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Economic, financial, and statistical applications in measuring firm performance: The case of Ohio commercial farmers

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ECONOMIC, FINANCIAL, AND STATISTICAL APPLICATIONS IN MEASURING FIRM PERFORMANCE: THE CASE OF OHIO COMMERCIAL FARMERS

DISSERTATION

Presented in partial fulfillment of the requirements for the degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

The Ohio State University

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DEDICATION

To: Mary Ann Pica,

whose mind, heart, and spirit have lightened my life.

To: My parents: Norberto Solis Elizondo and
Consuelo Fallas Ceciliano,

of whom I feel proud and to whom I give thanks for all they have done.

To: My sisters, brothers, and extended family,

who are part of my treasure.

To: Jean, Tracy, Wendy, and Joe,

whose existence brings me happiness.

To: All the individuals,

who seek truth, love, and God.

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CHAPTER I

INTRODUCTION

1.1. The issue of firm performance:

The issue of firm performance definition and measurement has been studied by a number of researchers in different contexts. Although the literature is not consistent in the definition of firm performance or in the measure of firm performance that should be used, several aspects of firm performance have been emphasized in different studies such as: profitability, risk, growth, production/technological efficiency, and personal satisfaction (as a proxy of utility).

Rolfe (1992, p. 32) suggests that decision makers should focus on as few as possible firm performance measures in order to avoid data (information) overload. That is, "the goal is not more information but improved information. Frequently, there is an inverse relationship between the two" (p.32).

Doyle and Hooley (1992, p.60, 70) explain that although the objectives of a given firm may differ from firm to firm, firms usually "prioritize those objectives and translate them into measures of performance".

McCrory and Gerstberger (1992, p.38) note that knowing what should be maximized (what is the main firm performance measure that should be focused on) is essential both at the policy making level and at the business-firm level. For example, knowing what commercial farmers in general aim to accomplish and which socioeconomic variables influence such accomplishment, may allow policy makers to influence the relevant socioeconomic variables affecting farmers in general and society as a whole.

In the words of Morgan and Cameron (1990, p.40), "who (what) is the target (to maximize)?" is the first question to answer in any meaningful research attempt. In this context, the two following questions may summarize the points of interest exposed above by Rolfe (1992, p. 32), Doyle and Hooley (1992, p.60, 70), McCrory and Gerstberger (1992, p.38), and Morgan and Cameroon (1990, p.40):

1. How can firm (farm) performance be defined and measured?
2. What variables affect firm performance?

As mentioned above, although from the literature one cannot give consistent answers to such questions, a number of definitions and measures of firm performance have been found in the literature.

1.2. Firm performance and policy implications:

This is relevant because using a firm performance measure, lets say "y1", may produce a model "y1 = f(x1, x2, ..., xn) = f(xi)", where the "xi´s" are socioeconomic variables affecting the outcome "y1". If "y1" is not a firm performance measure reflecting the real goals of a given population (such as commercial farmers), and if, instead, it is "y2" the measure which does it, then policy makers will be misled to influence the set of variables "xi" following the model "y1 = f(xi)", instead of the set of variables "xj", following the model "y2 = f(x1, x2, ..., xm) = f(xj)". This hypothetical example makes it obvious that the issue of firm performance measure has essential importance in policy making at all levels.

1.3. Satisfaction (utility) as performance measure:

Olatunbosun (1967, p.175), Datta, Rajagopalan, and Rasheed (1991, p.548), and Perrin (1968, p.55), among other authors, suggest that satisfaction (as proxy of personal utility) should be the core of the firm performance definition and measurement, which agrees with the conceptualization of economics as a social science whose main goal is to maximize the utility (or satisfaction) of the individual (Datta, Rajagopalan, and Rasheed (1991, p.548), Randall (1987, p.33), Russell and Wilkinson (1979, p.36), and Tweeten and Mylay (1986, p.1-3)). Indeed, Tweeten and Mylay (1986, p.1) state (that):

> "There is some agreement that people pursue what is variously termed happiness, utility, satisfaction, well-being, or quality of life. Efforts to increase utility of people lie directly or indirectly at the core of economic theory and applications" (Tweeten and Mylay (1986, p.1)).

Therefore, it seems reasonable to justify the use of farmer´s satisfaction level (a "subjective" measure, as proxy of utility) as a firm performance measure to be compared with other firm performance measures ("objective" measures) found in the literature (such as profitability, risk, and growth measures).

1.4. Main goal of this study:

The main goal or objective of this study can be stated as follows:

> To study the different firm performance measures used by different authors, including their relationship among themselves and with a number of socioeconomic variables. Specifically, a proxy measure of utility will be related with other performance measures and with a number of socioeconomic variables.

1.5. Structure of the rest of the dissertation:

The "Literature review" ("Chapter II") deals mainly with the issue of firm performance definitions and measures.

In "Chapter III" ("Methodology"), the analytical methods and a number of statistical tools to be used will be addressed.

Moreover, "Chapter IV" ("Results and discussion: descriptive analysis") and "Chapter V" ("Results and discussion: inferential analysis") will narrate the developments in the statistical analysis and will comment upon the results. Finally, "Chapter VI" ("Summary and conclusions") will state and summarize the main findings of the dissertation, will recognize some of the limitations of this study, and will suggest further research.

1.6. Bibliography for "Chapter I":

Datta, D.K.; Rajagopalan, N.; and Rasheed, A.M.A. 1991. Diversification and performance: critical review and future directions. Journal of Management Studies 28 (5:September): p.529-558.

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Russell, R.R. and Wilkinson, M. 1979. Microeconomics: a synthesis of modern and neoclassical theory. John Wiley & Sons Inc. USA. 459p.

Tweeten, L. and Mylay, G. 1986. Marginal utility of income estimated and applied to economic problems in agriculture. Agricultural policy analysis project U.S. Agency for international Development, Contract No. DAN-4084-C-00-3087-00. Report B-21, Department of Agricultural Economics, Oklahoma State University. Stillwater, Oklahoma. 31p.

