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Determinants of Farm Size in U.S. Row Crops

Randy H. Scollan
Southern Illinois University Carbondale, randyhan7@gmail.com

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DETERMINANTS OF FARM SIZE IN U.S. ROW CROPS

by

Randy Scollan

B.A., Eastern Illinois University, 2009

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Agribusiness Economics
Southern Illinois University Carbondale
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RESEARCH PAPER APPROVAL

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Approved by:

Dwight R. Sanders

Graduate School
Southern Illinois University Carbondale
September 2, 2011

AN ABSTRACT OF THE RESEARCH PAPER OF

Randy Scollan, For the Master of Science in Agribusiness Economics.

TITLE: DETEMINANTS OF FARM SIZE IN U.S. ROW CROPS

MAJOR PROFESSOR: Dr. Dwight R. Sanders

Agriculture in America has become precariously dependent on energy. Agriculture accounts for 17% of the total U.S. energy budget making it the single largest consumer of petroleum products as compared to other industries. The U.S. military, in all of its operations, uses about half that amount. About 350 gallons (1,500 liters) of oil equivalents are required to feed each American each year, and every calorie of food produced requires, on average, ten calories of fossil-fuel inputs. This is a food system profoundly vulnerable, at every level, to fuel shortages and oil price shocks. This study explores the relationship between producer input costs using ten major US row crop production budgets and their corresponding farm sizes so that, with the implications of the results, Illinois soybean producers might make better decisions about the scale of their operations considering the immense financial and operational risk producers are facing.

ACKNOWLEDGEMENTS

The Illinois Soybean Association (ISA) funded this research paper in order to derive implications for Illinois Soybean producers. It is with gratitude and thankfulness that this study is presented for the review of and use by the ISA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

According to a report by the U.S. Labor Department, wholesale food prices for the month of February, 2011, rose 1.6% marking the largest one month increase in 36 years. Headlines like these come as little surprise anymore since the frequency in which we hear them seems to have grown in recent years. Along with price increases, geopolitical uprisings around the globe are mounting at a breakneck pace due to soaring food costs and oppressive governments. Additionally, the seemingly endless occurrences of huge natural disasters are rocking countries all around the world during a period in world history when nations are desperately looking for recovery from the Financial Crisis of 2008. Global GDP growth is starting to sputter along while the bulls on Wall Street are riding the Dow Jones to impressive levels. Still, there is an eerie sense that while the global economy is trying to muster up every ounce of hope it can, the fundamentals of supply and demand are not necessarily helping our case. For instance, US grain reserves are at their lowest levels in 15 years, according to a recent Wall Street Journal article. (Henshaw, 2011) Not only are grain supplies low but the outlook for global oil supply does not look good either. According to the International Energy Agency's Chief Economist, Fatih Birol, in a statement made in 2008, forecasted global oil production to decline at the rate of 6.7% annually. (Connor, 2009) While it is prudent to note that global oil supply estimates differ vastly depending on whom you ask, it is nonetheless sobering to know that even if a fraction of their forecast is correct, there are many implications for the global economy that run wide and deep, not the least of which is the production of agriculture.

It is at this intersection of current financial, political, and economic factors that this study aims to begin. The U.S. agriculture industry, and in particular the Illinois soybean industry, finds itself in an uncanny position that brings with it much uncertainty due to heightened risk but also an element of excitement due to the prospect of new opportunity. The U.S. produced 3.359 billion bushels of soybeans in 2010, 43% of which was exported and over one-half of the exports were shipped to China. Despite a relatively large U.S. crop and record production out of South America, U.S. soybean prices have remained historically high with an average farm price near $9.75 for the 2010 crop. At the same time, producers have faced diesel fuel prices that ranged from a low of $2.75 to a high of nearly $4.50 per gallon. Collectively, these output and input price swings paint a picture of a financially risky production environment that may favor producers who are large enough to manage fluctuating prices and potentially gain privileged market access. Likewise, larger producers may be able to obtain an optimum capital structure (i.e., outside debt or equity investors) that prove to be advantageous in achieving economies of scale. As the Illinois soybean industry evolves, it will be important to understand the eventual structure that may emerge (number of firms and their average size). In particular, it is important to know if the trend towards larger individual producer units (not necessarily land owners) will continue in the coming years. As illustrated in Figure 1 and Figure 2, Illinois farm size has increased markedly over the past 60 years while the number of total farms has decreased. It is possible that today's marketplace--characterized by high input costs and an export-driven market--may require even greater producer concentration (fewer and larger producers), which can impact rural communities, input suppliers, down-stream industries, and producer groups.

