Fall 11-6-2017

Financial Measures That Influence Equity and Income In Illinois Farms

Hans Carmien
carmienh@siu.edu

FINANCIAL MEASURES THAT INFLUENCE EQUITY AND INCOME IN ILLINOIS FARMS

by

Hans Carmien

B.S., Southern Illinois University, December 2016

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

Department of Agribusiness Economics
in the Graduate School
Southern Illinois University Carbondale
December 2017

RESEARCH PAPER APPROVAL

FINANCIAL MEASURES THAT INFLUENCE EQUITY AND INCOME IN ILLINOIS FARMS

By

Hans Carmien

A Research Paper Submitted in Partial

Fulfillment of the Requirements

For the Degree of

Master of Science

in the field of Agribusiness Economics

Approved by:

Dr. Wanki Moon

Graduate School
Southern Illinois University Carbondale
November 6, 2017

AN ABSTRACT OF THE RESEARCH PAPER OF

HANS CARMIEN, for the Master of Science degree in AGRIBUSINESS ECONOMICS, presented on NOVEMBER 6th, 2017 at Southern Illinois University Carbondale.

TITLE: FINANCIAL MEASURES THAT INFLUENCE EQUITYAND INCOME IN ILLINOIS FARMS

MAJOR PROFESSOR: Dr. Wanki Moon

This paper examines financial ratios that have a significant impact on Illinois net farm income and farm net worth. Ten regression analyses were used representing various farm sizes throughout the state. The data used for these regression models comes from the Illinois Farm Business Farm Management cooperative and contains aggregate information within Illinois from the years 1991-2007. The models found a few different ratios with statistical significance varying based on the size of the farm.

TABLE OF CONTENTS

CHAPTER PAGE

ABSTRACT i

LIST OF TABLES iii

CHAPTERS

CHAPTER 1 – Introduction 1

CHAPTER 2 – Review of Literature 3

CHAPTER 3 – Data 5

CHAPTER 4 – Specification of Regression Models for Net Worth 12

CHAPTER 5 – Specification of Regression Models for Net Farm Income 21

CHAPTER 6 – Discussion 30

BIBLIOGRAPHY 32

VITA 33

LIST OF TABLES

TABLE PAGE

Table 1: Definitions of Variables....7

Table 2: Mean Comparisons....10

Table 3: Hypothesis Tests Net Worth....14

Table 4: Net Worth Farm Class 1 <$75,000....16

Table 5: Net Worth Farm Class 2 $75,000 - $300,000....17

Table 6: Net Worth Farm Class 3 $301,000 - $600,000....18

Table 7: Net Worth Farm Class 4 $601,000 - $900,000....19

Table 8: Net Worth Farm Class 5 >$900,000....20

Table 9: Hypothesis Tests Net Farm Income....22

Table 10: Net Farm Income Farm Class 1 <$(20,000)....25

Table 11: Net Farm Income Farm Class 2 $(20,000) - $20,000....26

Table 12: Net Farm Income Farm Class 3 $21,000 - $60,000....27

Table 13: Net Farm Income Farm Class 4 $61,000 - $100,000....28

Table 14: Net Farm Income Farm Class 5 >$100,000....29

CHAPTER 1

INTRODUCTION

In retaliation to the Soviet Union invading Afghanistan, President Jimmy Carter enforced a grain embargo in 1980 canceling all shipments to the U.S.S.R. creating a sharp drop in commodity prices. The next year, in an attempt to curb inflation, the Federal Reserve Bank raised interest rates to an all-time high at 21% (tradingeconomics.com). After two decades of growth in the 1960's and 1970's, the overall farm economy hit a bubble in the early 1980's. During the times of growth, the loan application process was simple for farmers and varied from lending institutions. This allowed farmer's easy access to capital to expand their operations without much equity needed. In 1985, after interest rates rose, cropland values in Illinois dropped 25.1% (farmdoc.edu) leaving farmers with massive interest bearing payments. Farmers that expanded their operations with easy credit and little money down backing up their loans lost their equity positions. Faced with rising interest, low profitability, and decreased ownership of their farms from land values dropping, many farmers went bankrupt and foreclosed with no means to make payments.

With the new era farm debt crisis upon the economy, the Agricultural Division of the American Bankers Association formed the Farm Financial Standards Council (FFSC). Their main objective was to create both a universal loan application system and accounting standards for farm businesses from which business analysis could be conducted. This newly formed council would inherently decrease the amount of risk for farmers and lenders by providing financial analysis capabilities and rigorous standardized measures for loan rendering. Following the crash of farm values, the new FFSC created multiple financial measurements to track liquidity, solvency, profitability, financial efficiency, and repayment capacity. Based on numbers

derived from income statements and balance sheets, these new measurements, most of them ratios, are used as comparisons to farms of different types and sizes.

