to the present. Data were then sorted into quartiles and deciles by value of farm production. Value of farm production is a measure of farm size. It was chosen over other size measures because it is a universal method of combining diverse products into a single measure. Averages of the top and bottom quartiles were used for the trend regressions described below. Deciles, sorted again by value of farm production, were used to test for convergence. A description of the convergence tests can be found below. In an attempt to quantify where the farms were located in Kansas that were included in the top and bottom quartiles, the percent of farms from various regions was computed. Farms were sorted into Eastern, Central, and Western Kansas regions by using the Kansas Farm Management Association regional code system (Langemeier, 2003). The Kansas Farm Management Association is divided into six districts; North Central, South Central, Southwest, Northeast, Northwest, and Southeast. In this study, North Central and South Central farms were designated to be in the Central region. Southwest and Northwest farms were labeled the Western region, and Northeast and Southeast farms were labeled the Eastern region.

3.4 Trend Regression Analysis

In order to calculate the growth rates and determine if economies of size are present during each five-year period, an exponential trend regression was performed. The equation for such a trend is represented as:

$$\mathbf{Y_t = \alpha\beta^t} \qquad \mathbf{(3.1)}$$

where Y_t is the trend value of the time series at time period t. This equation represents a situation in which the variable grows at a constant percentage rate per year (Allen et al., 2005). It is convenient to estimate equation (3.1) in log-linear form:

$$\mathbf{\ln Y_t = A + B_t} \qquad \mathbf{(3.2)}$$

where A = log α and B = log β. This transforms the exponential function into an easily computable linear function. The antilogs of A and B are then taken to estimate α and β. The growth rate of Y_t equals β – 1.

The exponential trend regression was calculated using six different measures. The six measures used as the dependent variable in the exponential trend regressions included value of farm production, total acres, economic total expense ratio, operating profit margin ratio, asset turnover ratio, and percent of livestock income. Each regression had thirty one observations, one observation for each five-year period. These measures were used in two different ways. First, a regression over time was estimated using the average values of each of the six variables for each five-year snapshot to determine the growth rate of each variable over the study period. Growth rates are calculated as the exponential of the β coefficient minus one. These results will tell us if the variables have been increasing or decreasing over time. Second, a regression was run on the difference between the average values of the top and bottom quartiles over time. The results of the

trend regression between the top and bottom quartiles were used to determine if the ratios were changing over time. By analyzing the growth rates, evidence of economies or diseconomies of size will be revealed. Growth rates calculated are interpreted as percentages.

Value of farm production and total acres represent size measures. It was expected that these two measures will have a positive relationship with time. So, value of farm production and farm size were predicted to increase. Percent of livestock income was chosen to be a dependent variable to represent how farm enterprises were changing over time. It was expected that this variable will be negatively related to time. When regressing the difference between the top and bottom quartiles, we will be able to determine if financial performance is widening or narrowing over time and if economies of size are present.

3.5 Convergence Analysis

The data were broken down into deciles by value of farm production to study convergence. Convergence will help answer the question, "Are small farms catching up with large farms?" The first test of convergence examined was β-convergence. This follows from the assumption of diminishing returns (Islam, 2003). This type of convergence can be represented as:

$$\mathbf{g_i = f(vfp_1)} \qquad \mathbf{(3.3)}$$

where g_i represents the growth rate and vfp_1 represents the initial level of value of farm production. The initial level of value of farm production is the average value of farm production for each decile. In addition to examining value of farm production; total acres, economic total expense ratio, operating profit margin ratio, asset turnover ratio,

and the percent of livestock income will be examined and their growth rates used as the dependent variable. Six regressions will be run, each having ten observations. If the relationship between the growth rate of a key variable and the initial level of value of farm production is significant and negative, smaller farms are growing faster or performing relatively better than larger farms. If larger farms in the sample are growing faster or performing relatively better than smaller farms, a positive and significant relationship will exist. If convergence is not found, the difference between farms has not changed.

In order to obtain the growth rates used in the calculation of β-convergence, sixty regressions will be run, six for each decile. Growth rates will then be calculated from the regressions as the exponential of the β coefficient minus one for all key variables except the operating profit margin ratio that was calculated using linear regression.

The second type of convergence examined is σ-convergence. σ represents the standard deviation of the cross-sectional distribution of growth rates (Islam, 2003). It can be represented by:

$$\sigma = f(\text{time}) \qquad (3.4)$$

where σ indicates the standard deviation of each key variable in each five-year period. Six regressions will be run using the same key variables with thirty-one observations in each regression. This type of convergence recognizes the dispersion of the cross-sectional distribution of growth rates (Islam, 2003). σ-convergence will show if the difference between the deciles is growing or narrowing. If a negative relationship exists, the standard deviation between the groups is getting smaller. Conversely, if a positive relationship exists between the deciles, the standard deviation is getting larger between

the groups. Again, the same variables listed above will be used to test for σ-convergence.

CHAPTER 4 - Data

4.1 Introduction

This study encompasses a thirty-five year period, beginning in 1973 and ending in 2007. Section 4.2 discusses the data source and the criteria used to determine whether a farm was included in the study. Section 4.3 summarizes the farm characteristic data and Section 4.4 summarizes the financial measures and distribution of farms by region in Kansas. Finally, Section 4.5 discusses the means of variables broken down by quartiles and deciles.

4.2 Data Source

The Kansas Farm Management Data Bank provided the data used in this study. Farms represented in this data bank are members of the Kansas Farm Management Association (KFMA) and generally provide the association with annual data. Employees of the KFMA are responsible for the collection of the data from the association members. To be included in this study, a farm had to have five years of continuous, usable data for a five-year period between 1973 and 2007. In addition to not having five years of data, farms were deleted from the study if they had negative expenses (negative labor, purchased inputs, or capital expenses), if they were primarily sheep or turkey farms, if they recorded zero workers, and/or had negative value of farm production. A new data set was then created by computing five-year averages for each farm included in the study. Averages were then taken of the five-year snapshots to obtain final mean values of each

farm characteristic or financial performance measure. The total number of farms in each five-year period is presented in Table 4.1.

4.3 Farm Characteristics Data

Average farm characteristic data for the five-year periods are presented in Table 4.2. This table contains information pertaining to crop, livestock, and asset/liability characteristics. Only a few of the variables will be discussed, for a complete picture of farm structure, refer to Table 4.2. Mean value of farm production, measured in nominal dollars, was $85,116 in the 1973-1977 period and $304,663 for the ending period (2003-2007). The average number of workers fell in the time period studied while total acres rose rapidly from 1,369 in the beginning period to 1,873 in the ending period. Mean corn acres saw a increase during the study period. In 1973-1977, an average of 77 acres was planted to corn while in the period 2003-2007 an average of 215 acres was planted to corn. Acres planted to wheat have remained fairly constant over the study period. The percent of soybean acres planted saw an increase with an average of 4.72 percent of the acres planted to soybeans in 1973-1977 and an average of 22.28 percent planted to soybeans in 2003-2007. Percent of soybean acres was calculated by taking total soybean acres and dividing it by total acres.

Data presented in Table 4.2 were used to calculate trend regressions to determine growth rates over the study period. Specifically, the value of farm production, total acres, and percent of livestock income variables were used. The outcome of these regressions can be found in the results section.

Table 4.1 Data Set Definitions

Observation Year	Number of Farms
1973-1977	1,301
1974-1978	1,338
1975-1979	1,308
1976-1980	1,238
1977-1981	1,202
1978-1982	1,127
1979-1983	1,051
1980-1984	1,011
1981-1985	973
1982-1986	992
1983-1987	1,001
1984-1988	1,049
1985-1989	1,135
1986-1990	1,222
1987-1991	1,235
1988-1992	1,248
1989-1993	1,263
1990-1994	1,345
1991-1995	1,381
1992-1996	1,398
1993-1997	1,428
1994-1998	1,436
1995-1999	1,448
1996-2000	1,451
1997-2001	1,414
1998-2002	1,386
1999-2003	1,352
2000-2004	1,317
2001-2005	1,224
2002-2006	1,188
2003-2007	1,064

Table 4.2 Average Farm Characteristics Data 1973-2007

	1973 - 1977	1974 - 1978	1975 - 1979	1976-1980	1977 - 1981
Farm Characteristics					
Value of Farm Production	$ 85,116	$ 86,990	$ 99,487	$ 103,266	$ 110,037
Number of Operators	1.14	1.15	1.15	1.13	1.13
Number of Workers	1.72	1.71	1.68	1.67	1.68
Net Farm Income	$ 24,852	$ 21,358	$ 27,584	$ 26,047	$ 24,354
Crop Labor Percentage	na	na	na	na	na
Owned Land Value	$ 220,911	$ 248,774	$ 278,570	$ 295,094	$ 314,805
Acre Characteristics					
Harvested Acres	na	na	na	na	713.87
Total Acres	1369.14	1381.52	1432.60	1405.04	1423.60
Total Crop Acres	856.68	855.93	864.33	846.56	861.49
Total Wheat Acres	335.09	334.71	333.06	324.00	330.51
Total Corn Acres	77.06	76.71	72.31	64.04	60.17
Total Sorghum Acres	137.11	134.96	137.65	141.79	138.27
Total Soybean Acres	40.48	44.08	49.98	54.77	64.66
Total Hay and Forage Acres	97.03	97.08	97.83	98.84	99.85
Total Owned Acres	566.14	571.63	588.31	568.47	567.13
Percent of Crop Acres					
Wheat	39.12%	39.10%	38.53%	38.27%	38.36%
Feed Grains	25.00%	24.73%	24.29%	24.31%	23.03%
Soybeans	4.72%	5.15%	5.78%	6.47%	7.51%
Hay / Forage	11.33%	11.34%	11.32%	11.68%	11.59%
Accrual Income Characteristics					
Grain Income	$ 45,753	$ 42,648	$ 45,539	$ 47,178	$ 50,010
Wheat Income	na	na	na	na	na
Feed Grain Income	na	na	na	na	na
Hay and Forage Income	$ 4,302	$ 3,972	$ 4,199	$ 4,348	$ 4,493
Oilseed Income	$ 5,321	$ 5,669	$ 6,439	$ 7,335	$ 8,723
Crop Income	$ 60,599	$ 58,174	$ 63,003	$ 65,921	$ 71,466
Beef Income	$ 19,879	$ 24,407	$ 31,810	$ 32,361	$ 33,003
Dairy Income	$ 7,994	$ 8,481	$ 9,739	$ 10,568	$ 11,699
Swine Income	$ 11,092	$ 11,372	$ 10,909	$ 11,437	$ 11,775
Livestock Income	$ 38,922	$ 44,024	$ 52,307	$ 54,247	$ 56,321
Percent Income from Livestock					
Beef	23.35%	28.06%	31.97%	31.34%	29.99%
Dairy	9.39%	9.75%	9.79%	10.23%	10.63%
Swine	13.03%	13.07%	10.97%	11.07%	10.70%
Number of Livestock					
Beef Cows	38.00	39.19	40.77	40.30	40.95
Swine Litters	13.80	13.99	13.80	14.37	14.97
Dairy Cows	6.38	6.19	6.04	6.01	6.21
Beef Feeders	135.69	116.58	102.67	92.09	92.06
Swine Feeders	139.80	119.86	95.35	91.90	101.61
Asset/Liability Characteristics					
Crop Inventories	$ 44,350	$ 44,059	$ 44,113	$ 44,919	$ 47,227
Livestock Inventories	$ 40,199	$ 42,191	$ 49,618	$ 56,697	$ 62,388
Misc. Asset Inventories	$ 20,099	$ 19,873	$ 19,365	$ 18,329	$ 18,523
Interm. Asset Inventories	$ 79,714	$ 89,439	$ 100,921	$ 108,889	$ 118,816
Total Assets	$ 405,273	$ 444,336	$ 492,587	$ 523,927	$ 561,760
Current Liabilities	$ 46,883	$ 51,391	$ 57,465	$ 59,204	$ 61,708
Total Liabilities	$ 87,975	$ 99,982	$ 116,172	$ 124,412	$ 137,625
Net Worth	$ 317,298	$ 344,353	$ 376,415	$ 399,515	$ 424,135

Table 4.2 Continued.

	1978-1982	1979 - 1983	1980-1984	1981 - 1985	1982-1986
Farm Characteristics					
Value of Farm Production	$ 119,286	$ 121,187	$ 121,124	$ 127,504	$ 132,791
Number of Operators	1.13	1.14	1.14	1.13	1.14
Number of Workers	1.72	1.69	1.67	1.67	1.67
Net Farm Income	$ 23,596	$ 19,896	$ 13,351	$ 11,798	$ 14,412
Crop Labor Percentage	12.83%	25.62%	38.94%	53.10%	65.98%
Owned Land Value	$ 320,952	$ 318,236	$ 309,424	$ 310,823	$ 290,128
Acre Characteristics					
Harvested Acres	705.43	685.89	700.35	733.41	739.04
Total Acres	1410.00	1360.97	1361.98	1408.05	1433.35
Total Crop Acres	857.42	837.59	868.66	922.80	942.26
Total Wheat Acres	321.60	320.27	324.72	337.72	321.45
Total Corn Acres	59.00	53.37	51.12	53.30	54.64
Total Sorghum Acres	129.35	124.19	134.47	147.53	159.04
Total Soybean Acres	76.15	81.55	79.62	82.70	88.37
Total Hay and Forage Acres	97.71	93.88	96.71	96.11	97.54
Total Owned Acres	544.86	519.71	516.97	529.78	531.17
Percent of Crop Acres					
Wheat	37.51%	38.24%	37.38%	36.60%	34.11%
Feed Grains	21.97%	21.20%	21.37%	21.76%	22.68%
Soybeans	8.88%	9.74%	9.17%	8.96%	9.38%
Hay / Forage	11.40%	11.21%	11.13%	10.42%	10.35%
Accrual Income Characteristics					
Grain Income	$ 52,239	$ 55,674	$ 54,760	$ 57,141	$ 54,964
Wheat Income	na	na	$ 4,158	$ 10,271	$ 15,233
Feed Grain Income	na	na	$ 50,602	$ 46,870	$ 39,732
Hay and Forage Income	$ 4,646	$ 4,804	$ 5,021	$ 4,940	$ 4,343
Oilseed Income	$ 10,253	$ 11,008	$ 10,078	$ 10,673	$ 11,147
Crop Income	$ 76,195	$ 81,038	$ 82,448	$ 88,950	$ 90,524
Beef Income	$ 36,196	$ 32,201	$ 31,823	$ 32,284	$ 35,279
Dairy Income	$ 13,081	$ 14,301	$ 14,002	$ 14,049	$ 14,876
Swine Income	$ 13,937	$ 14,572	$ 14,520	$ 13,727	$ 15,284
Livestock Income	$ 63,071	$ 61,127	$ 60,372	$ 60,100	$ 65,550
Percent Income from Livestock					
Beef	30.34%	26.57%	26.27%	25.32%	26.57%
Dairy	10.97%	11.80%	11.56%	11.02%	11.20%
Swine	11.68%	12.02%	11.99%	10.77%	11.51%
Number of Livestock					
Beef Cows	40.27	37.73	36.75	34.04	33.26
Swine Litters	16.56	17.17	16.55	15.70	17.34
Dairy Cows	6.60	6.88	6.75	6.79	7.22
Beef Feeders	98.47	98.11	101.32	108.31	117.73
Swine Feeders	119.01	138.62	139.27	141.90	151.37
Asset/Liability Characteristics					
Crop Inventories	$ 48,455	$ 49,541	$ 49,217	$ 48,363	$ 46,192
Livestock Inventories	$ 69,120	$ 69,835	$ 70,072	$ 68,694	$ 72,110
Misc. Asset Inventories	$ 20,530	$ 22,169	$ 22,255	$ 24,325	$ 27,558
Interm. Asset Inventories	$ 125,655	$ 130,740	$ 134,780	$ 142,575	$ 147,348
Total Assets	$ 584,713	$ 590,521	$ 585,748	$ 594,781	$ 583,337
Current Liabilities	$ 66,338	$ 65,615	$ 66,622	$ 68,534	$ 69,257
Total Liabilities	$ 149,550	$ 156,416	$ 164,815	$ 174,870	$ 177,101
Net Worth	$ 435,163	$ 434,104	$ 420,933	$ 419,910	$ 406,236

Table 4.2 Continued.