REVIEW OF LITERATURE

With regards to farm size, authors have taken several avenues of research. Some argue that perhaps smaller farm size of better due to the ecological benefits and not so much the economic viability. One study ultimately presents a case for policy instruments that encourage sustainable small scale farming. (Nuppenau, 2009) The author suggest a energy use tax on large scale farms and a recycling subsidy for small scale farmers with the hopes of the direct effect of impacting technology/capital choices and promoting recycling. The indirect effects of these tax and subsidy policies would shift farm structure and land use to promote a more diverse balance of large and small farms. In conclusion, sustainability versus viability is a controversial topic that can reference low-cost high-volume commercial production agriculture as non-ecological although it still makes the most economic sense. However, in light of scarcer energy and climate change, this blend of policies of to integrate more small farmers into agriculture is worth considering for its ecological economic viability (Nuppenau, 2009) .

Other authors have looked to explore optimal farm size from an efficiency standpoint. In Bousemart's 2006 study of optimal farm size in the Estonian dairy industry, he concludes that smaller farms are not as efficient but that efficiency is also dependent on production methods independent of farm size. The analysis of the results of a panel of 170 dairy farms from the Estonian Farm Accountancy Data Network (FADN) allows measurement of economies of scale on a sample where there is great size variation between farms. In a synthesis of studies carried out in six transitional countries, researchers demonstrated that the estimate of economies of scale depended on the countries and production orientation in each country. (Bousemart, 2006) The main point of his research was to show that in the cases studied, the extent of economies of scale depended on the methods used. Four remarks with contradictory meanings arise from this analysis: 1- There are large disparities of efficiency between holdings, independently of their size. 2- It is clear that small holdings are not efficient, on account of excessive work. 3-The assumption of constant returns is not to be rejected in view of certain results. 4-Other estimations lead to returns of scale, as a function of farm size, increasing at first and then declining. According to this last result, it is essentially family run medium sized farm although availing of waged labour as a support, which performs best. Corporate farms are thus less efficient even though they pay their employees more. These two elements could come into play in a restructuring of family farming as much as in the corporate sector. Better performances of medium sized farms suggest however that they are more flexible in the use of production factors, with labor particularly, to deal with these developments. (Bousemart, 2006)

Additionally, farm size has been explored frequently for the purpose of analyzing its role in developing nations and their role in alleviating poverty, chiefly because of the inherent relationship that may exist between farm size and productivity. According to the Fann, Shenggen, Chang-Kong, Connie (2003) study, a popular fact in development economics is that a strong Inverse Relationship (IR) exists between farm size and land productivity. Sen, in a seminal paper published in 1962, observed that small farmers were more productive per unit of land than large farmers. The IR is typically explained by the difference in factors endowments between small and large farms: by using family labor small farms face lower labor transaction costs than larger farms. As a result, smaller farms have higher labor/land ratios and can achieve higher yield per hectare. The IR has important implications for land policy as it entails that any type of land reform that reduces landholdings inequality will have a positive effect on productivity. A significant volume of literature has been produced on the IR since Sen's paper, however it has failed to reach a consensus. On the one hand, a body of literature supports the hypothesis that small farms produce more per unit of land than large farms. With the advent of the Green Revolution however, research has also shown that the relationship diminished or even reversed, as agriculture becomes more capital intensive. Although the IR has been studied in various countries, the literature has focused mostly on India. Several explanatory factors on the IR have been advanced. Some supporters stress that the differences in the intensity of land use across farms of different sizes influence land productivity. A typical example is the study by Cornia (1985), which analyzed the relationship between factor inputs, yields, and labor productivity for farms of different sizes in 15 developing countries. In all but three countries (Peru, Bangladesh, and Thailand), a negative relationship was established between farm size and land productivity. Cornia attributed the higher yields observed on small farms to greater application of inputs and to a more intensive use of land. Similarly, another researcher observed that smaller farms in the district of Nadia in West Bengal use their land and fertilizer inputs more intensely than the larger farms. Banerjee took the analysis a step forward and showed that the cost per unit of output is directly related with the size of holdings, but inversely related with the value of output. This finding implies that small size farms are using their variable resources more efficiently than the bigger farms yielding to higher output per hectare. (Fann, Shenggen & Chang-Kong, Connie, 2003)[4]