According to Don Holfstrand Extension Specialist at Iowa State University, "farm equity is important to generate future income, retirement income, and a legacy to pass on to heirs." (extension.iastate.edu). It can also be used as a base point for expansion. For farms to stay competitive and protect their equity positions, growth must be achieved. The USDA reported that from 2007-2012 the number of farms decreased by 4.3% across the US (USDA.gov). As the number of farms decrease, the size of farms increase. This means that remaining farms are growing their farm equity.

Regarding the importance of farm equity and farm income, the objective of this paper is to statistically identify which financial measurements influence both these relative measurements of farm financial health. The financial variables that have the most statistically significant impact on equity and net farm income will be discovered and the information provided will be useful for farmers who wish to focus on improving financial efficiency. The analysis will use ten multiple regression models for various farm sizes that will demonstrate the relationship between financial measurements with farm equity and net farm income. The models will reveal which variables impact equity and net farm income for each of the different farm sizes. The study could be of use to farmers who recognize the importance of equity and may use this research too implement business planning strategies in their own operations.

CHAPTER 2

REVIEW OF LITERATURE

There have been few studies that revealed the importance of financial ratios using regression methods among farms in Illinois. However, there have been several studies that have analyzed growth, managerial ability, and structural characteristics of farm operations each using their own unique approach and similar variables to financial ratios. Research conducted by Villatoro and Langemeier (2006) and Henneings and Katchova (2005) used regression analysis to provide factors pertaining to farm growth and managerial skill. The following paragraphs briefly describe each studies objective and results.

Mario Villatoro and Micheal Langemeier (2006) broke down farm growth into two separate categories, internal and external factors. External factors are acts that our out of the operators or farmers control such as the weather, policies, and commodity prices, whilst internal factors are directly in the operator's hand and include traits like: farm size, farm type, managerial ability, farm organization, capital structure, and technology adoption. The objective of the research was to "quantify the relationship between farm growth rates and managerial ability" (Villatoro and Langemier 2006) therefore an emphasis is placed on internal factors of a farm. To do this the, total farm assets was used as a proxy for farm growth and therefore set as the dependent variable. The independent variables of the study were: farm size, percent of farm income derived from crop production, managerial ability, capital structure, operator age, family size, and off-farm income. The data used comprised of whole-farm information from 353 individual farms in Kansas through 1983-2002. The data collected came from the Kansas Farm Management Association. The expected coefficients of each of the variables were listed.

The results of the study conducted, concluded out of the 353 farms, 73 experienced an annual negative growth rate of (-1.73%) and 280 farms had a positive growth annual rate of 4.21%. Farms that had achieved growth had tendencies: of being a crop farm, had a small economic total expense ratio representing having better management capabilities, had lower debt-to-asset ratio and inverted current ratio, had younger farmers controlling the operation, had a larger family, and a lower level of off-farm income representing that more time was spent on the farm. The pertinence of the study conducted exemplifies which factors had an effect on overall growth by unit measurement of total farm assets. The study found that the most significant effect on growth was characterized by total economic expense ratio. This symbolizes that above average managers with the knowledge of cost control to achieve farm growth.

Enrique Hennings and Ani L. Katchova (2005) implemented a quantile regression approach to provide business growth strategies to farmers. Rather than using assets as their measure of growth as Langemeier and Villatoro (2006) did, they used preexisting research and determined that the best measure of growth on a farm was related to equity. By using Illinois Farm Business Farm Management Individual farm data, they were able to identify variables for each quantile that impacted farm growth. The ten quantiles represented ten different sizes of farms so therefore each quantile could have different measureable results pertaining to growth. The financial variables chosen as the independent variables for the quantile regression were based around four main strategies that were identified as the leading factors to equity growth: Financial Management, Asset Management, Revenue Enhancement, and Cost Reduction (Hennings and Katchova 2005). The study found that all strategies had an effect on farm growth consistently through all of the different quantiles except for Financial Management, which had a negative impact at the lower quantiles and a positive impact at the higher quantiles.

CHAPTER 3

DATA

The data collected for this research comes from the Illinois Farm Business Farm Management Association (IllinoisFBFM.org). This association is a cooperative-service program that helps farmers with accounting procedures, financial analysis, business analysis, and tax preparation. Any farmer in the state can enroll into the association and become a cooperator but must have over $40,000 in assets and annual gross farm income to qualify. When Illinois FBFM conducts financial analysis for member cooperator farmers, the data for all financial information is entered into a database. To conceal farmer identity, individual farm level data is not public information available by the organization. However, the database does provide aggregate data for farms of similar structure and financial makeup. Data for this specific analysis will be derived from two different datasets, net worth and net farm income. Each set organizes the descriptive data into five different categories pertaining to a monetary amount of farm net worth and net farm income. These organized size categories houses the aggregate data of farms with similar net worth or net farm income, depending on which data set is being analyzed. This allows for trend analysis possibilities across different sized farms throughout the state of Illinois.