	1983 - 1987	1984-1988	1985 - 1989	1986-1990	1987 - 1991
Farm Characteristics					
Value of Farm Production	$ 136,397	$ 146,710	$ 152,485	$ 155,994	$ 157,271
Number of Operators	1.13	1.13	1.14	1.13	1.12
Number of Workers	1.66	1.66	1.68	1.64	1.62
Net Farm Income	$ 19,461	$ 26,818	$ 30,045	$ 35,821	$ 37,241
Crop Labor Percentage	66.32%	67.34%	66.56%	66.87%	67.29%
Owned Land Value	$ 264,582	$ 245,455	$ 233,810	$ 226,047	$ 223,657
Acre Characteristics					
Harvested Acres	734.79	766.20	787.64	781.93	798.06
Total Acres	1482.56	1511.68	1565.94	1583.95	1571.89
Total Crop Acres	971.74	1003.81	1005.82	995.69	998.08
Total Wheat Acres	312.84	315.04	317.27	324.08	338.52
Total Corn Acres	51.46	58.93	66.67	65.89	71.49
Total Sorghum Acres	163.69	170.35	166.01	150.46	140.62
Total Soybean Acres	90.12	101.42	110.15	117.82	125.89
Total Hay and Forage Acres	97.29	98.86	106.02	103.35	103.86
Total Owned Acres	534.26	532.52	552.40	544.92	529.25
Percent of Crop Acres					
Wheat	32.19%	31.38%	31.54%	32.55%	33.92%
Feed Grains	22.14%	22.84%	23.13%	21.73%	21.25%
Soybeans	9.27%	10.10%	10.95%	11.83%	12.61%
Hay / Forage	10.01%	9.85%	10.54%	10.38%	10.41%
Accrual Income Characteristics					
Grain Income	$ 51,745	$ 51,565	$ 49,817	$ 47,517	$ 49,962
Wheat Income	$ 19,777	$ 26,034	$ 26,122	$ 23,889	$ 24,330
Feed Grain Income	$ 31,968	$ 25,531	$ 23,695	$ 23,628	$ 25,632
Hay and Forage Income	$ 4,432	$ 4,882	$ 5,300	$ 5,509	$ 5,867
Oilseed Income	$ 12,185	$ 14,331	$ 16,193	$ 17,217	$ 17,692
Crop Income	$ 93,492	$ 101,265	$ 103,539	$ 103,379	$ 104,220
Beef Income	$ 38,541	$ 40,782	$ 44,054	$ 46,938	$ 46,098
Dairy Income	$ 14,536	$ 15,459	$ 16,459	$ 16,022	$ 16,993
Swine Income	$ 13,606	$ 13,973	$ 15,460	$ 16,828	$ 16,528
Livestock Income	$ 66,780	$ 70,362	$ 76,314	$ 80,069	$ 79,763
Percent Income from Livestock					
Beef	28.26%	27.80%	28.89%	30.09%	29.31%
Dairy	10.66%	10.54%	10.79%	10.27%	10.81%
Swine	9.98%	9.52%	10.14%	10.79%	10.51%
Number of Livestock					
Beef Cows	33.23	32.33	35.17	36.61	36.67
Swine Litters	15.77	16.10	16.62	16.90	16.72
Dairy Cows	6.84	7.04	6.98	6.48	6.69
Beef Feeders	125.36	149.11	157.44	156.69	150.49
Swine Feeders	141.33	146.03	166.28	170.00	167.69
Asset/Liability Characteristics					
Crop Inventories	$ 44,299	$ 45,974	$ 48,203	$ 48,914	$ 50,237
Livestock Inventories	$ 75,079	$ 78,617	$ 86,818	$ 90,020	$ 92,017
Misc. Asset Inventories	$ 30,277	$ 32,802	$ 34,706	$ 35,558	$ 36,906
Interm. Asset Inventories	$ 147,768	$ 150,640	$ 149,781	$ 146,030	$ 144,224
Total Assets	$ 562,004	$ 553,489	$ 553,319	$ 546,569	$ 547,042
Current Liabilities	$ 70,303	$ 72,642	$ 75,780	$ 74,071	$ 71,333
Total Liabilities	$ 175,748	$ 177,289	$ 182,823	$ 175,078	$ 169,748
Net Worth	$ 386,256	$ 376,200	$ 370,496	$ 371,491	$ 377,294

Table 4.2 Continued.

	1988-1992	1989 - 1993	1990-1994	1991 - 1995	1992-1996
Farm Characteristics					
Value of Farm Production	$ 159,434	$ 157,356	$ 159,264	$ 160,749	$ 172,809
Number of Operators	1.11	1.09	1.07	1.06	1.05
Number of Workers	1.58	1.56	1.53	1.53	1.50
Net Farm Income	$ 39,911	$ 37,746	$ 37,418	$ 35,052	$ 42,832
Crop Labor Percentage	67.91%	68.61%	68.92%	69.60%	70.97%
Owned Land Value	$ 238,092	$ 246,851	$ 259,561	$ 262,704	$ 269,332
Acre Characteristics					
Harvested Acres	812.31	836.13	840.17	858.31	883.78
Total Acres	1577.80	1608.79	1606.74	1654.25	1666.98
Total Crop Acres	974.95	984.74	981.90	1001.19	1012.01
Total Wheat Acres	348.89	367.27	365.95	368.28	369.00
Total Corn Acres	75.69	76.68	84.45	88.83	95.55
Total Sorghum Acres	140.48	143.67	138.78	142.98	152.87
Total Soybean Acres	129.96	134.27	139.67	146.59	152.24
Total Hay and Forage Acres	100.97	99.21	96.56	96.68	97.47
Total Owned Acres	545.76	557.32	559.00	576.54	578.61
Percent of Crop Acres					
Wheat	35.79%	37.30%	37.27%	36.78%	36.46%
Feed Grains	22.17%	22.38%	22.73%	23.15%	24.55%
Soybeans	13.33%	13.64%	14.22%	14.64%	15.04%
Hay / Forage	10.36%	10.07%	9.83%	9.66%	9.63%
Accrual Income Characteristics					
Grain Income	$ 52,889	$ 52,405	$ 55,286	$ 60,797	$ 68,880
Wheat Income	$ 25,305	$ 25,105	$ 26,348	$ 30,594	$ 36,724
Feed Grain Income	$ 27,585	$ 27,300	$ 28,938	$ 30,203	$ 32,156
Hay and Forage Income	$ 5,635	$ 5,385	$ 5,460	$ 5,808	$ 6,240
Oilseed Income	$ 18,451	$ 18,721	$ 20,430	$ 22,247	$ 26,248
Crop Income	$ 105,899	$ 104,870	$ 108,816	$ 114,726	$ 128,560
Beef Income	$ 46,870	$ 44,819	$ 44,561	$ 42,474	$ 42,079
Dairy Income	$ 17,862	$ 18,318	$ 17,669	$ 17,079	$ 16,454
Swine Income	$ 15,855	$ 15,369	$ 14,736	$ 13,762	$ 13,185
Livestock Income	$ 80,628	$ 78,419	$ 76,781	$ 73,008	$ 71,436
Percent Income from Livestock					
Beef	29.40%	28.48%	27.98%	26.42%	24.35%
Dairy	11.20%	11.64%	11.09%	10.62%	9.52%
Swine	9.94%	9.77%	9.25%	8.56%	7.63%
Number of Livestock					
Beef Cows	38.62	39.50	39.26	41.31	42.93
Swine Litters	16.01	15.82	15.62	15.36	14.21
Dairy Cows	6.86	6.93	6.75	6.47	5.90
Beef Feeders	140.06	139.31	129.33	133.42	128.83
Swine Feeders	166.80	157.67	158.48	156.43	145.12
Asset/Liability Characteristics					
Crop Inventories	$ 52,157	$ 53,783	$ 54,822	$ 57,365	$ 62,900
Livestock Inventories	$ 96,310	$ 96,392	$ 98,352	$ 96,932	$ 93,284
Misc. Asset Inventories	$ 33,771	$ 31,689	$ 30,979	$ 29,390	$ 26,880
Interm. Asset Inventories	$ 141,876	$ 139,859	$ 140,550	$ 143,228	$ 145,566
Total Assets	$ 562,206	$ 568,574	$ 584,263	$ 589,618	$ 597,962
Current Liabilities	$ 72,981	$ 71,043	$ 71,820	$ 72,931	$ 71,736
Total Liabilities	$ 172,063	$ 171,526	$ 175,768	$ 179,090	$ 178,928
Net Worth	$ 390,143	$ 397,048	$ 408,496	$ 410,528	$ 419,034

Table 4.2 Continued.

	1993-1997	1994 - 1998	1995-1999	1996 - 2000	1997-2001
Farm Characteristics					
Value of Farm Production	$ 186,558	$ 187,049	$ 198,023	$ 206,184	$ 210,405
Number of Operators	1.05	1.05	1.04	1.04	1.03
Number of Workers	1.51	1.50	1.50	1.48	1.49
Net Farm Income	$ 45,306	$ 40,052	$ 42,954	$ 45,860	$ 39,253
Crop Labor Percentage	71.80%	73.32%	74.25%	75.05%	75.66%
Owned Land Value	$ 272,587	$ 278,466	$ 289,195	$ 293,798	$ 308,338
Acre Characteristics					
Harvested Acres	915.40	936.76	957.08	974.07	1008.79
Total Acres	1683.02	1681.47	1707.79	1707.43	1736.08
Total Crop Acres	1029.01	1036.77	1053.68	1063.56	1088.86
Total Wheat Acres	370.15	366.36	355.08	348.00	344.20
Total Corn Acres	104.92	115.03	121.44	133.29	152.47
Total Sorghum Acres	155.45	159.89	165.65	168.38	162.09
Total Soybean Acres	165.77	180.78	196.50	206.09	224.40
Total Hay and Forage Acres	102.03	97.37	100.12	99.52	105.01
Total Owned Acres	563.52	559.78	575.45	566.81	575.40
Percent of Crop Acres					
Wheat	35.97%	35.34%	33.70%	32.72%	31.61%
Feed Grains	25.30%	26.52%	27.25%	28.36%	28.89%
Soybeans	16.11%	17.44%	18.65%	19.38%	20.61%
Hay / Forage	9.92%	9.39%	9.50%	9.36%	9.64%
Accrual Income Characteristics					
Grain Income	$ 76,695	$ 80,050	$ 78,138	$ 76,761	$ 74,338
Wheat Income	$ 41,794	$ 43,958	$ 44,301	$ 43,917	$ 42,855
Feed Grain Income	$ 34,902	$ 36,092	$ 33,837	$ 32,844	$ 31,483
Hay and Forage Income	$ 7,568	$ 7,191	$ 7,169	$ 7,016	$ 8,027
Oilseed Income	$ 30,594	$ 31,534	$ 31,556	$ 29,488	$ 27,932
Crop Income	$ 142,335	$ 146,860	$ 153,511	$ 158,605	$ 161,677
Beef Income	$ 43,819	$ 40,043	$ 43,841	$ 46,148	$ 45,730
Dairy Income	$ 15,869	$ 14,740	$ 14,890	$ 14,608	$ 14,674
Swine Income	$ 13,489	$ 11,889	$ 12,374	$ 11,411	$ 10,976
Livestock Income	$ 72,959	$ 66,507	$ 71,024	$ 72,410	$ 71,532
Percent Income from Livestock					
Beef	23.49%	21.41%	22.14%	22.38%	21.73%
Dairy	8.51%	7.88%	7.52%	7.09%	6.97%
Swine	7.23%	6.36%	6.25%	5.53%	5.22%
Number of Livestock					
Beef Cows	43.15	44.43	45.85	46.47	47.48
Swine Litters	14.81	13.81	13.86	12.12	12.42
Dairy Cows	5.65	5.07	4.87	4.76	4.73
Beef Feeders	139.69	136.69	141.71	134.17	128.62
Swine Feeders	140.68	133.84	132.60	157.12	162.91
Asset/Liability Characteristics					
Crop Inventories	$ 70,743	$ 75,936	$ 79,107	$ 78,756	$ 79,920
Livestock Inventories	$ 93,889	$ 88,442	$ 89,523	$ 91,587	$ 94,977
Misc. Asset Inventories	$ 27,286	$ 26,918	$ 26,202	$ 25,735	$ 26,906
Interm. Asset Inventories	$ 153,036	$ 159,460	$ 170,850	$ 178,222	$ 190,711
Total Assets	$ 617,542	$ 629,222	$ 654,877	$ 668,098	$ 700,852
Current Liabilities	$ 74,297	$ 73,225	$ 76,711	$ 78,078	$ 82,910
Total Liabilities	$ 182,277	$ 183,122	$ 190,122	$ 198,064	$ 210,812
Net Worth	$ 435,265	$ 446,100	$ 464,755	$ 470,034	$ 490,039

Table 4.2 Continued.