CHAPTER II

LITERATURE REVIEW

The literature review will study the definitions and measures of firm performance found in the literature. A number of authors (Olatunbosun (1967, p.175), Datta, Rajagopalan, and Rasheed (1991, p.548), and Perrin (1968, p.55)) have suggested that personal satisfaction (as proxy of utility) should be the core of the firm performance definition. Moreover, besides utility (a "subjective" measure of firm performance), other firm performance measures ("objective" measures) found in the literature are profitability, growth, and risk measures, as it will be noted latter.

2.1. Firm performance: definitions and measures:

In general, there is not consistency across authors regarding the definitions or the measures of firm performance used. Thus, in order to guide the reader in reading "Chapter II", "Table 1" provides a list of some of the most common firm performance measures used by different researchers.

Table 1: List of some of the most common firm performance measures used by different researchers.

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1. Profitability measures:

   a. Net income
   b. Gross income
   c. Return on equity
   d. Return on assets
   e. Sales

2. Growth measures:

   a. Growth in equity
   b. Growth in total assets
   c. Growth in sales
   d. Growth in market share

3. Risk measures:

   a. General risk: usually measure by the variability (variance) in profitability.

   b. Debt (leverage) related measures, which are referred to by most authors as "financial risk" measures:

      -Absolute amount of debt
      -Debt to equity ratio
      -Debt to assets ratio
      -Liquidity measures such as current ratio

4. Efficiency/technological measures

5. Firm survival

6. Self-assessment of performance:

   a. Self-assessment of satisfaction
   b. Self-assessment of condition related to other firms
   c. Self-assessment of condition compared to several years ago.
   d. Self-assessment of predicted future condition

2.1.1. Firm performance: definitions:

In this sub-section of the review of literature several explicit definitions of firm performance are presented. The following section ("Section 2.1.2.", titled "Other performance measures") contains listings of firm performance measures used by several researchers.

It should be clear that if a given firm performance measure is used (measured or modeled) by a researcher, implicitly that firm performance measure is a firm performance definition. In other words, if an author used (let´s say) net profit as the firm performance measure, the author is implying that firm performance is defined as the accomplishment of higher net profits. This point may be important because a number of authors have studied the issue of firm performance by means of using a given firm performance measure and modeling it as a function of a number of variables, without offering an explicit definition of firm performance.

Moreover, some authors explicitly define firm performance in one way, but use firm performance measures which are not evidently related with the firm performance definition provided. That is why sections "2.1.1." and "2.1.2." may be seen as a single unit. However, for the sake of clarity, the two sections will be kept separated under different subtitles ("Section 2.1.1" or "Firm performance: definitions" and "Section 2.1.2." or "Other performance measures").

Just as an illustration of a case in which the firm performance definition offered by a researcher and the firm performance measure used by the same researcher are not evidently related is the following case, dealing with the issue of farm performance in Nigeria (Olatunbosun (1967, p.65)).

Olatunbosun (1967, p.65) studied Nigerian farms and defined farm performance as the capacity of that organization to:

1. Survive
2. Adapt
3. Maintain itself
4. Grow

However, Olatunbosun (1967, p.175) used the following three measures of farm performance to measure the performance of Nigerian farmers:

1. Social-psychological characteristics of the farmer determined by the farmer's self-assessment of satisfaction (self- reported level of satisfaction with farming in the present, self-reported opinion of improvement with respect to the past, and self-reported opinion of optimism for the future).

2. Efficiency of tree crop production (a technological indicator).

3. Internal rates of return (IRR) on investment.

As it can be seen, Olatunbosun's (1967, p.65) definition and measures of firm performance are not explicitly related and, certainly, in his study, such relationship is not explicitly established.

Bailey (1983, p.80) defined good-farm's performance or farm's success as the probability that the farm operator will receive at least 5% return on equity (ROE). Moreover, Bailey (1983, p.80) defined farm survival as the probability that the typical farm will remain solvent for 10 years.

Datta, Rajagopalan, and Rasheed (1991, p.529-558) reviewed 135 studies related with the issue of firm's economic performance measures, definitions, and relationships. Datta, Rajagopalan, and Rasheed (1991, p.530) note that the findings of empirical studies dealing with the issue of firm performance measure do not allow easy generalizations since the studies usually have been inconclusive and often contradictory.

However, Datta, Rajagopalan, and Rasheed (1991, p.532-3) note that most studies have defined economic performance at the firm level as a measure of firm profitability and/or as a measure of risk. A few studies have used other measures of performance such as sales growth and cash flows (p.532). Profitability has been primarily determined as one or more of the following measures: profits, return on investment (ROI), return on equity (ROE), return on assets (ROA), or return on capital (ROC). The use of one or other measure depends mainly on the information available and on the terminology used in the balance sheet statement. Risk typically has been measured as the variability (variance) in profitability.

Datta, Rajagopalan, and Rasheed (1991, p.548) raise an interesting issue: are economic measures of performance (profitability and/or risk) the only outcome variables or do they reflect biases imposed by researchers´ framework?. They argue that if managers or owners try to improve their overall performance in order to achieve other objectives (such as enhancement of personal power, personal prestige, or personal satisfaction), research needs to acknowledge and examine these objectives.

Datta, Rajagopalan, and Rasheed (1991, p.548) note that this might imply alternative conceptualizations of performance. They (p.548) propose that firm performance could be conceptualized as a measure of personal satisfaction, as a measure of profitability, or as a composite of personal satisfaction along with profitability.

Finally, Datta, Rajagopalan, and Rasheed (1991, p.545) conclude that given the mixed findings they cannot conclude that one or other definition of firm performance is "the best". The only conclusion the authors (p.548) could agree upon is that most studies measure firm performance as firm profitability (any profit related measure) and/or risk.

Perrin (1968, p.55) also studied the issue of firm performance measure (which he also calls firm success measure). Perrin (1968, p.55) explores the question

"what is firm success or good firm performance?".