In order to understand the data and variables, a brief description of farm financial analysis is necessary. In short, financial analysis "analyzes the farms position and performance, and finds opportunities and problems." (Olson 188). By converting financial data into ratios, this task can be done on a universal level comparing these characteristics for farms of different sizes no matter how big or small the farm is. The financial ratios calculated from farm financial statements contribute to measuring four main categories of financial health each with its own importance: Liquidity, Solvency, Profitability, and Efficiency. Liquidity is defined by the ability

for a farm to pay all obligations within the next twelve months of operating. A high liquidity rate would be attractive to lenders and firms that provide services and financing to the farm knowing that there is a lower risk of payment defaulting. A low liquidity would translate into a riskier business arrangement with the farm. Similar to liquidity, solvency measures the ability of a farm to pay all debts if every asset were to be sold at a certain point in time. Solvency represents how leveraged an overall farm operation can be. The more solvent an operation, the less debt there is present. Profitability is the measurement of income being produced in a given time frame. Efficiency measures how well the farm is at using resources available to either produce a profit or limit expenses.

The financial data obtained from Illinois Farm Business Farm Management consist of ratios that are used to measure the four categories of financial health. Table 1 lists the mathematical description of how each variable or ratio is derived by the FBFM organization. Following the table, is a verbal description of each variable, and a brief descriptive analysis of the data that will be used.

TABLE 1: Definitions of Variables

Variable	Mathematical Description
Net Worth ($)	Total Assets ($) - Total Liabilities ($)
Net Farm Income ($)	Gross Farm Revenue ($) - Total Operating Expenses ($)
Asset Turnover Ratio (%)	Gross Farm Revenue ($) / Total Farm Assets ($)
Tenure Ratio (%)	Owned Acreage / Total Acreage
Debt-to-Asset Ratio (%)	Total Debt ($) / Total Assets ($)
Interest Expense Ratio (%)	Total Farm Interest Expense ($) / Gross Revenue ($)
Net Farm Income Ratio (%)	Net Farm Income ($) / Gross Revenue ($)
Operating Expense Ratio (%)	(Total Operating Expenses ($) - Depreciation ($)) / Gross Revenue ($)

The first variable in the table, net worth, is the amount of ownership or equity one has in the farm business. The net worth of a farm can be used as a measure of solvency for the operation. In the Net Worth dataset, the variable net worth is listed as a dollar amount. Net farm income is the amount of farm income after all expenses are paid in one fiscal year. This number also determines what tax bracket the farm will fall into. Net farm income is an absolute measure of profitability.

The first of six ratios used in this study is the asset turnover ratio. A measure of efficiency, the asset turnover ratio presents how well expenditures on assets are being used to give a return. Using gross revenues and the total assets owned by the farm, the ratio equates to how efficiently the farm turns over its assets. The Farm Financial Standards Council recommends the asset turnover ratio should be between 40%-50% (Olson 201). The higher the ratio the greater return on assets the farm is receiving.

The tenure ratio is the only variable in this study that is not a financial measurement instead a farm characteristic. There are many different types of farming contracts in the state of Illinois. Some of these include: custom farming, land rental arrangements, and crop share agreements. The tenure ratio shows the percentage amount of how much of its own land the farm owns. The other portion of the ratio implies that one of the other types of farm contracts derives the other acreage of the farm operation. This implies that a higher tenure ratio results in more land owned by the farm.

The debt-to-asset ratio is a vital measurement that reflects in one number the amount of risk a farm operation is undertaking. Lenders use this ratio to determine how solvent the operation is and if the farm can take on more debt. Borrowed money is pivotal for growth to occur in a business but too much is dangerous. A debt-to-asset ratio equaling to or less than 30%

would be considered very good. On the other hand, 70% would mean that the operation is vulnerable (Olson 194).

The interest expense ratio displays how much the farm is paying for borrowed money compared to the income that is being generated. This ratio is a measurement of financial efficiency where the higher the number, the more money is being spent on interest and thus less efficient the operation is. This ratio is in part, out of the operators control because of how closely this number reflects interest rates nationwide. However, the lower the ratio is the more efficient an operation can be due to less wasted funds on borrowed money.

The net farm income ratio is a relative measure of financial efficiency. This ratio illustrates how much net farm income comes from gross revenue in percentage format. The relativity of this measure can be used to link farms with significantly different incomes and study which farm is more efficiently producing it's given income. The higher the ratio amount the more net income the farm is generating in relationship to its gross income.