	1998-2002	1999 - 2003	2000-2004	2001 - 2005	2002-2006	2003-2007
Farm Characteristics						
Value of Farm Production	$ 207,101	$ 213,557	$ 220,693	$ 234,858	$ 259,637	$ 304,663
Number of Operators	1.04	1.02	1.02	1.02	1.01	1.03
Number of Workers	1.49	1.44	1.41	1.41	1.45	1.45
Net Farm Income	$ 31,418	$ 37,375	$ 41,800	$ 45,908	$ 50,940	$ 70,645
Crop Labor Percentage	76.78%	77.37%	77.92%	77.51%	77.71%	78.83%
Owned Land Value	$ 325,962	$ 336,920	$ 350,254	$ 389,045	$ 437,664	$ 505,452
Acre Characteristics						
Harvested Acres	1047.77	1055.79	1068.02	1086.74	1135.66	1208.88
Total Acres	1776.23	1807.86	1805.98	1827.23	1861.55	1873.16
Total Crop Acres	1135.85	1153.34	1151.89	1149.65	1180.32	1236.83
Total Wheat Acres	352.63	360.86	375.27	374.37	399.29	433.52
Total Corn Acres	165.94	167.24	171.39	177.08	188.11	215.26
Total Sorghum Acres	164.04	164.47	161.44	154.18	145.53	139.02
Total Soybean Acres	230.77	227.28	226.79	241.30	257.31	275.57
Total Hay and Forage Acres	112.72	112.97	111.80	118.34	123.87	124.66
Total Owned Acres	587.04	592.07	593.62	608.62	618.12	615.28
Percent of Crop Acres						
Wheat	31.05%	31.29%	32.58%	32.56%	33.83%	35.05%
Feed Grains	29.05%	28.76%	28.89%	28.81%	28.27%	28.64%
Soybeans	20.32%	19.71%	19.69%	20.99%	21.80%	22.28%
Hay / Forage	9.92%	9.80%	9.71%	10.29%	10.49%	10.08%
Accrual Income Characteristics						
Grain Income	$ 72,255	$ 75,637	$ 81,746	$ 83,165	$ 96,778	$ 118,412
Wheat Income	$ 42,006	$ 42,293	$ 45,859	$ 44,999	$ 52,608	$ 70,527
Feed Grain Income	$ 30,249	$ 33,344	$ 35,888	$ 38,166	$ 44,170	$ 47,885
Hay and Forage Income	$ 8,418	$ 8,450	$ 8,831	$ 9,689	$ 10,815	$ 11,129
Oilseed Income	$ 24,676	$ 25,566	$ 28,851	$ 35,772	$ 41,099	$ 52,027
Crop Income	$ 159,688	$ 164,675	$ 170,594	$ 177,592	$ 196,379	$ 236,815
Beef Income	$ 44,636	$ 48,690	$ 50,422	$ 58,959	$ 64,752	$ 69,732
Dairy Income	$ 15,559	$ 14,809	$ 13,962	$ 15,408	$ 15,530	$ 15,349
Swine Income	$ 8,351	$ 5,882	$ 6,410	$ 6,122	$ 11,749	$ 13,475
Livestock Income	$ 68,725	$ 69,656	$ 71,053	$ 80,672	$ 91,687	$ 98,864
Percent Income from Livestock						
Beef	21.55%	22.80%	22.85%	25.10%	24.94%	22.89%
Dairy	7.51%	6.93%	6.33%	6.56%	5.98%	5.04%
Swine	4.03%	2.75%	2.90%	2.61%	4.52%	4.42%
Number of Livestock						
Beef Cows	48.05	46.95	46.66	46.98	48.23	46.48
Swine Litters	9.79	5.83	5.50	4.64	9.78	10.82
Dairy Cows	4.98	4.83	4.43	4.62	4.53	4.20
Beef Feeders	144.43	153.92	144.39	156.61	167.49	151.42
Swine Feeders	104.84	67.84	67.04	65.35	109.78	117.88
Asset/Liability Characteristics						
Crop Inventories	$ 76,399	$ 71,850	$ 71,871	$ 77,074	$ 85,081	$ 100,607
Livestock Inventories	$ 98,653	$ 98,796	$ 100,050	$ 112,883	$ 126,258	$ 132,378
Misc. Asset Inventories	$ 28,096	$ 30,184	$ 31,507	$ 34,331	$ 37,882	$ 40,863
Interm. Asset Inventories	$ 198,406	$ 197,854	$ 198,438	$ 202,210	$ 221,154	$ 239,535
Total Assets	$ 727,517	$ 735,604	$ 752,121	$ 815,544	$ 908,039	$ 1,018,834
Current Liabilities	$ 86,451	$ 86,986	$ 87,517	$ 95,753	$ 105,503	$ 110,749
Total Liabilities	$ 218,893	$ 221,293	$ 227,475	$ 243,805	$ 265,803	$ 284,687
Net Worth	$ 508,623	$ 514,311	$ 524,645	$ 571,740	$ 642,236	$ 734,147

4.4 Financial Measures and Distribution of Farms Data

The summary of financial measures and number of farms in each region can be found in Table 4.3. For definitions of the variables presented, refer to Table 3.1. Farms were categorized into three regions; Central, Western, and Eastern. In the start of the study period, farms were fairly evenly distributed between the different regions with Eastern Kansas having slightly more farms in the study. By the end of the study period, Eastern Kansas had 49.53 percent of the farms, Central Kansas contained 37.22 percent, and Western Kansas had 13.25 percent.

Total economic cost is calculated as the sum of labor cost plus purchased input cost plus capital cost. This variable increased over the sample period from $111,245 to $335,514. In analyzing inputs as a percent of total cost, it can be seen that the percent of total cost attributed to labor increased over the study period and the percent of total cost attributed to capital decreased over the study period. Labor as a percent of total cost was 13.68 percent in 1973-1977 and 17.13 percent in 2003-2007. Capital as a percent of total cost was 67.34 percent in the beginning period and 50.90 percent in the ending period. The economic total expense ratio is calculated by dividing total economic cost divided by value of farm production. An economic total expense ratio below one indicates a farm is covering operating expenses, depreciation, unpaid operator and family labor, and owned asset charges. A ratio below one signifies economic profit is being earned. The economic total expense ratio fluctuates over the sample period. It peaked in the 1981-1985 period at 1.737 and was at its lowest in the 2003-2007 period at 1.101. The asset turnover ratio increased over the period indicating farms are doing a better job of utilizing their assets. In the beginning period the ratio was 0.210 and in the ending period it was

Table 4.3 Average Financial Measures and Distribution of Farms 1973-2007

	1973 - 1977	1974 - 1978	1975 - 1979	1976-1980	1977 - 1981
Cost Measures					
Unpaid Family/Operator Labor	$ 11,205	$ 12,410	$ 13,712	$ 14,416	$ 15,158
Labor	$ 15,216	$ 16,460	$ 17,864	$ 18,668	$ 19,744
Feed	$ 14,406	$ 15,208	$ 15,824	$ 16,902	$ 17,750
Purchased Inputs-Feed	$ 21,111	$ 23,287	$ 25,281	$ 27,266	$ 30,163
Interest Expense	$ 6,275	$ 7,404	$ 8,934	$ 10,229	$ 12,385
Depreciation Expense	$ 11,472	$ 12,310	$ 13,234	$ 13,924	$ 14,966
Opp. Interest Charge on Net Worth	$ 31,387	$ 34,276	$ 36,375	$ 43,087	$ 52,233
Capital	$ 74,918	$ 81,691	$ 89,311	$ 100,197	$ 115,627
Total Expenses	$ 60,264	$ 65,633	$ 71,902	$ 77,219	$ 85,684
Total Economic Cost	$ 111,245	$ 121,437	$ 132,456	$ 146,131	$ 165,534
Input as a Percent of Total Cost					
Labor	13.68%	13.55%	13.49%	12.78%	11.93%
Purchased Inputs	18.98%	19.18%	19.09%	18.66%	18.22%
Capital	67.34%	67.27%	67.43%	68.57%	69.85%
Efficiency Ratios					
Total Expense Ratio	0.708	0.754	0.723	0.748	0.779
Adjusted Total Expense Ratio	0.840	0.897	0.861	0.887	0.916
Economic Total Expense Ratio	1.307	1.396	1.331	1.415	1.504
Asset Turnover Ratio	0.210	0.196	0.202	0.197	0.196
Operating Profit Margin Ratio	0.234	0.188	0.229	0.212	0.196
Liquidity and Solvency Ratios					
Current Ratio	2.232	2.065	1.968	2.026	2.077
Debt to Asset Ratio	0.217	0.225	0.236	0.237	0.245
Earnings					
Net Farm Income above Operator Labor	$ 13,647	$ 8,948	$ 13,872	$ 11,631	$ 9,196
% Negative Earnings	21.60%	33.63%	25.23%	31.26%	36.19%
% Having High Debt	1.15%	1.49%	1.76%	1.62%	2.16%
% Financially Stressed	0.69%	0.01%	1.38%	1.45%	1.83%
Regional Distribution					
% of Farms from Western Kansas	31.21%	29.75%	28.06%	25.36%	25.96%
% of Farms from Central Kansas	31.67%	34.23%	36.24%	36.03%	33.03%
% of Farms from Eastern Kansas	37.13%	36.02%	35.70%	38.61%	41.01%

Table 4.3 Continued.

	1978-1982	1979 - 1983	1980-1984	1981 - 1985	1982-1986
Cost Measures					
Unpaid Family/Operator Labor	$ 16,104	$ 16,780	$ 17,182	$ 17,809	$ 18,580
Labor	$ 21,232	$ 21,898	$ 22,770	$ 23,965	$ 25,058
Feed	$ 19,980	$ 20,978	$ 21,695	$ 21,546	$ 23,283
Purchased Inputs-Feed	$ 34,012	$ 36,165	$ 38,280	$ 41,141	$ 42,086
Interest Expense	$ 14,724	$ 15,968	$ 17,543	$ 18,957	$ 18,873
Depreciation Expense	$ 16,310	$ 17,774	$ 19,190	$ 20,924	$ 21,584
Opp. Interest Charge on Net Worth	$ 59,520	$ 63,296	$ 64,073	$ 62,785	$ 56,709
Capital	$ 129,951	$ 139,214	$ 147,004	$ 156,395	$ 159,928
Total Expenses	$ 95,691	$ 101,291	$ 107,773	$ 115,706	$ 118,379
Total Economic Cost	$ 185,196	$ 197,276	$ 208,055	$ 221,501	$ 227,073
Input as a Percent of Total Cost					
Labor	11.46%	11.10%	10.94%	10.82%	11.04%
Purchased Inputs	18.37%	18.33%	18.40%	18.57%	18.53%
Capital	70.17%	70.57%	70.66%	70.61%	70.43%
Efficiency Ratios					
Total Expense Ratio	0.802	0.836	0.890	0.907	0.891
Adjusted Total Expense Ratio	0.937	0.974	1.032	1.047	1.031
Economic Total Expense Ratio	1.553	1.628	1.718	1.737	1.710
Asset Turnover Ratio	0.204	0.205	0.207	0.214	0.228
Operating Profit Margin Ratio	0.186	0.157	0.113	0.102	0.111
Liquidity and Solvency Ratios					
Current Ratio	2.082	2.157	2.125	2.063	2.106
Debt to Asset Ratio	0.256	0.265	0.281	0.294	0.304
Earnings					
Net Farm Income above Operator Labor	$ 7,492	$ 3,116	$ (3,831)	$ (6,011)	$ (4,168)
% Negative Earnings	38.69%	48.62%	60.44%	65.98%	64.11%
% Having High Debt	2.57%	3.62%	7.32%	8.32%	9.58%
% Financially Stressed	2.31%	3.14%	6.73%	7.61%	8.77%
Regional Distribution					
% of Farms from Western Kansas	25.82%	20.17%	22.65%	23.43%	22.38%
% of Farms from Central Kansas	28.22%	30.35%	30.96%	33.50%	35.18%
% of Farms from Eastern Kansas	45.96%	49.48%	46.39%	43.06%	42.44%

Table 4.3 Continued.

	1983 - 1987	1984-1988	1985 - 1989	1986-1990	1987 - 1991
Cost Measures					
Unpaid Family/Operator Labor	$ 19,335	$ 20,668	$ 21,846	$ 22,853	$ 24,286
Labor	$ 26,039	$ 27,900	$ 29,505	$ 30,558	$ 31,887
Feed	$ 23,875	$ 24,918	$ 27,368	$ 27,454	$ 26,712
Purchased Inputs-Feed	$ 41,271	$ 42,811	$ 43,994	$ 43,657	$ 44,588
Interest Expense	$ 17,951	$ 17,590	$ 17,824	$ 16,485	$ 15,601
Depreciation Expense	$ 21,152	$ 20,578	$ 19,266	$ 17,347	$ 16,102
Opp. Interest Charge on Net Worth	$ 50,048	$ 46,660	$ 44,183	$ 42,928	$ 42,548
Capital	$ 160,815	$ 166,045	$ 167,804	$ 162,672	$ 151,458
Total Expenses	$ 116,936	$ 119,892	$ 122,439	$ 120,173	$ 120,030
Total Economic Cost	$ 228,124	$ 236,756	$ 241,302	$ 236,887	$ 227,934
Input as a Percent of Total Cost					
Labor	11.41%	11.78%	12.23%	12.90%	13.99%
Purchased Inputs	18.09%	18.08%	18.23%	18.43%	19.56%
Capital	70.49%	70.13%	69.54%	68.67%	66.45%
Efficiency Ratios					
Total Expense Ratio	0.857	0.817	0.803	0.770	0.763
Adjusted Total Expense Ratio	0.999	0.958	0.946	0.917	0.918
Economic Total Expense Ratio	1.672	1.614	1.582	1.519	1.449
Asset Turnover Ratio	0.243	0.265	0.276	0.285	0.287
Operating Profit Margin Ratio	0.133	0.162	0.171	0.189	0.182
Liquidity and Solvency Ratios					
Current Ratio	2.129	2.167	2.240	2.356	2.512
Debt to Asset Ratio	0.313	0.320	0.330	0.320	0.310
Earnings					
Net Farm Income above Operator Labor	$ 126	$ 6,150	$ 8,199	$ 12,968	$ 12,955
% Negative Earnings	56.84%	48.05%	45.29%	37.48%	38.30%
% Having High Debt	10.79%	13.06%	14.71%	13.26%	13.12%
% Financially Stressed	9.49%	10.10%	10.84%	8.51%	8.34%
Regional Distribution					
% of Farms from Western Kansas	23.18%	22.97%	21.94%	20.29%	19.92%
% of Farms from Central Kansas	34.57%	34.70%	32.51%	31.83%	31.34%
% of Farms from Eastern Kansas	42.26%	42.33%	45.55%	47.87%	48.74%

Table 4.3 Continued.