Perrin (1968, p.55) starts his exposition with three main potential answers commonly found in the literature:

1. Firm success or good firm performance is "profit maximization at a high level" (Perrin (1968, p.55)),
2. Firm success or good firm performance is "rapid and sustained growth" (p.55), and
3. Firm success or good firm performance is "a high level of satisfaction (perhaps measurable only subjectively...) in the minds of ... owners, managers, ..." (p.55).

Moreover, Perrin (1968, p.55) states that

"this last statement comes closest to a true definition (of firm performance), while the earlier statements simply represent various criteria of success popular because they are apparently objective and easy to calculate..." (p.55).

Perrin (1968, p.55) adds that "efficiency" (technological and financial) has also been used to define firm performance. However, he states that "a firm can be efficient (financially and/or technologically) without being successful..." (p.55).

Perrin (1968, p.56) suggests that "efficiency" should be measured in terms of "utility" or "human satisfaction".

He (p.56) emphasizes that any efficiency ratio or measure should include the utility or human satisfaction obtained and/or the "sacrificed satisfaction".

In this context, Perrin (1968, p.56-69) proposes several potential ways to measure firm performance. These potential firm performance measures are in the context that "human satisfaction" or "utility" is the central firm performance measure that should be used. These potential firm performance measures proposed by Perrin (1968, p.56-69) are:

1. Human satisfaction measured in terms of personal achievement and fulfillment through the activities and results of production, and in terms of the human resources of leisure and alternative activity sacrificed, together with the human costs of personal frustration, friction, and health loss involved (p.57).

2. Output measured in terms of social utility and benefit provided, valued relatively to the alternative uses for the resources consumed in production (p.57). The "ethical value" of the different activities could be stated as "moral taxes" on the users of, for example, gambling, smoking, and various luxury goods (p.57).

2.1.2. Other performance measures:

A number of authors have studied firm performance using different firm performance measures. In the following paragraphs, a selection of such studies is presented. In most cases the authors just used one or more firm performance measures without discussing why such measure was used. However, a few authors offer more discussion on the issue of choosing an adequate firm performance measure.

Brush and Vanderwerf (1992, p.159) did a systematic literature review on the issue of firm performance measures. Current issues of two journals ("Journal of Small Business Management" and "Journal of Business Venturing") and one conference proceeding ("Frontiers of Entrepreneurship Research") were selected. All of the articles in the 1987 and 1988 issues of these journals were considered. A total of 34 studies were identified as explicitly measuring some aspect of performance. Their review yielded two main observations.

The first observation made by Brush and Vanderwerf (1992, p.159) is related with operationalizations. In all, there were more than 35 different measures of performance noted. The use of the term "performance" by researchers also included other constructs measuring some aspect of performance, such as "success", "survival", and "growth". The most popular performance measures found in their literature review were:

1. Growth measures (growth in sales and growth in number of employees)
2. Business survival measures (operating business/discontinued business)
3. Profitability measures (net profit, return on sales, and return on investment).

Most studies used multiple objective measures with scales and multiple-choice or open questions, but a few studies also used subjective measures. "Subjective measures" are typically described as perceptual. They provide a relative assessment of performance (i.e., as compared with competitors) rather than exact numerical values (Brush and Vanderwerf (1992, p.159)).

The second observation made by Brush and Vanderwerf (1992, p.159-160) is related with the primary sources of performance information. The primary sources of performance information were managers, executives, founders, or owners. Most studies relied on a single source for information.

Lynch and Hooley (1990, p.73) measured firm performance using:

1. Financial measures:
    a. Overall profit
    b. Return on investment
2. Market measures
    a. Sales volume
    b. Market share

Moreover, Lynch and Hooley (1990, p.73) found that of the 1,201 respondents to their survey who answered the relevant questions, 143 were identified as top performers (top performers were firms with high profit, high return on investment, high sales volume, and high market share). Top performers were found in all business sectors and sizes of firms which suggests that firm´s size and firm´s business type do not influence firm performance.

Chandler and Jansen (1992, p.228) suggest that two separate dimensions as firm performance measures are particularly relevant for start-up organizations:

1. Profitability: measured by sales and earnings
2. Growth: measured by sales growth.

Farrimond (1989, p.2) studied 291 high-technology firms in the USA and abroad and measured firm performance (firm success) by:

1. Sales
2. Net income
3, Market share

Buckley (1990, p.63) studied US manufacturing firms and used profitability as the firm performance measure. The author (p.63) note that the proxy for profitability considered may vary according to the information available and the type of financial statements used. For example, Buckley (1990, p.63) used the following profitability measures as firm performance measures:

1. Return on stockholders´ equity
2. Return on invested capital
3. Return on net assets

Finally, Rahman (1980, p.iv) used the following measures of superior farm´s economic performance:

1. Lower debt-to-equity ratio
2. Higher net cash flow
3. Higher net income.

2.1.3. Profitability and growth as performance measures:

Several authors have studied firm performance using simultaneously profitability and growth as the firm performance measures.

Hamilton and Shergill (1992, p.102) measured firm performance in a sample of 67 manufacturing, service, or mining companies in New Zealand. The measures of firm performance were profitability (an index compound by return on equity (ROE) and return on assets (ROA)) and growth (and index compound by growth in net assets (GNA), growth in earnings per share (GEPS), growth in dividend (GDIV), and growth in sales (GSALES)). The authors noted that there will inevitably be some intercorrelation among the individual variables and so, they subjected the data to factor analysis to generate from them a composite index of company performance. Indeed, they ended up with two factors (one for growth and one for profitability).

Hamilton and Shergill (1992, p.105) used the general linear models:

PROFITABILITY = f(fit, strategy, size, leverage, risk, industry concentration) (1)

GROWTH = f(fit, strategy, size, leverage, risk, industry concentration). (2)

Thus performance was measured in terms of the composite variables GROWTH and PROFIT. Fit (structural fit) is an arbitrary variable representing structure. Hamilton and Shergill (1992, p.98, 29.1), used three structural forms (functional, holding company, and divisional). Strategy was measured by four levels of strategy (A, B, C, and D) reflecting increasing levels of diversity. Size was measured by the logarithm of total assets. Leverage was measured as the ratio of total debt to total assets. Risk was measured by the variance in return on equity.