On a global scale, Miguel Altieri (2008) suggests in his study that small scale farming is optimal because, among other reasons, small scale farmers are the key to the world's food security and small farming is more productive than commercial farming. Small farmers are the key to the world's food security: While 91% of the planet's 1.5 billion hectares of agricultural land are increasingly being devoted to agro export crops, biofuels and transgenic soybean to feed cars and cattle, millions of small farmers in the developing world produce the majority of staple crops needed to feed the planet's rural and urban populations. Of the 960 million hectares of land under cultivation (arable and permanent crops) in Africa, Asia and Latin America, 10-15% is managed by traditional farmers. In Latin America, about 17 million peasant production units occupying close to 60.5 million hectares, or 34.5% of the total cultivated land with average farm sizes of about 1.8 hectares, produce 51% of the maize, 77% of the beans, and 61% of the potatoes for domestic consumption. In Brazil alone, there are about 4.8 million family farmers (about 85% of the total number of farmers) that occupy 30% of the total agricultural land of the country. Such family farms control about 33% of the area sown to maize, 61% of that under beans, and 64% of that planted to cassava, thus producing 84% of the total cassava and 67% of all beans (Altieri,1999). Africa has approximately 33 million small farms, representing 80% of all farms in the region. Despite the fact that Africa now imports huge amounts of cereals, the majority of African farmers (many of them women) who are smallholders with farms below 2 hectares, produce a significant amount of basic food crops with virtually no or little use of fertilizers and improved seed. In Asia, the majority of more than 200 million rice farmers each cultivate around 2 hectares of rice making up the bulk of the rice produced by Asian small farmers. Farms of less than 2 hectares constituted 78% of the total number of farms in India but contributed nonetheless to 41% of the national grain production. Small increases in yields on these small farms that produce most of the world's staple crops can have a significant impact on food availability at the local and regional levels, in comparison to the increases predicted for distant and corporate-controlled large monocultures managed with such high-tech solutions as genetically modified seeds (Altieri, 2008).

In addition to providing food security the mentions that small farms are more productive and resource conserving than large-scale monocultures: Though the conventional wisdom is that small family farms are backward and unproductive, research shows that small farms are much more productive than large farms if total output is considered rather than yield from a single crop. Traditional multiple cropping systems provide as much as 20% of the world food supply. Polycultures constitute at least 80% of the cultivated area of West Africa, while much of the production of staple crops in the Latin American tropics occurs in polycultures (Francis 1986). These diversified farming systems in which the small-scale farmer produces grains, fruits, vegetables, fodder, and animal products out-produce yield per unit of single crops such as corn (monocultures) on large-scale farms. A large farm may produce more corn per hectare than a small farm in which the corn is grown as part of a polyculture that also includes beans, squash, potato and fodder. In polycultures developed by smallholders, productivity in terms of harvestable products per unit area is higher than under sole cropping with the same level of management. Yield advantages can range from 20% to 60%, because polycultures reduce losses due to weeds, insects and diseases and make a more efficient use of the available resources of water, light and nutrients. By managing fewer resources more intensively, small farmers are able to make more profit per unit of output, and thus, make more total profits – even if production of each commodity is less. In overall output, the diversified farm produces much more food, even if measured in dollars. In the USA data shows that the smallest 2-hectare farms produced $15,104 per hectare and netted about $2,902 per acre. The largest farms, averaging 15,581 hectares, yielded $249 per hectare and netted about $52 per hectare. Not only do small-medium-sized farms exhibit higher yields than conventional farmers, but do so with much lower negative impact on the environment. Small farms are 'multi-functional'– more productive, more efficient, and contribute more to economic development than do large farms. Communities surrounded by populous small farms have healthier economies than do communities surrounded by depopulated large mechanized farms. One recent study on the impact of small farms on local economies found that small producers create 10% more permanent jobs, a 20% larger increase in retail sales, and a 37% larger increase in local per capita income. Small farmers also take better care of natural resources, including reducing soil erosion and conserving biodiversity. The inverse relationship between farm size and output can be attributed to the more efficient use of land, water, biodiversity and other agricultural resources by small farmers. So in terms of converting inputs into outputs, society can benefit substantially from small-scale farmers. Building strong rural economies in the Southern Hemisphere based on productive small-scale farming will allow the people of the South to remain with their families and will help to stem the tide of out-migration. And as population continues to grow and the amount of farmland and water available to each person continues to shrink, a small farm structure may become central to feeding the planet, especially when large scale agriculture devotes itself to feeding car tanks (Altieri, 2008).[5]