	1988-1992	1989 - 1993	1990-1994	1991 - 1995	1992-1996
Cost Measures					
Unpaid Family/Operator Labor	$ 25,678	$ 26,882	$ 28,156	$ 29,524	$ 30,388
Labor	$ 33,234	$ 34,586	$ 35,942	$ 37,678	$ 38,416
Feed	$ 27,093	$ 25,933	$ 26,333	$ 26,984	$ 27,186
Purchased Inputs-feed	$ 45,108	$ 45,467	$ 47,016	$ 49,129	$ 51,704
Interest Expense	$ 15,550	$ 14,917	$ 14,625	$ 14,516	$ 14,222
Depreciation Expense	$ 14,897	$ 14,235	$ 13,933	$ 13,940	$ 14,196
Opp. Interest Charge on Net Worth	$ 42,259	$ 40,556	$ 39,248	$ 37,955	$ 37,689
Capital	$ 138,386	$ 125,680	$ 117,122	$ 110,452	$ 111,407
Total Expenses	$ 119,523	$ 119,610	$ 121,846	$ 125,697	$ 129,978
Total Economic Cost	$ 216,728	$ 205,733	$ 200,080	$ 197,259	$ 201,528
Input as a Percent of Total Cost					
Labor	15.33%	16.81%	17.96%	19.10%	19.06%
Purchased Inputs	20.81%	22.10%	23.50%	24.91%	25.66%
Capital	63.85%	61.09%	58.54%	55.99%	55.28%
Efficiency Ratios					
Total Expense Ratio	0.750	0.760	0.765	0.782	0.752
Adjusted Total Expense Ratio	0.911	0.931	0.942	0.966	0.928
Economic Total Expense Ratio	1.359	1.307	1.256	1.227	1.166
Asset Turnover Ratio	0.284	0.277	0.273	0.273	0.289
Operating Profit Margin Ratio	0.187	0.164	0.150	0.125	0.154
Liquidity and Solvency Ratios					
Current Ratio	2.497	2.560	2.564	2.519	2.552
Debt to Asset Ratio	0.306	0.302	0.301	0.304	0.299
Earnings					
Net Farm Income above Operator Labor	$ 14,233	$ 10,863	$ 9,262	$ 5,528	$ 12,443
% Negative Earnings	39.26%	44.34%	46.69%	52.64%	45.21%
% Having High Debt	11.22%	10.29%	10.33%	11.01%	10.23%
% Financially Stressed	7.29%	7.21%	8.10%	9.20%	6.87%
Regional Distribution					
% of Farms from Western Kansas	18.03%	17.74%	17.99%	18.90%	18.60%
% of Farms from Central Kansas	30.77%	31.12%	30.86%	30.34%	30.83%
% of Farms from Eastern Kansas	51.20%	51.15%	51.15%	50.76%	50.57%

Table 4.3 Continued.

	1993-1997	1994 - 1998	1995-1999	1996 - 2000	1997-2001
Cost Measures					
Unpaid Family/Operator Labor	$ 31,331	$ 32,002	$ 32,270	$ 32,508	$ 33,568
Labor	$ 39,975	$ 40,704	$ 41,331	$ 41,606	$ 43,314
Feed	$ 28,848	$ 26,495	$ 26,556	$ 24,759	$ 22,739
Purchased Inputs-feed	$ 56,213	$ 59,024	$ 61,983	$ 64,335	$ 69,321
Interest Expense	$ 14,497	$ 14,522	$ 15,321	$ 15,691	$ 16,231
Depreciation Expense	$ 15,170	$ 16,053	$ 17,290	$ 18,103	$ 19,590
Opp. Interest Charge on Net Worth	$ 39,371	$ 40,765	$ 42,434	$ 42,813	$ 43,644
Capital	$ 118,739	$ 122,681	$ 128,838	$ 131,765	$ 137,575
Total Expenses	$ 141,252	$ 146,997	$ 155,069	$ 160,323	$ 171,152
Total Economic Cost	$ 214,927	$ 222,408	$ 232,152	$ 237,707	$ 250,210
Input as a Percent of Total Cost					
Labor	18.60%	18.30%	17.80%	17.50%	17.31%
Purchased Inputs	26.15%	26.54%	26.70%	27.06%	27.71%
Capital	55.25%	55.16%	55.50%	55.43%	54.98%
Efficiency Ratios					
Total Expense Ratio	0.757	0.786	0.783	0.778	0.813
Adjusted Total Expense Ratio	0.925	0.957	0.946	0.935	0.973
Economic Total Expense Ratio	1.152	1.189	1.172	1.153	1.189
Asset Turnover Ratio	0.302	0.297	0.302	0.309	0.300
Operating Profit Margin Ratio	0.153	0.121	0.131	0.141	0.104
Liquidity and Solvency Ratios					
Current Ratio	2.583	2.612	2.540	2.511	2.434
Debt to Asset Ratio	0.295	0.291	0.290	0.296	0.301
Earnings					
Net Farm Income above Operator Labor	$ 13,975	$ 8,050	$ 10,684	$ 13,352	$ 5,685
% Negative Earnings	43.63%	50.56%	49.31%	47.28%	54.67%
% Having High Debt	10.01%	10.17%	10.08%	10.48%	10.96%
% Financially Stressed	6.79%	8.15%	6.98%	7.03%	8.20%
Regional Distribution					
% of Farms from Western Kansas	17.44%	17.06%	16.64%	17.37%	17.96%
% of Farms from Central Kansas	32.21%	33.22%	33.91%	33.56%	32.60%
% of Farms from Eastern Kansas	50.35%	49.72%	49.45%	49.07%	49.43%

Table 4.3 Continued.

	1998-2002	1999 - 2003	2000-2004	2001 - 2005	2002-2006	2003-2007
Cost Measures						
Unpaid Family/Operator Labor	$ 35,001	$ 35,798	$ 37,692	$ 40,524	$ 42,444	$ 45,815
Labor	$ 45,206	$ 45,478	$ 46,966	$ 50,076	$ 53,758	$ 57,476
Feed	$ 21,485	$ 20,746	$ 20,947	$ 23,565	$ 28,677	$ 31,076
Purchased Inputs-feed	$ 71,414	$ 73,150	$ 75,956	$ 81,897	$ 91,895	$ 107,253
Interest Expense	$ 16,191	$ 15,566	$ 14,916	$ 14,950	$ 15,749	$ 17,393
Depreciation Expense	$ 20,461	$ 20,238	$ 20,438	$ 21,093	$ 23,189	$ 25,283
Opp. Interest Charge on Net Worth	$ 43,466	$ 41,860	$ 40,709	$ 42,107	$ 47,601	$ 55,566
Capital	$ 139,074	$ 136,382	$ 135,208	$ 140,135	$ 153,405	$ 170,784
Total Expenses	$ 175,683	$ 176,182	$ 178,893	$ 188,950	$ 208,697	$ 234,018
Total Economic Cost	$ 255,694	$ 255,010	$ 258,129	$ 272,108	$ 299,057	$ 335,514
Input as a Percent of Total Cost						
Labor	17.68%	17.83%	18.19%	18.40%	17.98%	17.13%
Purchased Inputs	27.93%	28.69%	29.43%	30.10%	30.73%	31.97%
Capital	54.39%	53.48%	52.38%	51.50%	51.30%	50.90%
Efficiency Ratios						
Total Expense Ratio	0.848	0.825	0.811	0.805	0.804	0.768
Adjusted Total Expense Ratio	1.017	0.993	0.981	0.977	0.967	0.918
Economic Total Expense Ratio	1.235	1.194	1.170	1.159	1.152	1.101
Asset Turnover Ratio	0.285	0.290	0.293	0.288	0.286	0.299
Operating Profit Margin Ratio	0.061	0.080	0.086	0.087	0.093	0.139
Liquidity and Solvency Ratios						
Current Ratio	2.350	2.309	2.324	2.342	2.362	2.473
Debt to Asset Ratio	0.301	0.301	0.302	0.299	0.293	0.279
Earnings						
Net Farm Income above Operator Labor	$ (3,583)	$ 1,577	$ 4,108	$ 5,383	$ 8,497	$ 24,830
% Negative Earnings	63.13%	59.32%	56.72%	56.78%	55.56%	45.11%
% Having High Debt	11.90%	12.28%	13.52%	13.64%	12.46%	10.53%
% Financially Stressed	9.67%	9.47%	9.11%	9.89%	8.92%	6.39%
Regional Distribution						
% of Farms from Western Kansas	18.40%	18.93%	18.60%	14.95%	13.89%	13.25%
% of Farms from Central Kansas	33.41%	32.47%	32.57%	34.64%	35.10%	37.22%
% of Farms from Eastern Kansas	48.20%	48.59%	48.82%	50.41%	51.01%	49.53%

0.299. The operating profit margin decreased over the sample period with a value of 0.234 in 1973-1977 and 0.139 in 2003-2007. Financial stress occurs when a farm has a high debt to asset ratio (above 0.70) and negative earnings. Only 0.69 percent of the farms studied were financially stressed in 1973-1977 but 6.39 percent of the farms were financially stressed in the 2003-2007 time period. In the 1985-1989 time period, the percent of financially stressed farms peaked at 10.84 percent.

Data in this table were used to calculate trend regressions to determine growth rates over the study period. Specifically, the economic total expense ratio, asset turnover ratio, and operating profit margin ratio were used. The growth rates for each key variable can be found in the results section.

4.5 Farms Categorized by Quartiles and Deciles Data

Data, sorted by value of farm production, were also categorized in quartiles and deciles. Table 4.4 contains information on financial measurements by top and bottom quartiles. The top quartile represents the farms with the highest value of farm production and the bottom quartile represents the farms with the lowest value of farm production. Total acres increased substantially for the top quartile over the sample period. In the bottom quartile, total acres slightly decreased from 888 acres in the beginning period to 867 acres in the ending period. Using the economic total expense ratio, on average, the farms in the top quartile were covering all of their operating expenses, depreciation, unpaid family and operator labor, and equity charges in the 2003-2007 period. The economic total expense ratio for the bottom quartile in the same period was 1.684.

Table 4.4 Financial Measurements by Quartiles 1973-2007

	1973-1977		1974-1978		1975-1979		1976-1980		1977-1981	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 37,664	$ 158,841	$ 38,187	$ 162,921	$ 42,750	$ 188,053	$ 44,833	$ 194,698	$ 47,858	$ 206,718
Total Acres	887.53	1991.72	868.76	1980.14	861.40	2088.45	848.58	2048.98	855.28	2101.35
Economic Total Expense Ratio	1.541	1.198	1.672	1.273	1.624	1.228	1.717	1.298	1.829	1.380
Asset Turnover Ratio	0.173	0.244	0.158	0.230	0.158	0.231	0.157	0.227	0.152	0.227
Profit Margin Ratio	0.097	0.276	0.032	0.234	0.072	0.271	0.051	0.255	0.049	0.235
Percent of Livestock Income	0.499	0.389	0.483	0.455	0.437	0.511	0.462	0.509	0.476	0.509

Table 4.4 Continued.

	1978-1982		1979-1983		1980-1984		1981-1985		1982-1986	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 49,337	$ 225,446	$ 49,854	$ 226,784	$ 47,099	$ 232,768	$ 46,840	$ 250,243	$ 48,174	$ 260,215
Total Acres	807.49	2086.96	808.37	2055.85	777.56	2066.13	753.58	2154.27	755.34	2181.96
Economic Total Expense Ratio	1.935	1.417	2.046	1.484	2.187	1.552	2.248	1.574	2.168	1.565
Asset Turnover Ratio	0.153	0.238	0.155	0.238	0.153	0.246	0.152	0.254	0.166	0.264
Profit Margin Ratio	0.019	0.226	-0.033	0.202	-0.099	0.164	-0.123	0.152	-0.115	0.164
Percent of Livestock Income	0.494	0.536	0.540	0.490	0.525	0.497	0.474	0.472	0.457	0.508

Table 4.4 Continued.

	1983-1987		1984-1988		1985-1989		1986-1990		1987-1991	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 49,883	$ 264,712	$ 52,880	$ 287,076	$ 53,657	$ 303,103	$ 55,285	$ 310,061	$ 56,877	$ 313,555
Total Acres	750.32	2266.97	775.09	2337.07	800.27	2367.16	816.93	2391.04	837.10	2423.73
Economic Total Expense Ratio	2.117	1.545	2.018	1.515	1.957	1.480	1.892	1.423	1.809	1.354
Asset Turnover Ratio	0.179	0.275	0.201	0.289	0.211	0.300	0.212	0.314	0.212	0.320
Profit Margin Ratio	-0.094	0.184	-0.070	0.211	-0.063	0.219	-0.037	0.233	-0.042	0.227
Percent of Livestock Income	0.421	0.524	0.383	0.520	0.443	0.531	0.448	0.555	0.487	0.544

Table 4.4 Continued.

	1988-1992		1989-1993		1990-1994		1991-1995		1992-1996	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 56,652	$ 320,668	$ 55,222	$ 317,424	$ 54,060	$ 323,396	$ 52,713	$ 330,794	$ 54,630	$ 357,392
Total Acres	842.08	2467.65	842.65	2526.08	816.00	2535.84	862.99	2617.46	934.80	2588.25
Economic Total Expense Ratio	1.753	1.256	1.710	1.203	1.694	1.152	1.722	1.113	1.724	1.051
Asset Turnover Ratio	0.204	0.320	0.195	0.316	0.184	0.310	0.173	0.319	0.163	0.343
Profit Margin Ratio	-0.058	0.238	-0.086	0.218	-0.116	0.208	-0.176	0.190	-0.164	0.221
Percent of Livestock Income	0.473	0.540	0.466	0.526	0.494	0.498	0.501	0.465	0.470	0.414

Table 4.4 Continued.