The operating expense ratio is another measure of financial efficiency. Using overhead costs divided by gross revenues, this ratio computes how an operation uses its expenses. The more overhead an operation has the higher the ratio will be, reflecting less profitably margins and to high of costs. The lower the ratio, the lesser amount of expenses the operation is incurring and thus the more profitable and efficient the farm is at managing its costs. On page 10 Table 2 lists the descriptive statistics of the data for this research.

TABLE 2: Mean Comparisons 1991-2007

Variable	Net Worth Farm Class Means					Net Farm Income Farm Class Means				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Net Worth ($)	21,802	199,699	440,507	740,003	1,607,381	x	x	x	x	x
Net Farm Income ($)	x	x	x	x	x	(52,553)	5,831	38,560	77,019	156,698
Asset Turnover Ratio (%)	71.0	49.0	36.0	27.0	20.0	22.0	26.0	30.0	33.0	34.0
Tenure Ratio (%)	7.0	8.5	15.0	24.0	35.0	25.0	23.0	19.0	21.0	23.0
Debt-to-Asset Ratio (%)	83.0	49.0	35.0	25.0	15.0	45.0	34.0	29.0	26.0	24.0
Interest Expense Ratio (%)	7.8	6.6	6.4	5.9	4.5	1.4	8.6	5.8	4.7	4.1
Net Farm Income Ratio (%)	16.0	19.0	21.0	22.0	25.0	x	x	x	x	x
Operating Expense Ratio (%)	69.0	64.0	62.0	60.0	58.0	91.0	74.0	59.0	55.0	52.0

Looking at the means for the aggregate data of the net worth farm classes, it is evident that the financial ratios shift as the size of the classes change. Every ratio listed has a better financial standing than the farm class lower except for the asset turnover ratio. The higher the class size the lower the aggregate asset turnover ratio is. For the net farm income aggregate data, every ratio shifts accordingly for a healthier financial standing as the class sizes rise. The tenure ratio in this dataset is the only variable that does not follow the trend. Chapter 4 and Chapter 6 in this paper will cover a more in depth analysis to determine if these ratios have a statistical effect on net worth and net farm income.

CHAPTER 4

SPECIFICATION OF REGRESSION MODELS FOR NET WORTH

The research procedures for the Net worth Analysis component of this paper will consist of five multiple regression models, one for each farm class size. The equation will use the aggregate financial data presented by Illinois Farm Business Farm Management from 1991-2007. The five multiple regression models will determine the factors that six independent variables (X) will have an effect on (Y). The independent variables for the study are the: asset turnover ratio, tenure ratio, debt-to-asset ratio, interest expense ratio, net farm income ratio, and the operating expenses ratio. Since equity is the same measurement as farm net worth, the two terms will be interchangeable moving forward and represent the dependent variable (Y). The logic for the chosen variables is derived from Enrique Hennings and Ani Katchova (2005). Here, the asset turnover ratio and the tenure ratio reflect the asset management strategies of farmers. The debt-to-asset ratio and interest expense ratio echo the financial management strategy. The net farm income ratio is a component of the revenue enhancement strategy and the operating expense ratio reflects the cost reduction strategy.

Each variable will either have a positive or negative effect on equity. Asset turnover ratio, tenure ratio, and net farm income ratio are expected to have positive effects on equity. The higher these ratios are, the better off the farm is from a financial standpoint and thus should positively reflected. In contrast, debt-to-asset ratio, operating expense ratio, and interest expense ratio should have negative effects on equity.

The net worth segment in the Illinois FBFM database categorizes its financial data by size of farm with a Net Worth of: <$75,000, $75,000-$300,000, $301,000-$600,000, $601,000-$900,000, and >$900,000. Each regression model will compute the data for these farm sizes. The

Ordinary Least Squares method is used for estimating unknown parameters in a linear regression. By doing this, the OLS estimation will minimize error sums of squares of an equation. All five multiple regression models in this research will utilize the OLS method. Using the Ordinary Least Squares approach, a multiple regression equation can be formulated, one for each farm class size:

$$\text{Net Worth} = \beta_0 + \beta_1 \text{Asset Turnover Ratio} + \beta_2 \text{Tenure} + \beta_3 \text{Debt-to-Asset Ratio} + \beta_4 \text{Interest Expense Ratio} + \beta_5 \text{Net Farm Income Ratio} + \beta_6 \text{Operating Expense Ratio} + e_i$$