Much of the literature review for this study was favorable toward small scale farming. This is in part due to the geographic area some of the research was done that was more conducive to highly productive polycultures. The particular focus and leaning toward small scale can be attributed to the concept of competitive advantage. That is to say that small scale farming in these areas may in fact be a more efficient method of farming but not merely because smaller is better but because the competitive advantage for that region happens to favor that type of high intensity agricultural production as opposed to other more metropolitan areas which may have a competitive advantage in say computer sciences, thereby forcing them to adopt larger scale farming practices in order to make better use of their land, labor, and capital. Because of this disparity in a balanced approach to assessing the benefits of scale, or the lack thereof, this study attempts to discover determinants of farm size in U.S. row crops in order to draw conclusions about what factors impact scale, and further, how that change in scale might impact producers.

RESEARCH QUESTION

In view of future energy constraints and shortages, exploring determinants of farm size becomes a necessary component to sustaining U.S. commercial agricultural production. Farm size has increased dramatically in recent decades but is the notion that "bigger is better" still viable with escalating energy prices? Should Illinois soybean producers contract the businesses or expand their operations in view of dramatic input price increases on the horizon? This study hypothesizes that despite the growing popularity of ideas like re-localizing, going small-scale, or downscaling, the fact remains that under exponential price increases, small scale farms will simply not be able feed our country the way large farms do that utilize economies of scale. In fact, under an exorbitant cost environment, large scale farms may look towards becoming gigantic scale- that is, only by reducing average total cost per unit will producers be able shoulder such cost pressures while many small scale operators may not survive the operational and financial strain.

DATA AND METHODS

The research procedures for this study require the production data for ten different row crops in the U.S. Some row crop sectors (rice and cotton) that have export-driven marketing channels and an industry structure that is relatively more concentrated—with fewer and larger producers—than other row crops such as corn and soybeans. On the flipside, other row crop segments (grain sorghum, sunflowers, and soft wheat) exhibit much less concentration and smaller production units. This research will investigate the production budgets of U.S. row crops to better understand and project the future structure of the U.S farms. A cross section of these U.S. row crops will then be examined to perhaps uncover the determinants of farm size. In particular, production budgets will be collected for each crop (e.g., corn, soybeans, wheat, barley, and others) and the characteristics of the cost structure will be used to determine the average number of acres farmed. The important relationships uncovered in this analysis can then be used to predict potential changes for U.S farmers. For instance, one such relationship that may be examined is between the fixed cost of production (as a portion of total costs) and acres farmed.

By understanding the determinants of farm size, comparisons can be made across both industries. Then, alternative scenarios--such as export growth, cost inflation, output price changes--can be examined to understand how the Illinois industry may evolve in terms of the number of producers and the quantity of output under alternative scenarios.

Production budgets for the following row crops were gathered to analyze the relationship between input costs, revenue per acre and the size of the enterprise of the farm: soybeans, corn, wheat, cotton, rice, sorghum, peanuts, sugar beets, oats, and barley. The model used for this study can be expressed as follows:

(1) $\text{Farm Size}_i = \alpha + \beta_1(\text{Energy Intensity}) + \beta_2(\text{Chemical Intensity}) + \beta_3(\text{Overhead Intensity})$

Using this equation (1) data for each of the three independent variables, Energy Intensity Ratio, Chemical Intensity Ratio, and the Overhead Intensity Ratio were set as a function of average farm size. These variables were formatted as ratios in order to capture the proportional cost of the item or group of items. For instance, the Energy Intensity Ratio consists of the total combined costs of fuel, electricity, and fertilizer per acre. This figure was then divided by total cost of production to arrive at a ratio. The Chemical intensity ratio consisted of the total chemical costs per acre for the particular row crop divided by the total cost of production. Finally, the Overhead Intensity Ratio consisted of the total overhead costs per acre divided by total production costs. Then, "buckets" were created combining two of more years of cross-sectional data so that the same information could be related across different crops which also helped to maximize the total number of observations and degrees of freedom (adding to the chances of achieving data with statistical significance). Once the data was input and each cross-sectional regression was calculated, an equation for each crop was formulated as a way to estimate each variable of the function. The first four buckets utilized all three independent variables. The last two cross-sectional buckets used only two independent variables: Energy Intensity Ratio and Overhead Intensity Ratio. The OLS estimated equations are as follows:

TABLE 1: Equation Estimates

2006-2009 Cross Sectional Series

Farm Size = 649.217 - 29.742(Energy Intensity) + 24.213(Chemical Intensity) - 658.486(Overhead Intensity)

2003-2005 Cross Sectional Series

Farm Size = 1627.611-606.014(Energy Intensity) - 1176.448(Chem Intensity) - 1488.976(Overhead Intensity)

2000-2002 Cross Sectional Series

Farm Size = 1709.285 - 1521.305(Energy Intensity) -2816.444(Chemical Intensity) - 503.508(Overhead Intensity)

1997-1999 Cross Sectional Series

Farm Size = 1903.348 - 2511.626(Energy Intensity) -3728.777(Chemical Intensity) + 4.248(Overhead Intensity)

2006-2007 Cross Sectional Series

Farm Size = 641.4 + 4.96(Energy Intensity) - 651.4(Overhead Intensity)

2008-2009 Cross Sectional Series

Farm Size = 1034.8 - 316.5(Energy Intensity) - 1069.9(Overhead Intensity)

RESULTS

The R squared for each of the cross-sectional regression equations ranged between 0.16 to 0.98. With exception of two buckets, the R squared was well below statistical significance. In the two cases where the R-squared was in the .98 range (means that 98% of the variance in farm size can be determined by the independent variables), the p-values were well above the alpha of 0.05, deeming the estimates statistically insignificant. For the 2003-2005 bucket the intercept p value had an intercept value of 0.002, the energy intensity variable a value of 0.15 and the overhead intensity had a p-value of 0.01, which in this case causes on the reject the null hypothesis and deem to data statistically significant. Many of the equations had directional problems where the signs seemed inappropriate. Additionally, the intercept values looked quite high as many of them were well into the thousand range. The intercept is the value of the dependent variable, farm size, if the independent variables are kept at zero. Curiously, all but one regression equation stated that for each one percent increase in the energy intensity ratio, farm size will see a dramatic decrease. This is where the directional signs did not appear intuitive since clearly farm size has risen as overhead costs have increased. The lack of statistical significance likely stems from the small cross-section of data. Or, maybe these factors do not determine farm size. In either case, the results are inconclusive and show no direct relationship between energy intensity and the size of U.S. row crop operations.

DISCUSSION

The results of this study do not show any distinct relationships between farm size and the various input costs. While not altogether intuitive or expected, the data and methods that were used failed to highlight any statistically significant correlations between proportional energy costs and the scale of the enterprise. However, by not demonstrating any reliable connections, the study has demonstrated a need to continue to try new ways to explore these relationships. The data and methods used herein do not necessarily prove that relationships do not exist; rather they simply convey that the methods used lack the statistical integrity to do so. Therefore, as the need to make sound linkages between agricultural input costs and the producer's strategy for scale and size, new and innovative quantitative techniques should be attempted in future studies to better understand the nature and strength of these variables in order to provide producers and the U.S. agricultural industry continued clarity and direction about business and operational decisions.

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APPENDICES

APPENDIX

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.403
R Square	0.162
Adj R Square	-0.466
St Error	177.263

ANOVA

	df	*SS*	*MS*	*F*	*Signif. F*
Regression	3	24,334.0	8,111.3	0.258	0.853
Residual	4	125,688.9	31,422.2		
Total	7	150,022.9			

	Coeff	*St Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	649.217	1330.752	0.488	0.651	-3045.543	4343.977
Energy (x1)	-29.742	995.151	-0.030	0.978	-2792.724	2733.239
Chemical (x2)	24.213	2335.280	0.010	0.992	-6459.563	6507.989
Overhead (x3)	-658.486	1266.252	-0.520	0.630	-4174.164	2857.192

Table: 2006-2009 Cross-Sectional Series Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.987
R Square	0.975
Adj R Square	0.937
St Error	48.102
Observations	6