	1993-1997		1994-1998		1995-1999		1996-2000		1997-2001		1998-2002	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 56,896	$ 386,238	$ 56,056	$ 388,127	$ 58,675	$ 411,309	$ 60,535	$ 428,788	$ 59,531	$ 441,425	$ 58,358	$ 434,679
Total Acres	910.72	2623.23	902.42	2592.27	895.29	2601.53	877.08	2690.88	833.36	2776.76	883.73	2848.98
Economic Total Expense Ratio	1.687	1.044	1.763	1.074	1.723	1.066	1.663	1.053	1.725	1.091	1.844	1.125
Asset Turnover Ratio	0.171	0.358	0.164	0.357	0.171	0.358	0.181	0.363	0.170	0.359	0.152	0.342
Profit Margin Ratio	-0.152	0.215	-0.204	0.185	-0.186	0.190	-0.162	0.196	-0.204	0.153	-0.284	0.119
Percent of Livestock Income	0.462	0.384	0.457	0.341	0.418	0.359	0.396	0.348	0.385	0.328	0.386	0.326

Table 4.4 Continued.

	1999-2003		2000-2004		2001-2005		2002-2006		2003-2007	
	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top
Value of Farm Production	$ 61,342	$ 445,640	$ 63,290	$ 460,727	$ 68,417	$ 493,084	$ 71,007	$ 560,987	$ 82,564	$ 657,355
Total Acres	879.33	2960.95	887.07	2923.17	876.13	2910.48	864.09	2982.79	866.51	2995.73
Economic Total Expense Ratio	1.763	1.088	1.730	1.051	1.705	1.036	1.741	1.038	1.684	0.991
Asset Turnover Ratio	0.154	0.346	0.155	0.359	0.154	0.351	0.148	0.342	0.156	0.355
Profit Margin Ratio	-0.241	0.140	-0.238	0.155	-0.235	0.162	-0.252	0.163	-0.212	0.208
Percent of Livestock Income	0.374	0.327	0.363	0.330	0.366	0.355	0.372	0.388	0.362	0.351

The bottom quartile reported a positive profit margin ratio until the 1979-1983 period where it turned negative for the rest of the time periods studied. The percent of livestock income variable fluctuated during the study period. It did, however, decrease for both groups from the beginning period to the end. In the bottom and top quartiles respectively, the percent of livestock income values were 0.499 and 0.389 in 1973-1977 and 0.362 and 0.351 in 2003-2007. The asset turnover ratio for the top quartile increased over the study period from 0.244 in 1973-1977 to 0.355 in 2003-2007. In contrast, the asset turnover ratio for the bottom quartile decreased over the period indicating they were not using assets as efficiently at the end of the study period as they were at the beginning of the study period. Data on the differences between the top and bottom quartiles of the six variables discussed were used to determine growth rates in the results section.

Farm characteristic variables, sorted by value of farm production, were also broken down into deciles. This was done in order to determine if convergence or divergence is occurring in the farming sector. Table 4.5 presents the average data used for the deciles and Table 4.6 presents the standard deviation of the five-year averages used for σ-convergence. Six variables were examined; value of farm production, total acres, economic total expense ratio, operating profit margin ratio, asset turnover ratio, and percent of livestock income.

Table 4.5 Average of Data (1973-2007) by Deciles

Deciles	Value of Farm Production	Total Acres	Economic Total Expense Ratio	Profit Margin Ratio	Asset Turnover Ratio	Percent of Livestock Income
1st	453,577.28	2,856.34	1.22	0.21	0.32	0.46
2nd	270,361.88	2,264.66	1.27	0.20	0.29	0.43
3rd	209,065.36	1,961.60	1.32	0.18	0.27	0.42
4th	170,254.73	1,762.87	1.36	0.17	0.26	0.43
5th	142,385.41	1,625.97	1.41	0.14	0.25	0.43
6th	119,592.18	1,430.80	1.44	0.11	0.24	0.46
7th	99,265.90	1,295.19	1.52	0.08	0.22	0.44
8th	80,667.68	1,121.77	1.59	0.03	0.21	0.43
9th	61,525.30	926.56	1.73	-0.06	0.18	0.43
10th	36,808.10	654.05	2.17	-0.30	0.14	0.49

Note: The first decile represents the largest farms and the tenth decile represents the smallest farms.

Table 4.6 Standard Deviation of Five-Year Averages Used for σ-convergence

Observation Year	Value of Farm Production	Total Acres	Economic Total Expense Ratio	Profit Margin Ratio	Asset Turnover Ratio	Percent of Livestock Income
1973-1977	54,067.19	454.31	0.15	0.08	0.03	0.07
1974-1978	55,357.68	443.66	0.18	0.09	0.03	0.06
1975-1979	64,388.04	500.16	0.18	0.10	0.03	0.06
1976-1980	66,802.20	503.27	0.19	0.10	0.03	0.06
1977-1981	70,163.05	514.95	0.19	0.09	0.03	0.05
1978-1982	76,784.69	530.05	0.23	0.11	0.03	0.04
1979-1983	77,072.36	510.43	0.25	0.12	0.03	0.03
1980-1984	81,864.57	534.20	0.30	0.13	0.04	0.04
1981-1985	89,541.99	588.79	0.31	0.14	0.04	0.06
1982-1986	93,323.51	578.63	0.29	0.14	0.04	0.03
1983-1987	92,787.52	614.93	0.28	0.14	0.04	0.05
1984-1988	101,736.79	615.71	0.27	0.15	0.04	0.05
1985-1989	109,557.71	623.83	0.25	0.15	0.04	0.06
1986-1990	111,481.48	623.95	0.26	0.15	0.05	0.06
1987-1991	113,341.17	646.13	0.23	0.14	0.04	0.05
1988-1992	117,499.48	671.61	0.25	0.16	0.05	0.05
1989-1993	117,110.61	693.79	0.26	0.16	0.05	0.04
1990-1994	120,183.37	704.87	0.27	0.17	0.05	0.04
1991-1995	124,382.71	723.32	0.29	0.18	0.06	0.05
1992-1996	134,182.09	679.53	0.32	0.19	0.07	0.05
1993-1997	144,676.26	693.82	0.33	0.19	0.08	0.07
1994-1998	145,719.09	701.12	0.36	0.20	0.08	0.06
1995-1999	155,071.00	715.37	0.34	0.20	0.08	0.05
1996-2000	162,285.00	762.60	0.32	0.18	0.08	0.05
1997-2001	169,510.84	777.78	0.34	0.19	0.08	0.06
1998-2002	166,492.60	808.73	0.37	0.21	0.08	0.05
1999-2003	169,025.25	845.33	0.34	0.20	0.08	0.05
2000-2004	174,716.43	828.49	0.35	0.20	0.08	0.05
2001-2005	189,421.78	831.68	0.33	0.19	0.08	0.05
2002-2006	223,746.33	857.13	0.36	0.21	0.08	0.05
2003-2007	260,777.81	877.27	0.37	0.22	0.08	0.06

CHAPTER 5 - Results

5.1 Introduction

This chapter discusses the results of this thesis. Results pertaining to trend regressions on the means and the difference in the top and bottom quartiles will be discussed along with convergence results. The organization of this chapter is as follows. Section 5.2 presents growth rates calculated using five-year averages of six key variables. Section 5.3 also presents growth rates but calculated using the difference of each variable between the top and bottom value of farm production quartiles. Section 5.4 discusses the convergence results and Section 5.5 concludes with supporting evidence found in graphical depictions of key measures.

5.2 Trend Regressions

Exponential trends were estimated to determine the growth rate by regressing the appropriate variable on time (years). Six variables were used: value of farm production, total acres, economic total expense ratio, operating profit margin ratio, asset turnover ratio, and percent of livestock income. Table 5.1 presents the estimated growth rates and presents the significance levels of the parameters used to compute the growth rates. If a positive sign is reported for the growth rate, it indicates the variable is growing over time. If a negative sign is reported, the variable is decreasing over time. Growth rates computed from exponential trends can be interpreted as percentages.

Table 5.1 Growth Rates Calculated Using Trend Regressions

Characteristic	Growth Rate
Value of Farm Production	0.034579 ***
Total Acres	0.011167 ***
Economic Total Expense Ratio	-0.011842 ***
Operating Profit Margin Ratio	-0.024984 ***
Asset Turnover Ratio	0.016081 ***
Percent of Livestock Income	-0.017525 ***
PCE Price Index	0.037137 ***

Note: One astrick denotes significance at the 10% level, two astricks denote significance at the 5% level, and three astricks denote significance at the 1% level (one tailed test).

All six variables had growth rates that were statistically significant at the one percent significance level. Value of farm production had a growth rate of 0.0346. This is interpreted as value of farm production increasing 3.46 percent a year. To see the effects of inflation, a trend regression was run on the Personal Consumption Expenditures (PCE) Price Index (Federal Reserve Bank of St. Louis) to obtain the inflation rate. The growth rate for inflation was 0.0371 and was statistically significant at the one percent significance level. The price index closely mimics the value of farm production growth rate. We can see that the PCE price index growth rate is rising slightly faster than the value of farm production growth rate indicating that the real growth rate in value of farm production was slightly negative. Total acres also produced a positive growth rate of 0.0112 or 1.12 percent per year. Thus, average total acres are increasing over time. Referring back to Table 4.2, the beginning period average total acres were 1,369 and the ending period average total acres were 1,873.

The growth rate for the economic total expense ratio was a negative 0.0118. This indicates the economic total expense ratio is getting closer to a value of one over time. When the value of this ratio is one or below, farms are earning an economic profit. The operating profit margin ratio yielded a negative growth rate of -0.0250. Over time, the average profit margin of the farms included in this study has decreased. This may be explained by noting that the beginning period exhibited relatively high performance. The asset turnover ratio variable had a growth rate of 0.0161. This indicates the average asset turnover ratio is getting larger over-time and farms are utilizing their assets more effectively. Looking back at Table 4.3 we can see the average asset turnover ratio was 0.210 in the beginning period and 0.299 in the ending period. The growth rate of the

percent of livestock income variable was a negative 0.0175. The average percent of livestock income in the 1970's was 51 percent. In the 1980's and 1990's respectively, the average percent of livestock income was 49 percent and 38 percent. In the 2000's, the average percent of livestock income variable was 34 percent.

Growth rates using average values for each five-year snapshot were calculated as a beginning stage to looking at farm structure over time. From these results it is evident that acreage per farm is increasing, farms today are doing a better job of covering all economic costs, the profit margin per farm is decreasing, farms are utilizing their assets more effectively, and the percent of livestock income per farm is decreasing. It is worth noting that the profit margin ratio and the economic total expense ratio are not measured with the same costs. The profit margin ratio excludes the opportunity cost on equity in its calculation.

5.3 Trend Regression on the Difference Between the Top and Bottom Quartiles

Trend regressions were also used to estimate the growth rates for the difference between the average values of the top and bottom value of farm production quartiles. To obtain the quartiles, the data were sorted by value of farm production with the farms having the highest values in the top quartile. Table 5.2 presents the growth rates and significance levels of the parameters used to compute the growth rates. Exponential trend regressions were used to determine growth rates for each variable. A linear trend

Table 5.2 Growth Rates Calculated in Trend Regressions From Differences in Top and Bottom Quartiles of Farm Characteristics

Characteristic	Growth Rate
Value of Farm Production	0.044523 ***
Total Acres	0.021298 ***
Economic Total Expense Ratio	0.017539 ***
Operating Profit Margin Ratio	0.042360 ***
Asset Turnover Ratio	0.028089 ***
Percent of Livestock Income	-0.002316

Note: One astrick denotes significance at the 10% level, two astricks denote significance at the 5% level, and three astricks denote significance at the 1% level (one tailed test).

regression was performed on the percent of livestock income variable. This was done because the percent of livestock income variable was negative in certain years. It is not possible to take the natural log of a negative number. If a positive sign is reported for the growth rates, the difference between the top and bottom quartiles is growing. If the sign is negative, the difference between the quartiles is shrinking.

Value of farm production showed a growth rate of 0.0445. This value was significant at the one percent significance level. This indicates that the difference between the top and bottom quartiles is widening for this variable. Total acres also showed a positive growth rate of 0.0210 indicating that the gap between the top and bottom quartiles is also widening. This variable was also significant at the one percent significance level. By looking at the data in Table 4.4, it is evident that total acres in the top quartiles has increased substantially over time. Total acres in the bottom quartile has fluctuated, but mainly remained the same. The positive growth rate on total acres is the result of these trends for the top and bottom value of farm production quartiles.

The economic total expense ratio yielded a growth rate of 0.0175. This variable was also significant at the one percent significant level. Again, the difference between the top and bottom quartiles is widening. Referring back to Table 4.4, the average economic total expense ratio decreases for farms in the top quartile from the beginning to the ending period. When looking at just the beginning and ending period of the bottom quartile, the economic total expense ratio increases. This supports the findings of a positive growth rate for the economic total expense ratio and indicates economies of size are increasingly prevalent.

The operating profit margin ratio had a positive growth rate of 0.0424, indicating that the gap between the top and bottom quartiles is widening. This variable was also significant at the one percent significance level. Table 4.4 indicates that farms in the bottom quartile have positive profit margins until the period of 1979-1983. After this time period, the operating profit margin is negative for the bottom quartile. This trend in the profit margin for the bottom quartile is driving the widening of the difference in this ratio.

The asset turnover ratio had a positive growth rate of 0.0281 and was statistically significant at the one percent significance level. The farms in the top quartile are generating higher asset turnover ratios over time while the farms in the bottom quartile are generating lower asset turnover ratios over time. These phenomena are contributing to the widening between quartiles and the positive growth rate. The last variable studied, percent of livestock income, had an insignificant growth rate in the difference of this variable between the top and bottom quartiles. This variable had a corresponding p-value of 0.0787.

By looking at the results above, we are beginning to see evidence of divergence in the farming sector. Evidence suggests that the gap between the top and bottom quartiles of all significant variables was widening.

5.4 Convergence Analysis

Convergence analysis was conducted to help answer the question, "Are small farms catching up with large farms?" Data were sorted by value of farm production and broken into deciles. Six variables were used to study convergence; value of farm production, total acres, economic total expense ratio, operating profit margin ratio, asset

turnover ratio, and percent of livestock income ratio. Two types of convergence were used to examine farm structure; β-convergence and σ-convergence. These two ways of analyzing convergence will be discussed below.