Moreover, industry concentration was measured by sales-based Herfindahl Indices, as published by the New Zealand Department of Statistics in the Census of Manufacturing 1981-2, Census of Services 1982-3, and the Census of Mining and Quarrying 1983-4. The Herfindahl Index was opted because it reflects the relative market shares of all firms in the industry (Hamilton and Shergill (1992, p.98)).

Stepwise regression was used and for the profitability model all, but firm size (dropped) and risk (significant but with negative sign), were positively and significant (p=.95) in the linear regression with an adjusted R2 = 0.49 and significant F-statistic. For the growth model, only strategy, structure fit, firm size, and industry concentration had significant (and positive) coefficients with an adjusted R2 = 0.39 and significant F-statistic. The other variables were dropped in the stepwise regression used

(Hamilton and Shergill (1992, p.106)).

McCrory and Gerstberger (1992, p.33) recommend that profitability instead of growth should be used as firm performance measure. They propose that firm's growth rate (which has been used as a measure of firm performance by many authors) may be a misleading firm performance measure. In fact, they assert that the empirical evidence strongly suggests that most higher firm's growth rates have diminished profitability value for shareholders (p.33; see: Porter (1987)). Thus, the following hypothesis deserves to be studied:

Ho.1: Profitability measures are positively and significantly correlated with utility.

Ho.2: Growth measures are positively and significantly correlated with utility.

2.1.4. Firm's risk as a measure of firm's performance:

Some authors divide firm's total risk into business risk and financial risk (Al-Abdali (1987, p.11)). Business risk arises from the market, economic, and social environment facing the firm. It involves the variability of the returns to the firm's risky assets. Financial risk arises from the financial claims on the firm's asset. The greater the financial leverage (debt), the greater the risks are in meeting financial obligations to lenders and providers. As expansion occurs with borrowed capital, the potential loss of equity capital increases, the variation of expected returns to equity increases, and liquidity provided by credit reserves is reduced (Al-Abdali (1980, p.11)).

These effects may be important because, as leverage increases, unfavorable events have greater impact on the firm growth and survival than the favorable events. Financial risks are further increased by unanticipated variations in interest rates, credit availability, and other changes in loan terms, as well as in leasing terms (Al-Abdali (1980, p.11)).

Thus the paradigm generally used is that the less debt the firm has, the less financial risk the firm has. Since humans are usually assumed risk averse, debt levels can be used as a measure of firm performance (Al-Abdali (1980, p.12)). In the following paragraphs the basis of this issue is treated.

The measure of financial leverage may serve as a direct indicator of the firm's financial risk. If leverage is zero (100% equity capital and 0% debt capital or liability), then financial risk is zero and business risk and total risk are the same (Al-Abdali (1980, p.12)).

Barry (1983) suggested combining business risk (br) and financial risk (fr) in a multiplicative way to determine total risk (tr). In a risk-free cost of borrowing situation (fixed interest rate with "i" expected value and zero standard deviation):

$$tr = (br)(fr) = \text{standard deviation for return on equity} \tag{3}$$

where:

br = standard deviation of risky assets
fr = (total debt)/(total assets)
fr = financial leverage

Since variability of returns to assets and the index of financial risk (financial leverage) are both positively related to the level of total farm risk, a strategic trade-off could occur between financial management strategies and scale adjustments in leverage (Al-Abdali (1980, p.4)).

In contrast to Barry (1983), Gabriel and Baker (1980) proposed an additive relationship between business risk (br) and financial risk (fr) in determining total risk (tr):

$$tr = (br) + (fr). \tag{4}$$

This approach emphasizes a farmer's (direct) trade-off between business risk and financial risk, subject of a maximum risk tolerance. A decline in business risk, perhaps attributed to public policy, may lead to acceptance of greater financial risk, thus offsetting the lower business risk. Their analysis of the aggregate portfolio of farm sector yielded empirical evidence consistent with this phenomenon (Gabriel and Baker (1980; p.14)).

Collins (1985) and Gabriel and Baker (1980) concluded that a decrease in business risk should produce an increase in financial leverage (financial risk) , ceterus paribus, for a risk-averse, expected utility maximizer. Therefore, a change in leverage (financial risk) level, may be due to a change (on the other direction) in business risk, leaving the total risk (relatively) unchanged. In other words, Collins (1985) and Gabriel and Baker (1980) suggest that, using (financial) risk levels as a firm performance measure may be completely misleading since total risk would stay unchanged. However, since business risk affect all firms, the debt-related strategies (determining the financial risk) of a given firm may provide some information about the firm´s performance (see: Al-Abdali (1980, p.4)).

Therefore, from Collins´ (1985), it would be expected that for an "average" risk-averse expected utility maximizer, total risk level should remain the same. This would suggests once more the uselessness of financial risk measures as firm performance measure. In this way, one may look at other firm performance measures, such as profitability measures, as measures of firm performance.

With this in mind, it would be interesting to study the relationship between debt-related measures and other potential measures of firm performance such as utility and profitability measures. Assuming that humans are risk-averse and profit maximizers at the same time, then it would be expected that farmers with higher debt levels would have higher profitability since a decision maker would not incur on higher debt-levels (more financial risk) unless the expected economic return is high enough. Thus the decision maker is faced with a trade-off of options.

On the same lines of thought, assuming that humans are utility maximizers, profit maximizers, and risk averse, then it would be expected that farmers with lower financial risk levels and higher profitability (all else equal) would have higher levels of utility. Thus, the following hypothesis deserves to be studied:

> Ho.3: Financial risk is negatively and significantly correlated with the farmer´s utility.

From a general perspective of the treatment of risk at the firm level, some authors (see: Al-Abdali (1987, p.22)) suggest that risk can be widely measured in two ways:

a. Variability of income as measured by variance or standard deviation, and

b. "Chance of loss" or probability that random income will fall below some critical or "disaster" level.