For each of the five regression models, there will be several hypothesis and t-tests conducted. The t-test will concur the statistical significance of the independent variables (X) that have an effect on (Y). The t-test will use three calculated critical values that will be consistent across all five models. The three critical values will measure 90% significance, 95% significance and 99% significance. If the estimated beta coefficients are statistically significant from zero, then the null hypothesis will be rejected. This ultimately ensures that the selected independent variable has an effect on the dependent variable equity (Y). If these hypothesis fail to reject, then there will be no statistical significance between (X) and (Y). The rejection region will be greater or less than the three +/- critical value, while the Fail to reject region will be between the +/- critical value. The positive or negative impact the independent variables have on farm equity that reject the null hypothesis will be examined. Each model will reveal an R^2 value, which will be present in a percentage number the variation the dependent variables are explained by the independent variables. Since each regression model is using the same variables, the following list of hypothesis is credible to all five estimated models:

TABLE 3: Hypothesis Tests Net Worth

1. H_0 : Asset Turnover = 0
2. H_0 : Tenure = 0
3. H_0 : Debt-to-Asset = 0
4. H_0 : Interest Expense Ratio = 0
5. H_0 : Net Farm Income Ratio = 0
6. H_0 : Operating Expense Ratio = 0

4.2 ESTIMATION FOR NET WORTH

Of the five regression models estimated, there were a total of eight independent variables that rejected the null hypothesis. Of these rejections, there were different levels of significance listed at 90%, 95%, and 99%. If the hypothesis failed to reject then the variable proved statistically insignificant to the dependent variable (net worth). For this to happen, the t-value of the variable must fall out of the rejection region. To compute the percentage of significance a critical value was used and derived by the degrees of freedom present in the data. The three critical values for 90%, 95%, and 99% significance are, +/- 1.75, +/- 2.12, and +/- 2.92. Each model also has an R^2 value which represents the variation of net worth explained by the financial ratios. The following paragraphs lists the results from every model for the farm classes that had significant variables.

Table 4 shows the regression output for the smallest farm class. Farm class one contains an aggregate representation for farms with a net worth of $75,000 or less. Of the six independent variables used in the study, only one within this farm class proved to have a statistical significant impact on net worth. With a t-value of 1.83248, the tenure ratio falls in the 90% significance category. The higher the tenure ratio for small farms, the more of an effect it has on the farms

total net worth. As expected, the tenure ratio has a positive coefficient and thus has a positive influence on net worth. The validity of the regression model for farm class one is shown by the R^2 of 0.410599. This means that 41% of the variation in net worth is explained by the coefficients of the financial ratios.

The next farm class, representing farms with a net worth of $75,000-$300,000, has two significant variables. The first is the asset turnover ratio which has a 3.04280 t-value. With a t-value this high, the asset turnover ratio falls into the 99% confidence level of significance. The asset turnover ratio for this farm class has a positive significance on farm equity as expected. The other significant variable in this farm class is the operating expense ratio. Having a t-value of 2.4189, the level of significance is at 95%. Expected to be negative, the coefficient of this ratio is positive. The R^2 number is 0.752425 meaning 75% of the variation in farm net worth is explained by the financial ratios.

The output for farm class three is located on Table 6. This table represents farms with a net worth of $301,000-$600,000. Here, only one variable is significant. Like farm class two, the asset turnover ratio again appears to have an effect on farm equity. This time however, with a t-value of 2.32675 its confidence level is at 95%. Again, as expected the asset turnover ratio does have a positive effect on farm equity. The R^2 value for farm class three is 0.796456 which means 79% of variation in farm Net Worth is explained by the financial ratios.

The results for farm class four showed that none of the six independent variables had an effect on farm net worth. Farm class five, the largest classification of farms having a net worth of $900,000 or more, had more significant variables than any of the other farm classes. The asset turnover ratio was the first variable that proved to be significant. With a t-value of 5.69930, this ratio was significant at 99% with a positive effect. The interest expense ratio, which has not had

an effect on farm net worth in any other farm class, was significant in farm class five. As hypothesized, the interest expense ratio had a negative effect on equity. Along with the interest expense ratio, the net farm income ratio was significant for the first time in farm class five. The t-value was 2.35039 making the net farm income ratio significant with a 95% confidence level of significance. The net farm income ratio having a positive coefficient implies that there is a relationship between higher income and net worth. The last significant variable in farm class five was the operating expense ratio. This ratio is positively significant at 99% when it was believed to have a negative effect on equity