5.4.1 β-convergence

β-convergence is analyzed by regressing the growth rate of the six different variables listed above on the initial level of value of farm production for each value of farm production decile. Table 5.3 presents the growth rates and significance levels used to calculate β-convergence for each value of farm production decile. The growth rates calculated from exponential trend regressions can be interpreted as percentages. Exponential trend regression was used for all but the operating profit margin ratio where linear regression was used. A linear regression was used because the operating profit margin ratio becomes negative in later deciles. It is not possible to take the natural log of a negative number. The first decile represents the largest farms. The growth rate for value of farm production, total acres, profit margin ratio, and percent of livestock income growth rates are consistently significant for all deciles.

The growth rates presented in Table 5.3 were used to generate the results in Table 5.4 which presents the estimated functions used to determine β-convergence. If the initial level of value of farm production variable is negatively related to the growth rate for each variable, smaller farms are catching up with larger farms and convergence is

Table 5.3 Growth Rates Used to Calculate β-Convergence

Deciles	Value of Farm Production	Total Acres	Economic Total Exp. Ratio	Profit Margin Ratio[a]	Asset Turnover Ratio	% Livestock Income
1st	0.04145***	0.01663***	-0.01218***	-0.01027***	0.01632***	-0.00735**
2nd	0.03755***	0.01250***	-0.01263***	-0.01539***	0.01884***	-0.02437***
3rd	0.03662***	0.01413***	-0.01222***	-0.02282***	0.01862***	-0.02422***
4th	0.03477***	0.00952***	-0.01295***	-0.02302***	0.01949***	-0.02821***
5th	0.03304***	0.01168***	-0.01322***	-0.02847***	0.01973***	-0.01793***
6th	0.03102***	0.01109***	-0.01190***	-0.04408***	0.01684***	-0.02282***
7th	0.02759***	0.01143***	-0.00899***	0.31623***	0.01051***	-0.02096***
8th	0.02404***	0.00481***	-0.00704***	-0.02789***	0.00777**	-0.01223***
9th	0.01881***	0.00555***	-0.00338*	0.09621***	0.00010	-0.00925***
10th	0.00815***	-0.00266**	0.00197	0.07907***	-0.00952***	-0.00509**

Note: The first decile represents the largest farms and the tenth decile represents the smallest farms. One asterisk denotes significance at the 10% level , two asterisks denote significanceat the 5% level, and three asterisks denote significance at the 1% level (one tailed test).

[a]Statistically significance is based on the β coefficient in the linear regression.

Table 5.4 Estimated Functions to Determine β-Convergence

Independent Variable	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]	Model 6[f]
$Intercept_t$	0.01677 ***	0.00286	-0.00452	0.00303	0.08897	-0.01664 **
	(0.00287)	(0.26176)	(0.12607)	(0.58058)	(0.22695)	(0.01383)
VFP_t	1.47248E-07 ***	7.76528E-08 **	-5.55941E-08 *	1.03833E-07 *	-6.69553E-07	-7.06732E-09
	(0.00611)	(0.01149)	(0.07022)	(0.08535)	(0.35620)	(0.89785)

Note: The p-values are in parentheses. One asterisk denotes significance at the 10% level , two asterisks denote significance at the 5% level, and three asterisks denote significance at the 1% level (one tailed test).

[a]Model 1 = Growth Rate of Value of Farm Production regressed on initial Value of Farm Production

[b]Model 2 =Growth Rate of Total Acres regressed on initial Value of Farm Production

[c]Model 3 = Growth Rate of Economic Total Expense Ratio regresed on initial Value of Farm Production

[d]Model 4 = Growth Rate of Asset Turnover Ratio regressed on initial Value of Farm Production

[e]Model 5 = Growth Rate of Profit Margin Ratio regressed on initial Value of Farm Production

[f]Model 6 = Growth Rate of Percent Livestock Income regressed on initial Value of Farm Production

occurring. If the initial level of value of farm production variable has a positive sign, divergence is occurring. Divergence means larger farms are growing faster than smaller farms. The initial level of value of farm production variable for Model 1 was positive and statistically significant at the one percent significance level. This suggests that larger farms were growing faster than smaller farms. Similarly, the value of farm production variable in Model 2, which examines growth rates for total acres, was statistically significant at the five percent significance level. This result is consistent with the results for value of farm production; divergence is occurring in the farming sector.

The value of farm production variable in Model 3, which examines the economic total expense ratio, was statistically significant at the ten percent significance level. This is consistent with the notion that larger farms are improving relative to smaller farms, indicating that the gap in performance is widening between the two groups of farms. A lower economic total expense ratio is more desirable, thus divergence is evident with this ratio. The results in Model 4 are consistent with those of Model 3 and suggest that divergence in performance is occurring for the sample of farms studied. Models 5 and 6 were not statistically significant. These models used the growth rates of the operating profit margin ratio and the percent of livestock income variable.

5.4.2 σ-convergence

Evidence of σ-convergence is found by regressing the standard deviation of each of the six key variables listed on time. By studying σ-convergence, we will be able to determine if the difference between the deciles is growing or narrowing. If a negative sign on the time coefficient is found, the standard deviation between the groups is getting

smaller. This signifies convergence. If the relationship is positive, the standard deviation is growing between the deciles and divergence is occurring. Table 5.5 presents the σ-convergence results.

The time variable in Model 1 was statistically significant at the one percent significance level and yielded a positive sign. This means that according to the value of farm production measure, the standard deviation is growing between the value of farm production deciles and divergence is occurring. Model 2 also finds evidence of divergence. This model is statistically significant at the one percent significant level. The same results are true of models 3, 4, and 5. All have positive coefficient values and are statistically significant at the one percent significance level. These three models examine σ-convergence for the economic total expense ratio, operating profit margin ratio, and asset turnover ratio. In all three models, the dispersion of the standard deviation is growing. Model 6, which uses the standard deviation of percent of livestock income as the dependent variable was not statistically significant.

Table 5.5 Estimated Functions to Determine σ-Convergence

Independent Variable	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Model 5[e]	Model 6[f]
$Intercept_t$	39,348.52***	441.93***	0.18607***	0.08903***	0.02065***	0.05005***
	(<.00010)	(<.00010)	(<.00010)	(<.00010)	(<.00010)	(<.00010)
$time_t$	5,268.68***	13.62***	0.00603***	0.00427***	0.00215***	0.00011
	(<.00010)	(<.00010)	(<.00010)	(<.00010)	(<.00010)	(0.59123)

Note: The p-values are in parentheses. One asterisk denotes significance at the 10% level , two asterisks denote significance at the 5% level, and three asterisks denote significance at the 1% level (one tailed test).

[a]Model 1 = Standard Deviation of Value of Farm Production regressed on time

[b]Model 2 = Standard Deviaton of Total Acres regressed on time

[c]Model 3 = Standard Deviation of Economic Total Expense Ratio regressed on time

[d]Model 4 = Standard Deviation of the Profit Margin Ratio regressed on time

[e]Model 5 = Standard Deviation of the Asset Turnover Ratio regressed on time

[f]Model 6 = Standard Deviation of the Percent of Livestock Income regressed on time

5.5 Graphical Depiction of Results

Divergence in the farming sector is supported by looking at Figures 5.1, 5.2, 5.3, 5.4, and 5.5. In Figure 5.1, total acres were plotted against time for each decile. It is evident that total acres for the top deciles are increasing over time while total acres for the bottom decile is remaining relatively constant. This is consistent with the results presented above. The larger farms are growing faster than the smaller farms and the standard deviation between the deciles is growing.

In Figure 5.2, the economic total expense ratio was plotted against time. It is clear that over time, the gap between the top and bottom decile is widening. Here, divergence in economies of size is evident. Figure 5.3 plots the operating profit margin ratio against time. From Figure 5.3, it is evident that the bottom quartile of farms is doing continually worse over the years. For this variable, it is not so much that the top deciles of farms are doing better; it is that the bottom deciles are doing worse. These results are also consistent with the findings above; the standard deviation between the deciles is growing. Turning to Figure 5.4, the asset turnover ratio plotted against time seems to also exhibit signs of divergence. Here it can be seen that the asset turnover ratio for the top decile is growing over time and the asset turnover ratio for the bottom decile is decreasing over time. Farms in the top five deciles seem to be doing a better job of efficiently utilizing their assets. Again, the findings in this figure are consistent with the results presented above. The last decile graph presented, Figure 5.5, plots the percent of livestock income variable against time. From this figure, it is easy to see why β-convergence and σ-convergence were not found to be statistically significant. Over time,

the average farm's percent of livestock income varies, thus not producing consistent results. Divergence or convergence is not evident by looking at this figure.

Results presented in previous sections of this chapter are also supported by turning to economies of size presented in Figures 5.6 through 5.12. Here, the economic total expense ratio was plotted against value of farm production for seven different time periods; 1973-1977, 1978-1982, 1983-1987, 1988-1992, 1993-1997, 1998-2002, and 2003-2007. Several conclusions can be drawn by looking at these figures. First, there is evidence of a tightening up effect for larger farms in recent years. Second, it is apparent that smaller farms are doing a lot worse at covering their economic costs today than they were at the beginning of the study period. In Figure 5.6, the highest economic total expense ratio was just above 3.5. In Figure 5.12, the highest economic total expense ratio exceeded 4.5. These figures support the findings above and emphasis the importance of studying economies of size.