The first definition may be consistent (under very restrictive assumptions) with quadratic programming model in which the decision maker is assumed to maximize expected utility (Al-Abdali (1987, p.22)).

The second definition is more inclined toward "safety-first" models (Al-Abdali (1987, p.22)). The safety-first approach assumes that the decision maker is concerned with the ability to prevent total disaster rather than with the possibility of small losses and gains. It specifies that a decision maker first satisfies a preference for safety, or a risk constraint, in selecting among action choices, and then follows a profit-maximizing attitude (Al-Abdali (1987, p.22)).

Notice that under expected utility maximization, larger variances in income would decrease expected utility with respect to a less variable income, even in the event of similar return on equity or absolute net income in the two cases. If humans are assumed to be rational with a given level of ("average" or constant) risk aversion, then it may make sense that the variability on income could affect the utility level. However, assuming that each human has a particular (different) level of risk aversion, a given level of variability on income could have a positive effect on the marginal utility of income for individual "i", while having a negative effect on the marginal utility of income for individual "j".

Moreover, from the money fungibility assumption of neoclassical economics (the assumption that money can be used in different functions (Hyman (1993, p.616)) and the assumption of positive marginal utility of income (positive marginal utility of money), it should be clear that there should exist a given level of income or money equivalent in terms of utility to a given reduction on the level of risk (in this context, risk may be given by the debt levels (financial risk) or by the variability in one of the profitability measures (total risk)).

That is, it turns out that there can be a trade-off between profit and risk. Therefore, the decision maker´s problem may be reduced just to the profit maximization one since there will be a given amount of profit that the decision maker is willing to give up in exchange for less risk. This would confirm McCrory and Gerstberger´s (1992, p.38) suggestion that the only sensible firm performance measure is (should be) profitability.

Assuming that a firm performance measure such as net profit is positively and significanctly related with utility and that net profit is free from the debt-related strategy preferred by the decision maker and, therefore, free form risk-aversion differences among the decision makers, then net profit may be seen as a reasonable performance measure. Under this condition, studying the following hypothesis will provide interesting information.

Ho.4: Financial risk is statistically independent from profitability measures, while profitability is significantly and positively related with utility.

If the correlation coefficient of debt-related variables and profitability is statistically insignificant at the same time that profitability and farmer´s utility is statistically (positively) correlated, then "Ho.4" would be accepted. This would mean that empirical evidence for the profit maximization assumption, is obtained. That is, taken as a fact that humans are utility maximizers, a statistical positive correlation between utility and profitability (all else equal) suggests an agreement between the assumptions of utility maximization and profit maximization.

If financial risk and profitability are negatively correlated, then an assumption conflict arrives: either humans are risk averse (this would be the case if debt and farmer´s utility were negatively correlated) or profit maximizers (this would be the case if profitability and farmer´s utility were positively correlated) but not both. This results will seriously question the neoclassic economic assumption of profit maximization and risk aversion.

If financial risk is negatively (and significantly) correlated with utility, and profitability is positively (and significantly) correlated with utility, then there would be empirical (statistical) evidence that humans are both risk averse and profit maximizers, which will agree with standard believes.

2.1.5. Self-assessment of farmer´s satisfaction as firm performance measure:

Self-assessment of personal satisfaction has been used as a firm performance measure by a number of authors. Brush and Vanderwerf (1992, p.157-159) used subjective and objective performance measures to evaluate new venture firm performance. The objective performance measures used were: "change in sales", "operating/discontinued business", "changes in employees", and "profitability" (return on sales, return on investment, and net profit) (p.159). The self-reported or subjective performance measures used were self-report and competitor-opinion of satisfaction with the new venture performance (p.157). The authors found that both objective and self-reports (or subjective) performance measures were positively correlated, which gives reliability to both performance measure methods.

In other contexts, it has been found positive correlation between objective measures and self-assessments (subjective) measures of family quality of life as estimator of the individual´s real utility level (Muckler and Seven (1992, p.447)). The point here is that self-reports (or self-assessments) have been shown to be good predictors of measurable characteristics in humans.

Objective measures deal with what is happening. Subjective measures (such as self-assessments) can, in addition, consider how well one is coping, the resources consumed in coping, resources still in reserve, past experience, present knowledge, and probable level of motivation (Muckler and Seven (1992, p.449)). This perspective can give subjective measures an advantage over objective ones when predicting what is going to happen is as important as what is happening (p.449).

Thus it seems reasonable to assume that self-assessments of farmer´s satisfaction (a "subjective" measure) can be a meaningful proxy of overall farmer´s performance and of farmer´s real utility level, which would be the ultimate subjective farm performance measure.

Finally, as stated in section "2.2.1" above, titled "Firm performance: definitions", Perrin (1968, p.55) also suggests that personal "satisfaction" or "utility" should be the focus of any firm performance measure.

2.2. Financial statements analysis:

Financial statement analysis is the assessing of a firm´s performance, including firm´s position and prospects (Horngren and Sundem (1990, p.672)). The main financial statements used to analyze the firm´s general performance are the income statement and the balance sheet. However, because of the large amount of information available and controversies about the nature of the analysis in some cases, financial statement analysis is a very general term which does not have a fixed or determined definition. In this context, Horngren and Sundem (1990, p.672-673) explain that there is much room for stiles, judgements, and controversy about how to do a financial statement analysis.

Financial statement analysis is useful because past performance is usually a good indicator of future performance, and current position is the base on which future performance must be built (p.673).

The general objectives of financial statement analysis from the financial accounting point of view are to assess the firm´s profitability and to assess the firm´s risk level (Horngren and Sundem (1990, p.673)). Horngren and Sundem (1990, p.681) explain that the firm´s profitability is usually measured by means of net profit or profitability ratios (return on assets, return on equity, gross profit rate, return on sales, asset turnover, and pretax return on sales), while the firm´s risk level is usually measured by short-term liquidity ratios (current ratio and quick ratio) and long-term solvency ratios (total debt to total assets, total debt to equity, and interest coverage).