ANOVA

	df	*SS*	*MS*	*F*	*Signif. F*
Regression	3	179,943.1	59,981.0	25.923	0.037
Residual	2	4,627.7	2,313.8		
Total	5	184,570.8			

	Coeff	*St Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1627.611	203.210	8.010	0.015	753.270	2501.952
Energy (x1)	-606.014	210.237	-2.883	0.102	-1510.591	298.563
Chemical (x2)	-1176.448	709.087	-1.659	0.239	-4227.405	1874.509
Overhead (x3)	-1488.976	202.423	-7.356	0.018	-2359.934	-618.019

Table: 2003-2005 Cross-Sectional Series Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.929
R Square	0.863
Adj R Square	0.657
St Error	75.657
Observations	6

ANOVA

	df	*SS*	*MS*	*F*	*Signif.F*
Regression	3	72,077.5	24,025.8	4.197	0.198
Residual	2	11,447.9	5,723.9		
Total	5	83,525.3			

	Coeff	*St Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1709.285	409.391	4.175	0.053	-52.181	3470.751
Energy (x1)	-1521.305	714.612	-2.129	0.167	-4596.030	1553.420
Chemical (x2)	-2816.444	976.576	-2.884	0.102	-7018.311	1385.424
Overhead (x3)	-530.508	691.839	-0.767	0.523	-3507.250	2446.233

Table: 2000-2002 Cross-Sectional Series Regression Output

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.994
R Square	0.988
Adj R Square	0.951
St Error	30.519
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Signif. F*
Regression	3	74,794.6	24,931.5	26.768	0.141
Residual	1	931.4	931.4		
Total	4	75,726.0			

	Coeff	*St Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1903.348	188.558	10.094	0.063	-492.515	4299.210
Energy (x1)	-2511.626	334.794	-7.502	0.084	-6765.593	1742.342
Chemical (x2)	-3728.777	524.094	-7.115	0.089	-10388.028	2930.474
Overhead (x3)	4.248	267.473	0.016	0.990	-3394.313	3402.809

Table: 1997-1999 Cross-Sectional Series Regression Output

*Without Chemicals
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.3928984
R Square	0.1543691
Adjusted R Square	-0.1275078
Standard Error	145.4103
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	23159.075	11579.537	0.5476472	0.604703501
Residual	6	126864.93	21144.154		
Total	8	150024			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lo 95*
Intercept	641.44883	383.57468	1.6722919	0.1454968	-297.124604	1580.0223	-297
Energy (x1)	4.9571841	491.37541	0.0100884	0.9922778	-1197.39513	1207.3095	1197
Overhead (x3)	-651.41445	635.38353	-1.0252303	0.3447995	-2206.14194	903.31304	2206

Table: 2006-2007 Cross-Sectional Series Regression Output

*Without Chemicals
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.665414693
R Square	0.442776714
Adjusted R Square	0.257035618
Standard Error	167.1940463
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	133274.905	66637.4526	2.38383817	0.173016599
Residual	6	167723.095	27953.8491		
Total	8	300998			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1034.77401	332.462746	3.11245102	0.02078382	221.2669794	1848.28104
Energy (x1)	-316.5285582	527.720878	-0.599803	0.57057926	-1607.815026	974.757909
Overhead (x3)	-1069.940476	654.988469	-1.6335257	0.15347736	-2672.63952	532.758568