Figure 5.1 Total Acres

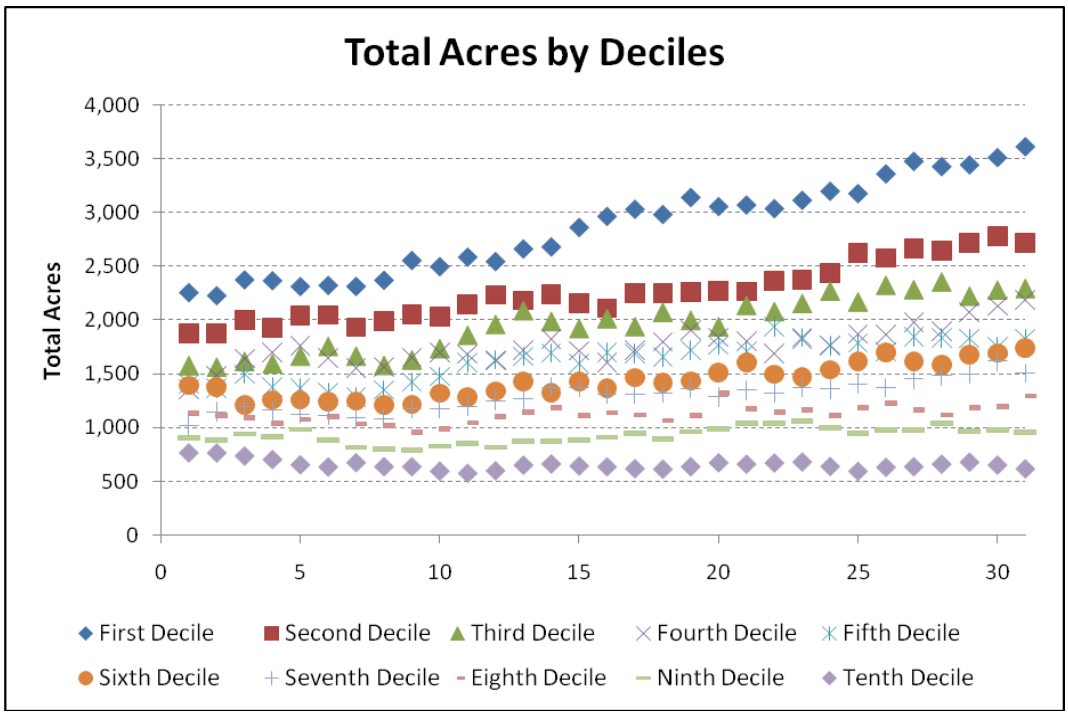


Figure 5.2 Economic Total Expense Ratio

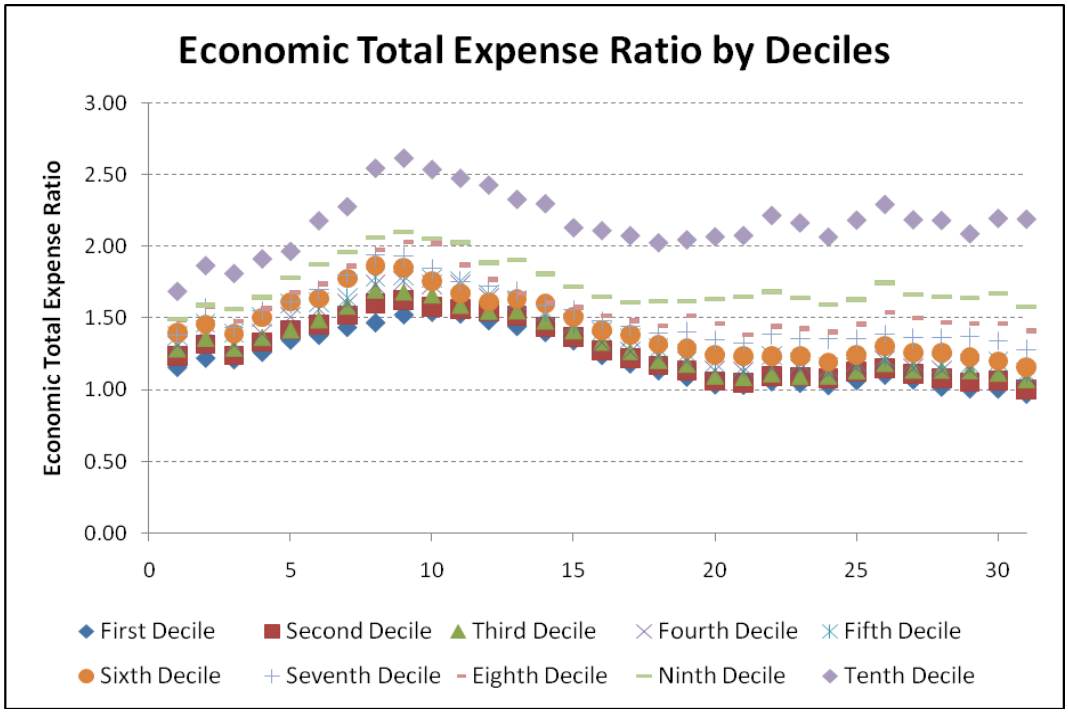


Figure 5.3 Operating Profit Margin Ratio

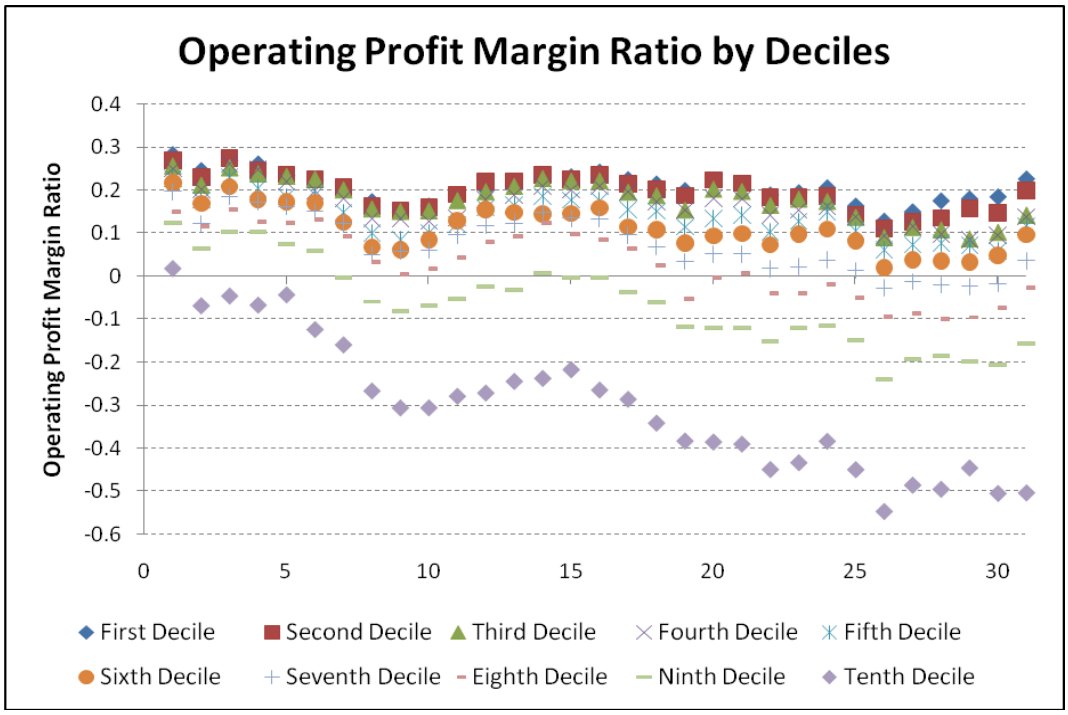


Figure 5.4 Asset Turnover Ratio

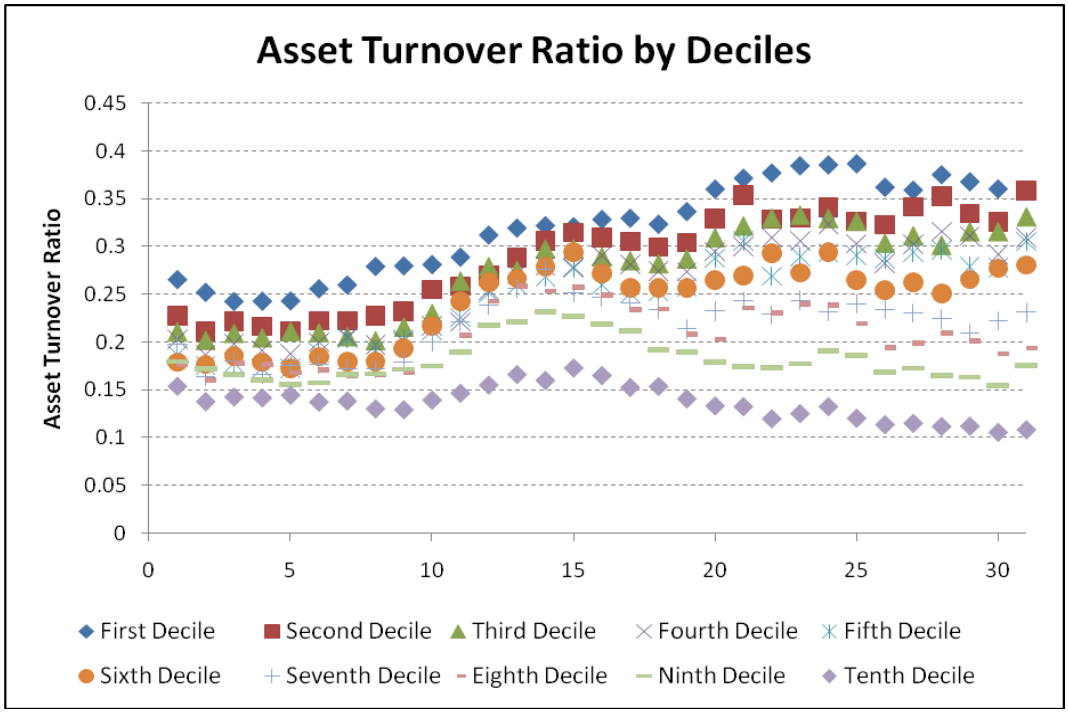


Figure 5.5 Percent of Livestock Income

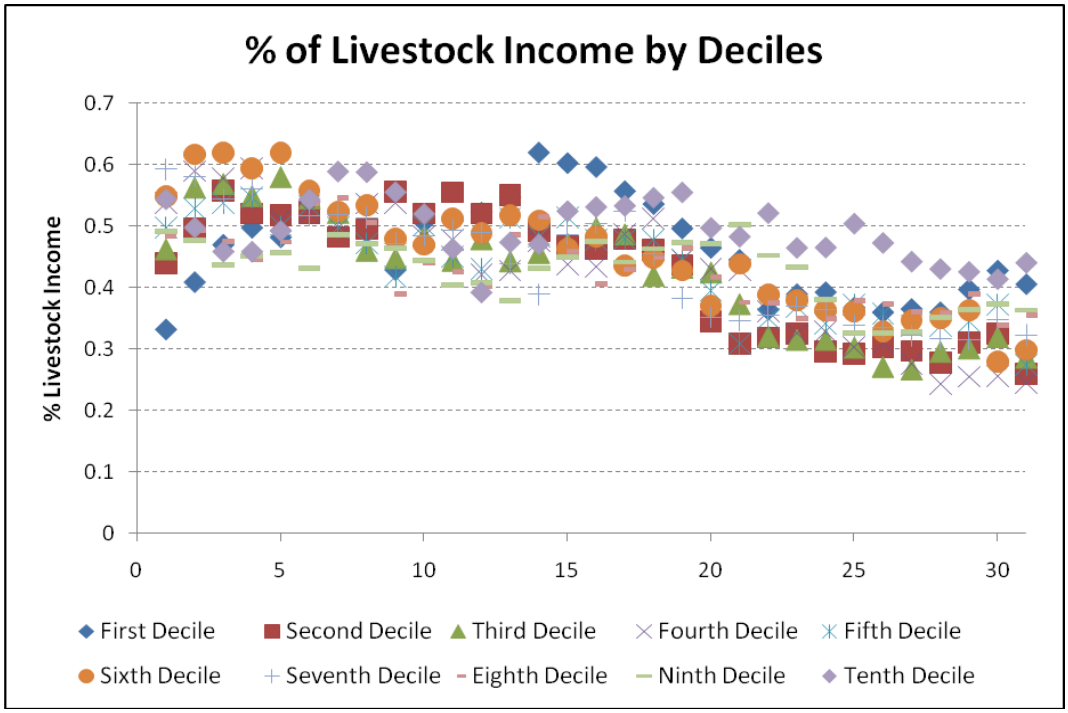


Figure 5.6 Economies of Size, 1973-1977

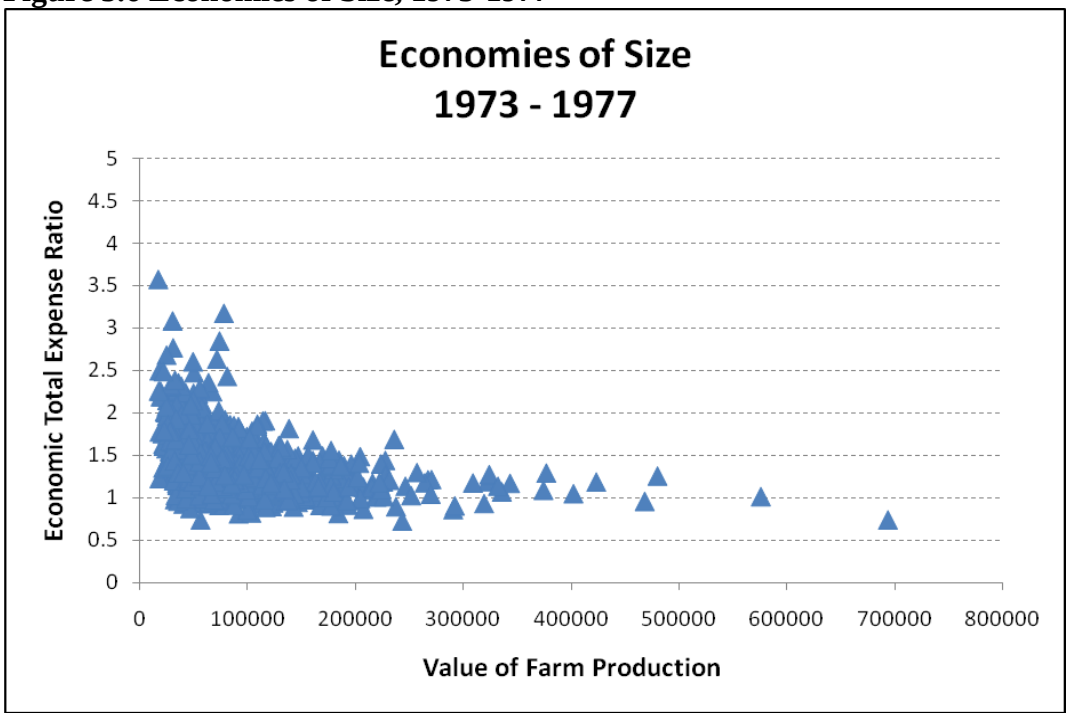


Figure 5.7 Economies of Size, 1978-1982

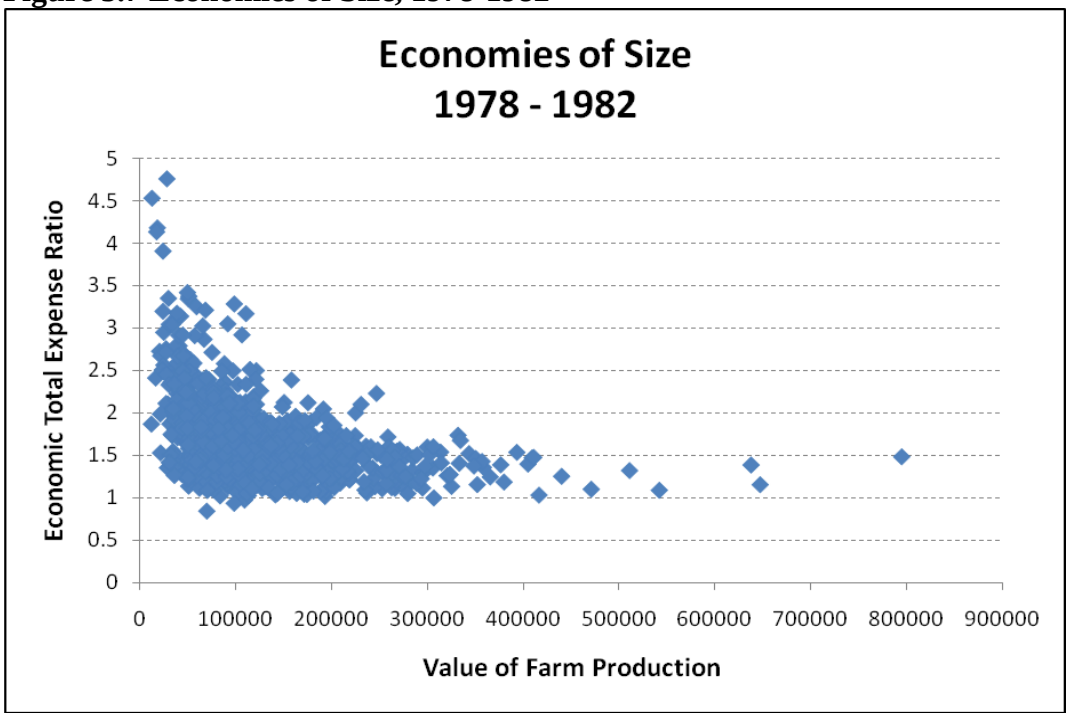


Figure 5.8 Economies of Size, 1983-1987

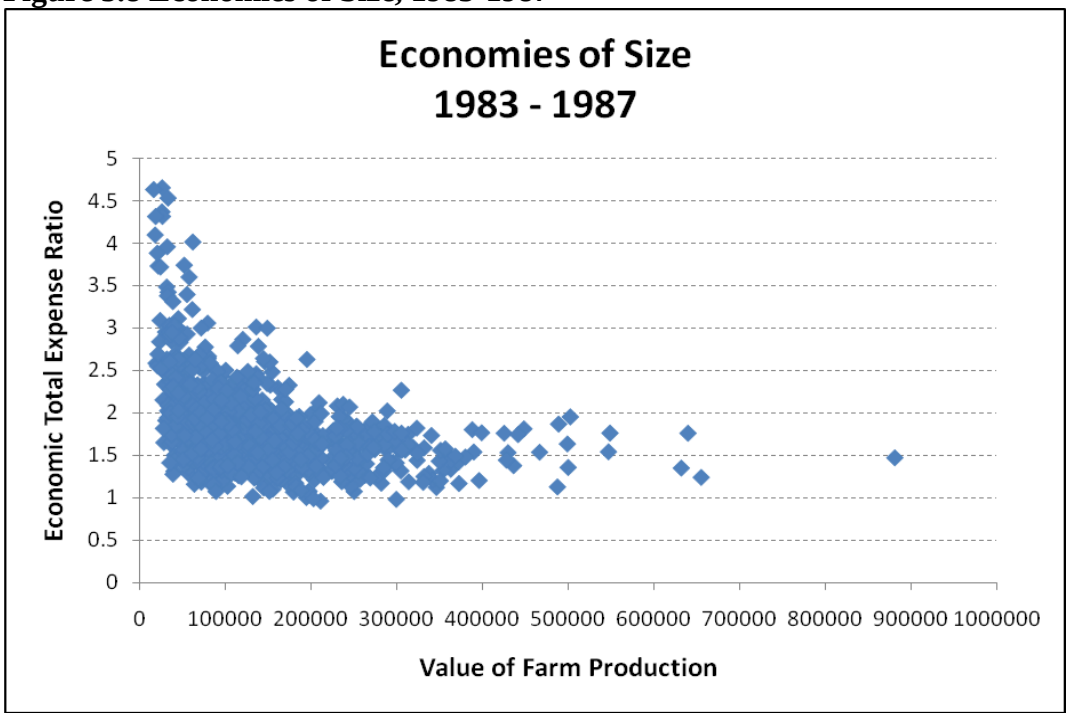


Figure 5.9 Economies of Size, 1988-1992

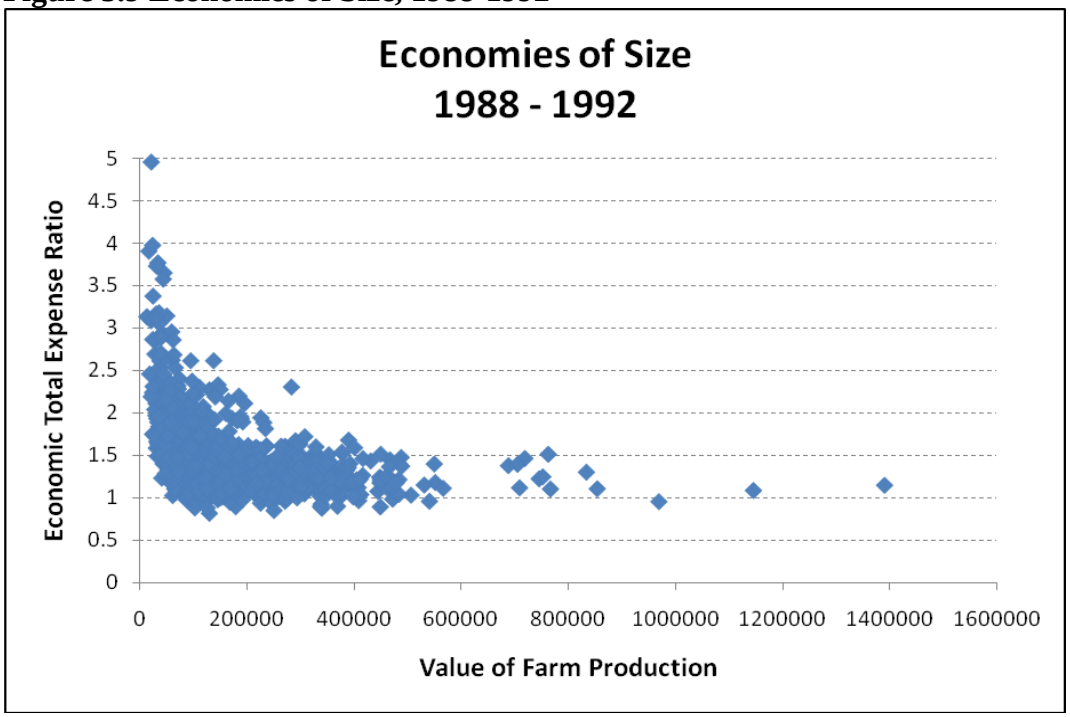


Figure 5.10 Economies of Size, 1993-1997

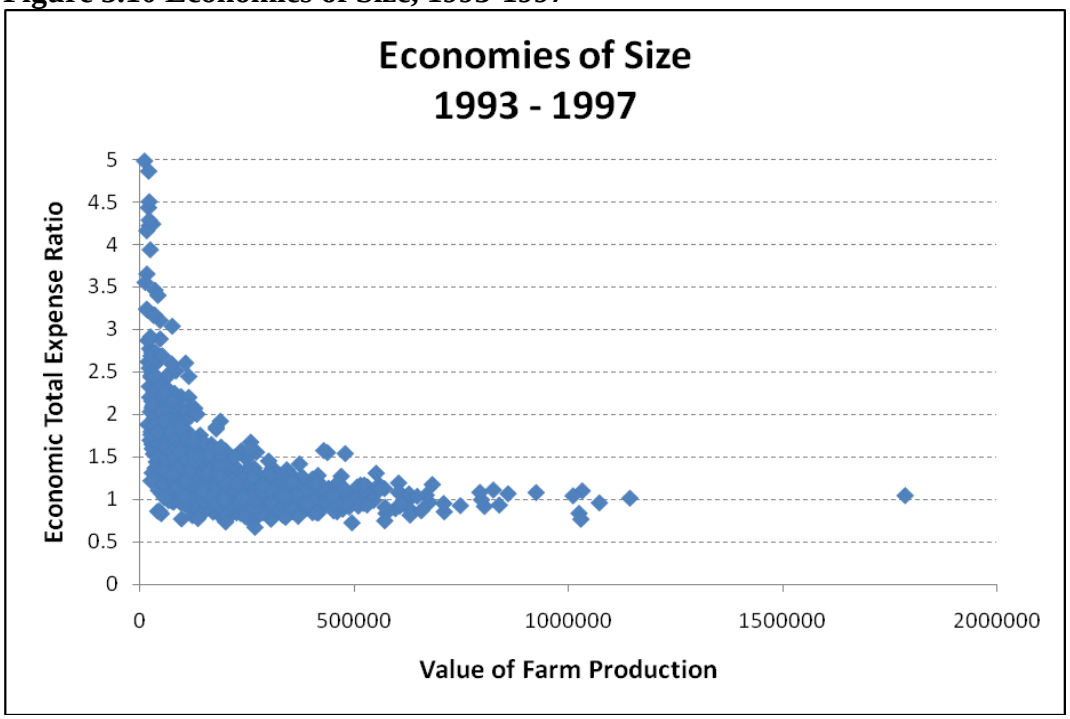


Figure 5.11 Economies of Size, 1998-2002

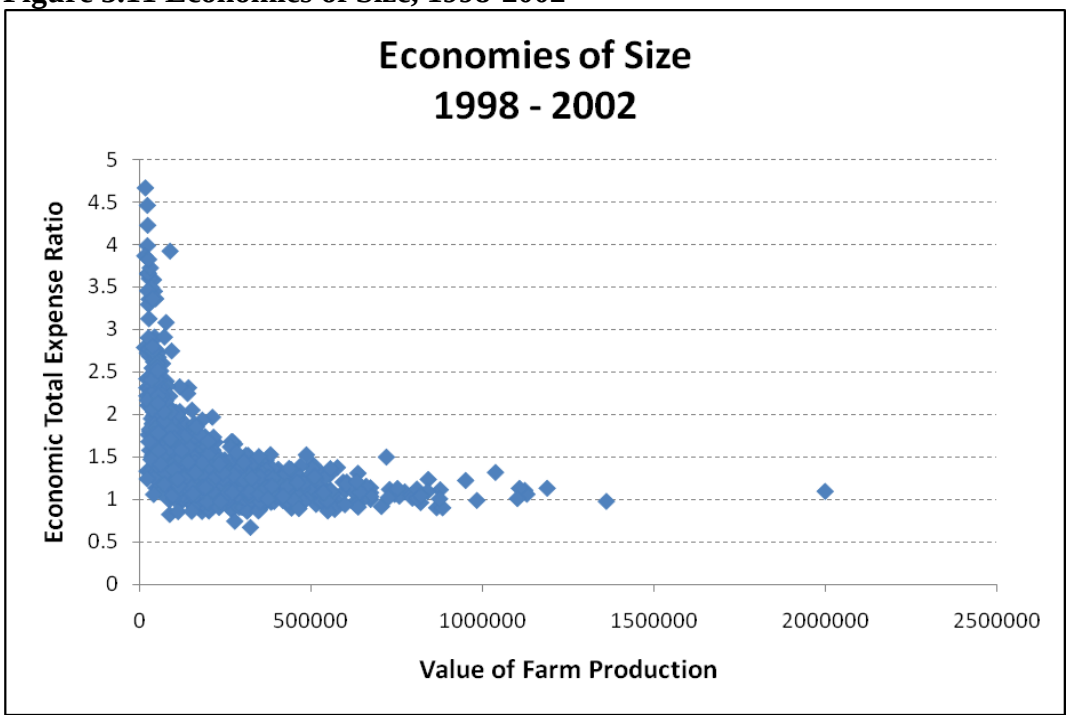
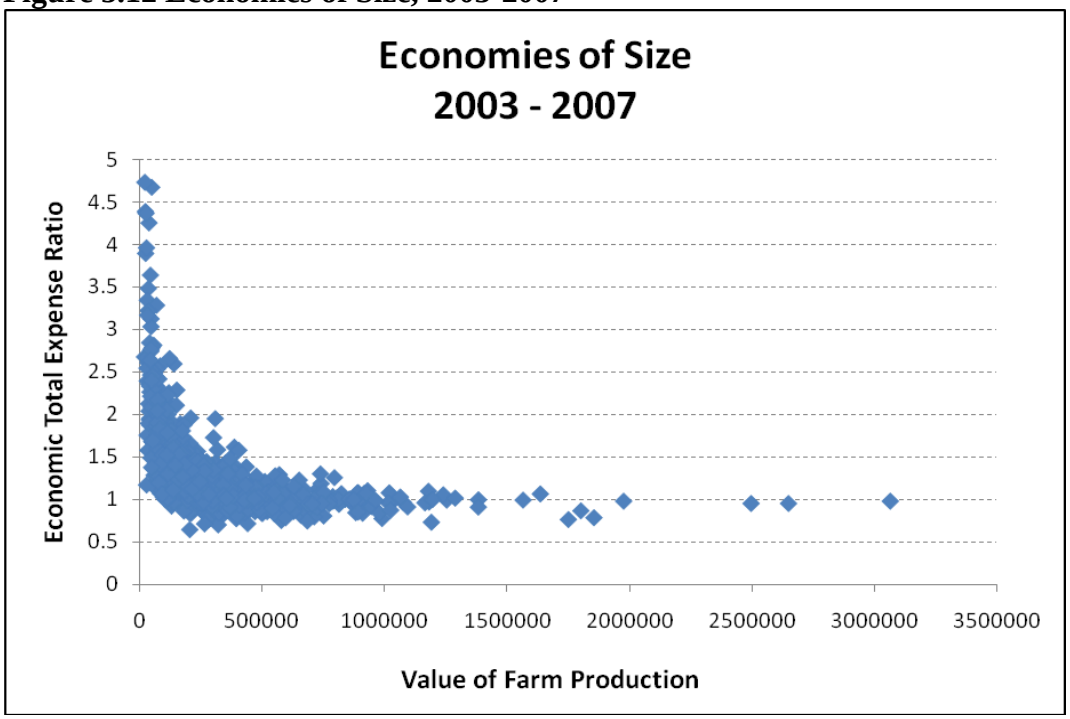


Figure 5.12 Economies of Size, 2003-2007



CHAPTER 6 - Conclusions

6.1 Introduction

To understand the present agriculture situation, we must look at the past. In this thesis, the structure of Kansas farms was studied starting in 1973 and ending in 2007. By looking back, this thesis helped to document the change that is happening in the agriculture sector today. Change in farm structure was analyzed using five-year moving averages from 1973 to 2007. Trends and differences in farm size and financial performance were analyzed. Key ratios were studied to determine if economies of size are prevalent in the agriculture industry and whether the economies of size are becoming more or less prevalent.

6.2 Summary

The primary objective of this thesis was to document the changing Kansas farm structure over time. The Kansas Farm Management Data Bank provided the data used in this study. To be included in the study, a farm had to have five-years of continuous, usable data for a five-year period between 1973 and 2007. Moving five-year averages were calculated for each farm that met this qualification. This created snapshots in time. Data were broken into quartiles and deciles using value of farm production to categorize the farms. Data in quartiles were used for trend regressions to determine growth rates of key variables and to examine differences in the performance of top and bottom value of farm production quartiles. Value of farm production deciles were used for convergence analysis.

The analysis focused on six key measures; value of farm production, total acres, economic total expense ratio, asset turnover ratio, operating profit margin ratio, and percent of livestock income. These variables represent size measures, performance measures, and enterprise specialization. Value of farm production equals the sum of livestock, crop, and other income computed on an accrual basis minus feed purchased. Total acres are a culmination of all crop and pasture acres, rented and owned. The economic total expense ratio is calculated by dividing total economic cost by value of farm production. The asset turnover ratio is calculated by taking value of farm production and dividing it by total assets. The operating profit margin ratio is a measure of financial performance and is calculated as net farm income plus interest expense minus unpaid family and operator labor, divided by value of farm production. Percent of livestock income is simply total livestock income divided by value of farm production.