2.3. Selection of one or more firm performance measures:

Given the variability of firm performance measures found in the literature, it is necessary at this point to design a statistical test in order to have a "objective" criterium to make comparisons among the different firm performance measures. The rationality to be used is to compare the different traditional (accounting or objective) firm performance measures found in the literature with farmer´s self-assessment of satisfaction, which may be a good proxy of real utility as explained in Muckler and Seven (1992).

2.3.1. Statistical/empirical analysis:

Brush and Vanderwerf (1992, p.163) proposed a statistical test in order to study the behavior of the different firm performance measures reported by the literature, aiming to select one or more firm performance measures. For any one pair of firm performance measures (for example, one measure of profitability such as net income and utility (self-assessment of farmer´s satisfaction), Brush and Vanderwerf (1992, p.163) recommend to begin the testing with calculation of a Pearson´s correlation coefficient. This test indicates whether there exists a close linear relationship between the performance estimates from the alternative sources of information. Brush and Vanderwerf (1992, p.163) explain that the existence of such a linear relationship will be adequate to enable the researcher to use either firm performance measure with confidence.

Following this procedure reported by Brush and Vanderwerf (1992, p.163) a statistical test can be formulated. That is, a number of different ("objective") firm performance measures found in the literature will be compared with farmer´s self-assessment of satisfaction (a "subjective" performance measure used here as a proxy of the farmer´s utility). From this test, a better understanding of the behavior and interests of the farmers is likely to be obtained.

2.4. Effect of socioeconomic variables on farm household´s income:

Studies of family earnings or income typically include personal characteristics variables such as education, race, experience, and gender (Tokle (1988, p.54-55)).

Tokle (1988, p.55) studied the effect of several socioeconomic variables on farm household´s income. He used total farm-household income as the measure of household performance, which was used as the dependent variable. Tokle (1988, p.26) used multivariable linear regression equation using a sample obtained from the USDA of 60,000 farm households from 1979 to 1982.

Farmers were divided into two subsets based on population density of the states. For farmers in the higher densely populated states, R2 of the model was 0.28. For the other group, R2 was 0.19. (p.109, 156). The results for both models were similar and reported as follows:

-Husband's age is positive but at diminishing rate on the percentage increase in household cash income. Farm household cash income increase peaks where the husband's age is 43.8 (p.104).

-Husband's and wife's schooling are shown to have similar effects: significantly (at 5%), an increase of 1 year to husband's or wife's schooling increases farm household cash income by 3% (p.105).

-Race was not statistically related to farm household cash income (p.105).

-The elasticity of total household cash income with respect to non-farm asset income is 0.127. That is, for every dollar increase on total household cash income, $0.127 increase on non-farm income was observed (p.106).

-Young children (age six or less) cause a reduction in farm household cash income of 11.6% per child. Older children (more than six) do not have statistically significant effect on farm household cash income (p.106).

-Higher state non-farm wage rates do result in larger total farm household cash income. This may be due to off-farm work when off-farm work occurs, especially for married farm males (p.106-7).

-A higher than normal state unemployment rate tends to reduce farm household income (significance of only 15%). This may be due to reduced probability of off-farm wage work (p.107).

-The state unemployment rate and the change in the share of the jobs that are in the service industries do not have a significant effect on farm household income (p.107).

-Geoclimatic conditions have statistically significant effects on household cash income. An increase of one inch per year in normal rainfall increases farm household cash income by 0.42 percent (p.107).

-Price of crop (grain, hay, etc) output is positively and significantly (5%) related to farm household cash income (p.107).

-However, livestock output price is negative and significantly (5%) related to farm household cash income. This may be due to the behavior of inventories when the price rises, as explained by Tokle (1988, p.107-108). Tokle (1988, p.107-108) suggests that an increase in price for livestock causes farmers to initially withhold female animals from the market so that the inventory of breeding stock can be built up. Thus, a rise in the livestock output price can actually cause a reduction in household cash income in the short run. However, Tokle's (1988, p.107-108) reasoning does not seem to make much sense since one could argue that actually when livestock prices rise, farmers will tend to sell more, following the law of demand and supply.

-Surprisingly, price of farm inputs (including farm wage) was positive and significantly related to household cash income in the equation. Besides recognizing that this result is surprising, the author could not offer any explanation of such a result (p.108).

-Region (North Central, Southern, and Western regions) was not significantly related to farm household cash income (p.108).

Therefore, as done by Tokle (1988, p.54-55), a number of socioeconomic variables may be studied. Specifically, it may be interesting to study the relationship between a number of socioeconomic variables and utility. Thus, the following hypothesis may be formulated:

Ho.5: Demographic characteristics of the farm household may be important variables affecting utility. Some of the demographic variables to be studied are:

a. Household origin (white, black, hispanic)

b. Farmer´s age

c. Farmer´s education level.

Ho.6: Farm enterprise characteristics are important variables affecting utility. The farm enterprise characteristics variables to be studied are:

a. Farm size

b. Use of different marketing strategies

c. Use of a number of (outside) information services.

2.5. A final comment about the issue of firm performance:

As stated above, the issue of firm performance has been studied by a number of authors in terms of utility, profitability, growth, and risk measures. A number of authors (Olatunbosun (1967, p.175), Datta, Rajagopalan, and Rasheed (1991, p.548), and Perrin (1968, p.55)) have suggested that personal satisfaction (as proxy of utility) should be the core of the firm performance definition.

Therefore, it seems reasonable to justify the use of farmer´s satisfaction level (a "subjective" measure) as a firm performance measure to be compared with other firm performance measures ("objective" measures) found in the literature (such as profitability, growth, and risk measures) and with a number of demographic variables (such as education and age). Hence one may think in the following model to be analyzed latter on:

$$\text{Utility} = f(\text{profitability, growth, risk, education, age, etc.}) \quad (5)$$

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CHAPTER III

METHODOLOGY

In this chapter, a general description of the methodology used in this study is done. The order of the contents of this chapter can be stated as follows: First, the main goals of this study will be re-stated. Second, the main questions to be answered and the main hypotheses to be studied are stated. Finally, a description of the data and statistical tests to be employed is done.