Table: 2008-2009 Cross-Sectional Series Regression Output

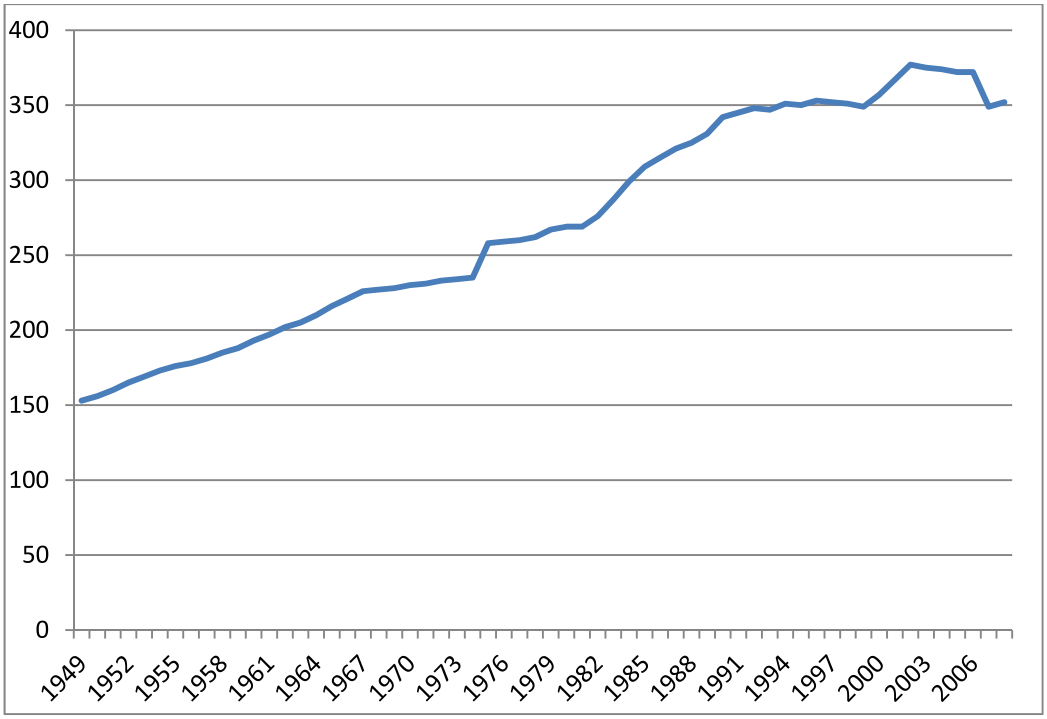

Figure 1: Average Farm Size in Illinois in Acres 1949-2008

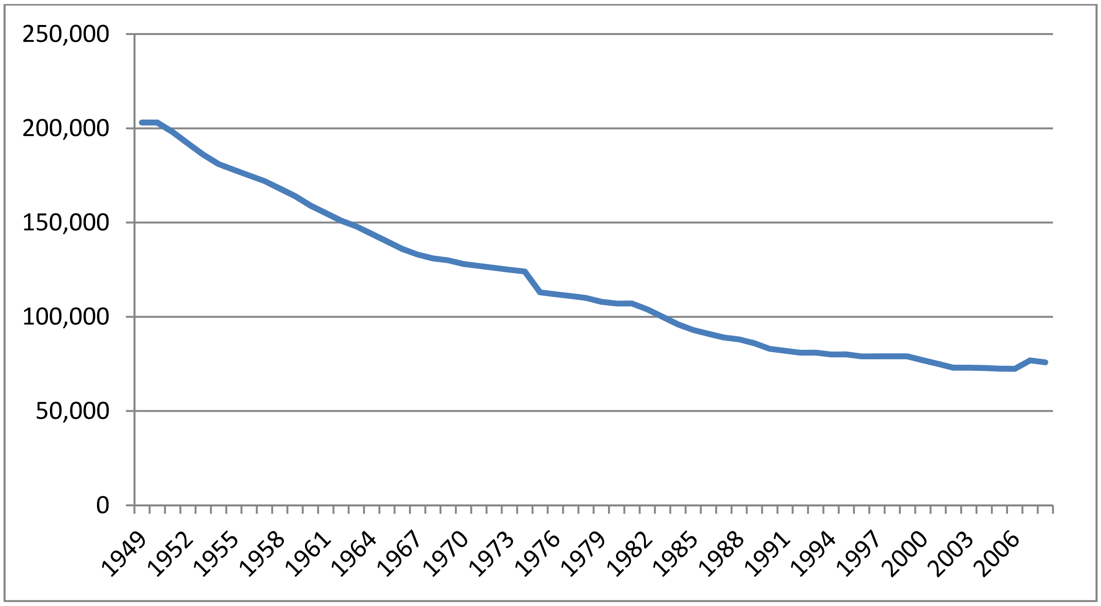

Figure 2: Total Number of Farm in Illinois from 1949-20

VITA

Graduate School
Southern Illinois University

Randy H Scollan Date of Birth: September 30, 1975

501 E College St, Apt 6, Carbondale, Illinois, 62901

rscollan@siu.edu

Southern Illinois University Carbondale
Bachelor of Arts, Liberal Arts, August 2009

Title:

Determinants of Farm Size in U.S. Row Crops

Major Professor: Dwight R. Sanders