Results pertaining to the growth rates of the key variables suggest that acreage per farm has increased, farms are doing a better job of covering their total economic costs, the profit margin per farm has decreased, farms are utilizing their assets more effectively, and the percent of livestock income per farm has decreased. When examining the difference between the top and bottom value of farm production quartiles, it was evident that the gap between the top and bottom quartiles has widened for value of farm production, total acres, the economic total expense ratio, the operating profit margin ratio, and the asset turnover ratio.

Two types of convergence were used to examine farm structure. The β-convergence results indicated that divergence is happening in the farming sector. In other words, larger farms are growing faster or performing relatively better than smaller farms.

These results support the evidence found when calculating growth rates. σ-convergence is found by regressing the standard deviation of each of the six variables on time. The results showed that all statistically significant variables found evidence of divergence, or the standard deviation growing between the value of farm production deciles. All variables were statistically significant in studying σ-convergence except percent of livestock income.

To further support the conclusions, graphical depictions of the results were generated. By looking at Figures 5.1 through 5.5, divergence is evident. The figures make it clear to see that farms in the top deciles are continuing to improve their financial performance and are growing their operation over time, while the bottom decile of farms is continuing to do worse or stay the same. Figures 5.6 through 5.12 reinforce the idea of smaller farms continuing to do a worse job at covering all of their costs.

6.3 Suggestions for Future Work and Limitations

This study encompassed a thirty-five year period, having an average of 1,243 farms in each five-year period. Other variables could have been used to study and evaluate changes in farm structure besides the six major ones used here. For example, interesting results could be obtained through the examination of trends in specific crops or the crop mix. It is evident from the results that it is becoming increasingly difficult for small farms to remain competitive. Additional research into the theory of why this is happening would be relevant. This thesis has laid the foundation for the examination of additional variables. The analysis could also easily be duplicated or extended to encompass future years.

One area that could have been enhanced was the convergence analysis. Instead of using deciles to break the data apart, a more accurate way would have been to break the data into percentiles. This would have allowed for more variation among farms and may have resulted in a more accurate depiction of convergence and divergence.

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