TABLE 4: Net Worth Farm Class 1 <$75,000

Variable	**Estimated Coefficient**	**t - value**	**Hypothesis Outcomes**
Constant	228050	0.638416	
Asset Turnover Ratio	759.648	.550677	Fail to Reject
Tenure Ratio	4860.32	1.83248	*
Debt-to-Asset Ratio	-35.9815	-1.50554	Fail to Reject
Interest Expense Ratio	51.0064	0.620020	Fail to Reject
Net Farm Income Ratio	13.1297	0.398475	Fail to Reject
Operating Expense Ratio	-8.28871	-0.241641	Fail to Reject
	R^2 = 0.410599	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 5: Net Worth Farm Class 2 $75,000 - $300,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	93611.6	1.41373	
Asset Turnover Ratio	1004.24	3.04280	***
Tenure Ratio	0.259616	1.26049	Fail to Reject
Debt-to-Asset Ratio	-14.7925	-1.43033	Fail to Reject
Interest Expense Ratio	8.93213	0.553063	Fail to Reject
Net Farm Income Ratio	1.27874	0.310810	Fail to Reject
Operating Expense Ratio	15.4519	2.41981	**
	R^2 = 0.752425	# Of Observations = 16	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 6: Net Worth Farm Class 3 $301,000 - $600,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	373440	5.93247	
Asset Turnover Ratio	1217.38	2.32675	**
Tenure Ratio	408.070	0.339724	Fail to Reject
Debt-to-Asset Ratio	-10.1316	-0.710552	Fail to Reject
Interest Expense Ratio	-8.79190	-0.434749	Fail to Reject
Net Farm Income Ratio	-1.08808	-0.142486	Fail to Reject
Operating Expense Ratio	9.76306	0.947104	Fail to Reject
	R^2 =0.796456	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 7: Net Worth Farm Class 4 $601,000 - $900,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	7145959	13.3247	
Asset Turnover Ratio	605.331	0.775748	Fail to Reject
Tenure Ratio	507.263	0.569043	Fail to Reject
Debt-to-Asset Ratio	4.93039	0.461151	Fail to Reject
Interest Expense Ratio	-30.1550	-1.50798	Fail to Reject
Net Farm Income Ratio	-4.26072	-0.541763	Fail to Reject
Operating Expense Ratio	1.92632	0.292911	Fail to Reject
	R^2 = 0.653281	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 8: Net Worth Farm Class 5 >$900,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	0.151917E+07	-1.40421	
Asset Turnover Ratio	45597.20	5.69930	***
Tenure Ratio	-2757.86	-0.311558	Fail to Reject
Debt-to-Asset Ratio	-45.1780	-0.271593	Fail to Reject
Interest Expense Ratio	381.830	-2.35379	**
Net Farm Income Ratio	147.346	2.35039	**
Operating Expense Ratio	314.450	4.89542	***
	R^2 = 0.975788	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

CHAPTER 5

SPECIFICATION OF REGRESSION MODELS FOR NET FARM INCOME

The net farm income analysis will closely mock the analysis on farm net worth. The study will conduct five multiple regression equations with each model representing a farm class size. The data used is the net farm income aggregate financial measurement information presented by Illinois Farm Business Farm Management for the years 1991-2007. These models will reveal which financial measurement ratios that will represent the independent variables (X) and will have an effect on the dependent variable, net farm income (Y). The effects that these independent variables have on net farm income will be either positive or negative depending on the estimated coefficient calculated. The financial ratios that are used are the same variables used in the net worth analysis except for the net farm income ratio. It is redundant to use this ratio, as it is a function of the dependent variable. The financial variables are the asset turnover ratio, tenure ratio, interest expense ratio, and the operating expense ratio. Using the ordinary least squares method to minimize error sums of squares, a multiple regression equation can be formulated for the five class sizes.

$$\text{Net Farm Income} = \beta_0 + \beta_1 \text{Asset Turnover Ratio} + \beta_2 \text{Tenure} + \beta_3 \text{Debt-to-Asset Ratio} + \beta_4 \text{Interest Expense ratio} + \beta_5 + \text{Operating Expense Ratio} + e_i$$

The five farm class sizes for the net farm income data are: <$(20,000), $(20,000)-$20,000, $21,000-$60,000, $61,000-$100,000, and >$100,000. The five estimated models will have several hypothesis and t-tests. Like the net worth analysis, there will be three t-tests used in each regression to uncover different levels of significance that each independent variable (X) has

an effect on the dependent variable (Y). The levels of significance will use different critical values too reflect levels of significance at 90%, 95%, and 99%. If the t-value meets this criteria of statistical significance than that variable will reject the null hypothesis. If the t-value does not, than that variable fails to reject the null hypothesis and is insignificant to the dependent variable. Table 9 below houses the hypothesis tests for the five models.

TABLE 9: Hypothesis Tests Net Farm Income

1. H_0 : Asset Turnover = 0
2. H_0 : Tenure = 0
3. H_0 : Debt-to-Asset = 0
4. H_0 : Interest Expense Ratio = 0
5. H_0 : Operating Expense Ratio = 0

The expected +/- signs for the independent variables, if significant are as follows. The asset turnover ratio should present a positive coefficient for all farm classes. The logic of this is as the higher the ratio, the greater dollar return on assets, which would result in higher farm income. The tenure ratio should also follow a positive suit. The greater the tenure ratio the more land the operation owns and should result in greater cash intake to the business. The debt-to-asset ratio exemplifies the risk of a farm operation and does not necessarily imply having a large impact on income. However, it is important to research its effects. If the ratio is higher, or the more debt an operation has, then it is possible the debt dollars are being used to produce an income. If they are then the coefficient should be positive. The interest expense ratio should be negative considering this ratio reflects dollars spent on interest or, the cost of borrowing money.