3.1. Main goal or objective of this study:

As mentioned earlier in "Chapter I", the main goal or objective of this study can be stated as follows:

> To study the different firm performance measures used by different authors, including their relationship among themselves and with a number of socioeconomic variables. Specifically, utility will be related with other performance measures (profitability, growth, financial risk, etc.) and with a number of socioeconomic variables.

3.2. Questions to be answered in this study:

The main questions to be addressed by this study can be written as restatement of this dissertation's main goal, as follows:

What is the relationship between self-assessment of farmer´s satisfaction (as a proxy of the farmer´s overall performance and utility level), and other firm performance measures reported by the literature (which can be seen as the more traditional "objective" measures of firm performance), and other socioeconomic variables?.

3.3.- Hypotheses:

In line with the main goals and questions to be answered in this dissertation, the main hypotheses can be stated as follows (these hypotheses were already stated in "Chapter II"):

Ho.1: Profitability measures are positively and significantly correlated with utility.

Ho.2: Growth measures are positively and significantly correlated with utility.

Ho.3: Financial risk is negatively and significantly correlated with utility.

Ho.4: Financial risk is statistically independent from profitability measures.

Ho.5: Demographic characteristics of the farm household may be important variables affecting utility. Some of the demographic variables to be studied are:

a. Household origin (white, black, hispanic)

b. Farmer´s age

c. Farmer´s education level

Ho.6: Farm enterprise characteristics are important variables affecting utility. The farm enterprise characteristics variables to be studied are:

a. Farm business (entity) size

b. Use of different marketing strategies

c. Use of a number of (outside) information services.

3.4. Data to be used for the empirical analysis:

The sample was chosen at random from the about 75,000 farm operator households in Ohio. Landlords and retired farmers who own but not operated land were not included in the survey (see: Department of Agricultural Economics and Rural Sociology, The Ohio State University: ESO 1877 (1991, p.1)).

The sample can be considered to be representative of all Ohio households and of other farmers in the eastern Corn Belt region (see: Asplund, Forster, and Stout (1989, p.3)).

The data to be used for the empirical analysis in this study comes from the longitudinal survey of Ohio farm operator households for the years 1986, 1987, 1988, and 1990 (no survey was conducted in 1989). Such survey is managed by the Department of Agricultural Economics and Rural Sociology at the Ohio State University together with the US Department of Agriculture or USDA (See: OSU-Ohio Agricultural Research and Development Center: Research Bulletin 1185 (1989, p.3-7)).

Each year, about 950 farm operator households were surveyed by phone; however, for data merging purposes, the size of the usable sample consistent for all years studied is about 400. This drop in sample size is due to the fact that for merging purposes, only the farm households participating in all four years surveyed were considered.

The survey provides information about profits, assets, debt, technological/production efficiency indicators, information services used, demographic variables, and a set of opinion questions containing a self-assessment of farmer's satisfaction (which will be used as a proxy of utility).

After each year, the sample was comprised of those participating in the previous year plus replacements for those dropping out of the study or those being systematically replaced. This is necessary to obtain representativeness of the sample (Blue and Forster (1992, p.2)).

Telephone interviews were detailed and took about an hour each. Interviews were performed in evenings around tax completion dates (February-May) so that tax records could be available as references or memory refreshers. All interviewers (about 25) had farm backgrounds and nearly all were women (most of them were farmers' wives). Many of the interviewers had previous interviewing experience and all understood the topics in the interviews. In addition, a one-day training session was offered to all interviewers, under the supervision of the OSU-Ohio Agricultural Research and Development Center (OSU-Ohio Agricultural Research and Development Center: Research Bulletin 1185 (1989, p.3)).

3.5. Statistical analysis:

As it seems natural, an important part of the statistical analysis will deal with the description of a number of variables in the context of Ohio commercial farmers. By means of central tendency measures (specially, means and standard deviations), correlation analysis, and factor analysis (when pertinent) a number of inferences may be obtained. This "variable description" step will appear in "Chapter IV" ("Results and discussion: descriptive analysis").

Being not less important that the "variable description" step, the step explicitly analyzing the relationship among the different variables studied will also be performed (by means of correlation and regression analysis). In this section, which will appear in "Chapter V" ("Results and discussion: inferential analysis"), the farmer´s utility measure (a "subjective" measure of firm performance) will be compared with other firm performance measures ("objective" firm performance measures) found in the literature.

It may be pertinent at this point to note that the utility measure to be used (level of personal satisfaction) is a discrete (ordinal) variable following a multinomial distribution. For this reason, the logistic model estimation (maximum likelihood estimation) will be performed when fitting the model using utility as the response (dependent) variable, as explained in SAS (SAS (1990)). More details about the estimation procedure and other statistical issues will be provided latter in this chapter or when it be necessary latter in the analysis ("Chapter IV" and "Chapter V").

3.5.1. Information to be used from the longitudinal survey:

In order to measure the farmer´s self-assessment of utility level (a "subjective" measure of farm performance) the last section of the longitudinal survey will be used. Such section is titled "Opinion questions" and it contains questions asking the farmer his self-assessment about his financial situation compared with the past and compared with other farmers, about his quality of life compared with the past, about his level of satisfaction with farming in the present time, about his future expectations, and about his level of day-to-day stress.

Factor analysis will be done in order to know if all this aspects (suspected to indicate general satisfaction or utility on a positive direction) are indeed positively correlated with a common share of factor variance. If such relationship is obtained, a compound index can be formulated. If one of these aspects is dominant in the consistency on the common factor (if any), then such an aspect could be considered as the single measure of utility.

Moreover, the survey provides information about profits, debts, assets, and other information useful in order to construct the main financial statements (the balance sheet and the income statement).

Personal utility can be seen as the target variable and different "objective" firm performance measures found in the literature (profitability, variability of earnings, financial risk, and growth) will be correlated with farmer´s utility in order to understand their relationship. For example, among the profitability measures to be studied, the one having significant correlation with utility will be chosen for estimation purposes.