The higher the ratio, the more dollars spent and therefore less income. The same is true with the operating expense ratio. The higher the ratio, the greater costs the operation is enduring which would lead to less income. That would result to the operating expense ratio having a negative effect on net farm income.

5.2 ESTIMATION FOR NET FARM INCOME

The five regression models formulated for this analysis were used to calculate which financial variables had a statistically significant effect positive or negative, on net farm income. Each of the five models which represents different farm sizes, underwent hypothesis testing to determine the which of the variables studied had significance. This study, which is similar to the previously conducted net worth analysis has the same critical values for 90%, 95%, and 99% level of significance. If any of the variable's t-values failed to reject within anyone of the critical value ranges then the ratio was considered statistically insignificant. If the t-value fell out of the +/- critical value region then the ratio was considered significant. A total of eight ratios were found to be significant across the five models.

The first regression model, which covered farms with a net farm income of less than ($20,000), can be located on Table 10. Here, it is shown that two ratios were found to have a significant effect on net farm income. First, the tenure ratio, had a t-value of -1.76092 making it significant at the 90% level. Its negative coefficient is unexpectedly displaying a rise in tenure equates to a decrease in net farm income. The other significant variable, the operating expense ratio, is also significant at 90% with a t-value of -1.89583. The negative coefficient for this was hypothesized correctly.

The second farm class, which represents farms with a net farm income between ($20,000) and $20,000 had only one significant variable. Again, the tenure ratio was reported as a

significant ratio. In this farm class, the ratio had a 99% confidence level of significance with its t-value of 3.31411. Unlike the first farm class, this farm class showed the tenure ratio to have a positive coefficient, which is the expected sign. The R^2 of this regression equation is 0.624023 meaning 62% of the variation in net farm income is explained by the coefficients.

Farm class three had two significant financial ratios located in its model. This farm class is a representation of farms with a net farm Income between $21,000-$60,000. Both with positive coefficients, the tenure ratio and the asset turnover ratio had statistically significant effects on net farm income. The tenure ratio had a t-value of 3.47712 making its confidence level of significance at 99%. The asset turnover ratio was verified as significant at 95%. Both ratios were assumed to have a positive relationship with net farm income. 57% of the variation in Net Farm Income can be explained by the coefficients of the financial ratios.

The fourth farm class representing farms with a net farm income between $61,000-$100,000 also had two significant financial ratios in its designated model. Located on page 31 it is shown that both the tenure ratio and the interest expense ratio are significant at 90%. The tenure ratio has a positive effect on net farm income, which was hypothesized as the correct coefficient. The interest expense ratio, which indicated the cost of borrowed money, has a negative coefficient in this class and thus a negative effect on net farm income. 56% of the variation of net farm income can be explained by the coefficients in this model.

The fifth and largest farm class embodies farms with a net farm income of $100,000 or more. Here it is shown on page 31 table 14 that only one variable, the asset turnover ratio, is significant. The ratio is significant with a confidence of 95% and a t-value of 2.44599 its positive coefficient was hypothesized correctly.

TABLE 10: Net Farm Income Farm Class 1 <$(20,000)

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	166709	1.36881	
Asset Turnover Ratio	582.386	0.432650	Fail to Reject
Tenure Ratio	-829.159	-1.76092	*
Debt-to-Asset Ratio	-1036.70	-1.27949	Fail to Reject
Interest Expense Ratio	391.431	0.215266	Fail to Reject
Operating Expense Ratio	-1876.51	-1.89583	*
	R^2 = 0.645227	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 11: Net Farm Income Farm Class 2 $(20,000) - $20,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	-4920.77	-0.385558	
Asset Turnover Ratio	276.128	1.37768	Fail to Reject
Tenure Ratio	330.236	3.31411	***
Debt-to-Asset Ratio	-31.8779	-0.220977	Fail to Reject
Interest Expense Ratio	-242.944	-0.595294	Fail to Reject
Operating Expense Ratio	-12.4174	-0.121523	Fail to Reject
	R^2 = 0.624023	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 12: Net Farm Income Farm Class 3 $21,000 - $60,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	-4826.57	-0.260858	
Asset Turnover Ratio	469.020	2.61890	**
Tenure Ratio	890.037	3.47712	***
Debt-to-Asset Ratio	191.135	0.839486	Fail to Reject
Interest Expense Ratio	-177.921	-0.415523	Fail to Reject
Operating Expense Ratio	116.397	1.04562	Fail to Reject
	R^2 = 0.571945	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 13: Net Farm Income Farm Class 4 $61,000 - $100,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	53726.4	2.10559	
Asset Turnover Ratio	235.270	0.752972	Fail to Reject
Tenure Ratio	520.423	1.76190	*
Debt-to-Asset Ratio	204.425	1.16471	Fail to Reject
Interest Expense Ratio	-1291.71	-1.80750	*
Operating Expense Ratio	99.5885	0.654797	Fail to Reject
	R^2 = 0.566700	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

TABLE 14: Net Farm Income Farm Class 5 >$100,000

Variable	Estimated Coefficient	t - value	Hypothesis Outcomes
Constant	-973252.4	-0.495948	
Asset Turnover Ratio	6883.61	2.44599	**
Tenure Ratio	-1173.14	-0.851391	Fail to Reject
Debt-to-Asset Ratio	-3839.95	-1.50261	Fail to Reject
Interest Expense Ratio	12896.5	0.845973	Fail to Reject
Operating Expense Ratio	1750.03	0.862808	Fail to Reject
	R^2 = 0.587371	# Of Observations = 17	

Note: *p<0.1; **p<0.05; ***p<0.01

CHAPTER 6

DISCUSSION

The objective of this paper was too identify which selected financial measurements had a statistical significant impact on net worth and net farm income in Illinois farms. The data used in this research is aggregate state-level data from Illinois Farm Business Farm Management. This data comprises of a large percentage of Illinois farms, which gives an accurate representation of the overall farm financial situation throughout the state. Although individual cross-sectional farm data from each individual farm represented in the farm classes analyzed might paint a more accurate picture that data is not made available to the public. Instead, using 17 years of aggregate farm data from 1991-2007 allows the research to capture average finances of farms of different sizes in a given year. Therefore, it is possible to relate farms with similar finances to the aggregate size categories.

There are many outside forces that control farm financial health and profitability. This research was not designed to conduct analysis on those macroeconomic principles affecting farms financial positions, but rather the micro characteristics of farm finances represented in somewhat controllable financial ratios. Conducting an analysis relating the effects of these financial ratios too the most important absolute measures of farm financial positions, net worth and net farm income, allows for farm operators and managers too have a statistical guideline for what financial ratios are pertinent to an operation. The regression analysis conducted were not too undermine the importance of the statistically non-significant ratios, but to value the importance of the significant.

The results of this study for the net worth segment analysis indicate greater performance on assets reflected by the asset turnover ratio had a statistically positive effect among three of the

farm classes. With significance in farm classes two, three, and five, it can be concluded that greater returns on assets could translate to greater amounts of equity. For the largest farm class, representing farms with a net worth of over $900,000, the net farm income ratio proved to be significant. This exemplifies a relationship between higher net profits and equity.

The net farm income segment of this research portrays significance among the tenure ratio and asset turnover ratio. The tenure ratio, which represents the ownership of land, was found to have a positive effect on net farm Income in farm classes two, three, and four. The asset turnover Ratio had positive significant effect on net farm income in classes three and five. This shows that land ownership and asset efficiency has the greatest effects on net farm income.

BIBLIOGRAPHY

Farmdoc - Finance., Financial Benchmarks. Accessed April 26, 2017. http://farmdoc.illinois.edu/finance/benchmarks.asp.

Farmdoc., "A Historic Look At Illinois Farm Real Estate Values." Accessed October 09, 2017 http://www.farmdoc.illinois.edu/manage/newsletters/fefo03_15/fefo03_15.html

Hennings, Enrique & Ani, Katchova., "Business Growth Strategies of Illinois Farms: A Quantile Regression Approach" (Paper presented at the at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005)

Iowa State University Extension., "Building Equity in Your Farm | Ag Decision Maker." Accessed April 25, 2017. http://www.extension.iastate.edu/agdm/wholefarm/html.

Olson, Kent D., "Economics of farm management in a global setting." Hoboken, NJ: Wiley, 2011.

United States Fed Funds Rate 1971-2017. Accessed April 26, 2017. http://www.tradingeconomics.com/united-states/interest-rate.

USDA Census of Agriculture, Preliminary Report Highlights; US Farms and Farmers. 2014 https://www.agcensus.usda.gov/Publications/2012/Preliminary_Report/Highlights.pdf

Villatoro, Mario & Micheal, Langemeier., "Factors Impacting Farm Growth." *Journal of the ASFMRA* (2006): 74-80.

VITA

Graduate School
Southern Illinois University

Hans H. Carmien

carmienh@yahoo.com

Southern Illinois University, Carbondale
Bachelor of Agribusiness Economics, December 2016

Research Paper Title:
Financial Measures That Influence Equity and Income in Illinois Farms

Major Professor: Dr. Wanki Moon