Once a conclusion about the statistical relationship among the different farm performance measures found in the literature is established, the next step may be to try to model (a financial) farm performance measure as a function of different socioeconomic variables. This may provide important information for farm-level and policy-level decision makers, as mentioned in "Chapter I".

3.5.2. Testing hypothesis:

In order to test each of the hypothesis listed above, correlation and regression analysis will be used. Indeed, the correlation analysis alone should be enough in order to test all the hypothesis. However, regression analysis will add more information about the relationship among the different variables.

Specifically, "Ho.1" will be accepted if the profitability measure chosen is positively and significantly correlated with utility. "Ho.2" will be accepted if the growth-related measure chosen is positively and significantly correlated with the farmer´s utility level. "Ho.3" will be accepted if the financial risk measure chosen is negatively and significantly correlated with the farmer´s utility level.

In the same way, "Ho.4" will be accepted if the financial risk measure is statistically independent (uncorrelated) from the respective profitability measure. "Ho.5" will be accepted if any of the demographic characteristics of the farm household is significally correlated with utility. Finally, "Ho.6" will be accepted if any of the farm enterprise characteristics is significantly correlated with utility.

3.6. Statistical notes about the analysis to be performed:

3.6.1. Factor analysis:

Factor analysis (or common factor analysis) examines relationships within a set of variables (SAS (1982, p.295)). Common factor analysis was invented by C. Sperman in 1904 (SAS (1982, p.309)).

A "common factor" is an unobservable, hypothetical variable that contributes to the variance of at least two of the observable variables. A "unique factor" is an unobservable, hypothetical variable that contributes to the variance of only one of the observed variables. The unique factors are uncorrelated with each other, and the unique factors are uncorrelated with the common factors (or principal factors). Each common factor is assumed to contribute with at least two variables, otherwise it would be a unique factor. Moreover, the common factors are assumed uncorrelated with each other and have unit variance (SAS (1982, p.310)).

The common factor model (or approach) implies that the partial correlations among the variables, removing the effects of the common factors, must all be "zero". When the common factors are removed, only unique factors remain, which are by, definition, uncorrelated (SAS (1982, p.311)).

Consider the model

$$x = u + Bf + error \qquad (6)$$

the elements of "f" are called "factors; "B" then consists of the coefficients of these factors and for that reason the elements of "B" are called "factor loading" (Dhrymes (1970, p.77-78)). In factor analysis one assumes that the elements in "x" are observable (quantitative) variables, while the elements of "f" represent nonobservable quantities, "u" is a constant (Dhrymes (1970, p.78)).

Factor analysts use methods that produced common factors defined as linear combinations of the variables analyzed. The "Statistical Analysis System" ("SAS") provides a procedure ("PROC FACTOR") which produces the principal component analysis (SAS (1982, p.311)). The output of this procedure includes all "eigenvalues" (in the context of "matrix algebra", "eigenvalues" are also called "characteristic roots", "latent roots", or "proper values" (Judge et al (1988, p.951)) and the pattern matrix for eigenvalues greater than one.

3.6.2. Index creation and factor analysis:

In general, in order to create an index the following steps may be performed:

1. Description of the variables by means of central tendency measures such as the mean ("PROC MEANS" in "SAS").

2. A correlation analysis may be performed in order to visualize the relationships between variable ("PROC

CORR" in "SAS"). The correlation coefficient measures the proportion of the variances of two variables which is common to both.

3. A factor analysis ("PROC FACTOR" in "SAS") may be performed with the "original" variables. This factor analysis tells the researcher which variables can be grouped in an index that represents them well (high "eigenvalues of the correlation matrix" and large percentage of the total variance explained by the given factor, high "factor pattern" (or "factor loading") for each variable (high correlation of the factor with the respective variable), and high "final communality estimates" (proportion of the respective variable´s variance accounted by the main factor(s) kept) (SAS (1982, p.331))). Moreover, several "rotation" procedures may be of great help in grouping a set of variables to create an "index".

Although the correlation matrix (from "PROC CORR" in "SAS") is not explicitly necessary or related with the factor analysis and the creation of an index, high values in the factor analysis imply highly correlated variables (in one direction). Indeed, many times an index is created just under the rationality of high and statistically significant correlation coefficients between the variables included in the index.

However, a factor analysis is likely to improve the predictability and/or descriptive power of a set of (related) variables by means of the creation of an index, including only the variables that not only are positive and highly significantly correlated, but also have an important common factor explaining "most" (or a given high proportion) of the variances of all the variables included in the index. Moreover, the correlation matrix is the "raw material" used by factor analysis. That is, the correlation matrix between all pairs of variables serves as the starting point for factor analysis (Norusis (1985, p.123)).

In this way, factor analysis is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables (Norusis (1985, p.125)).

The basic assumption of factor analysis is that underlying dimensions, or factors, can be used to explain complex phenomena. Observed correlations between variables result from their sharing these factors. The goal of factor analysis is to identify the not-directly-observable factors based on a set of observable variables (Norusis (1985, p.126)).

The mathematical model for factor analysis appears somewhat similar to a multiple regression equation in that each variable is expressed as a linear combination of factors which are not actually observed (Norusis (1985, p.126)). Norusis (1985, p.127) explains that for a factor to be a good solution, it must be "both simple and interpretable" (p.127).

3.6.3. Prior communality estimates in factor analysis:

The prior communality estimates is the proportion of each variable´s variance common for all the variables considered and it is measured as each variable´s squared multiple correlation with all other variables (SAS (1982, p.319)). That is:

$$pc1 = sq(r12) + sq(r13) + \ldots + sq(r1n) \qquad (7)$$

where:

pc1 = prior communality estimate for variable "1".
r1i = correlation coefficient for variables "1" and "i".
sq(r1i) = "r1i" squared
n = number of variables in the factor analysis.

3.6.4. Factor rotation phase:

As explained by Norusis (1985, p.139), although the factor matrix obtained in the factor-extraction phase indicates the relationship between the factors and the individual variables, it is usually difficult to identify meaningful factors based solely on this matrix. Often the variables and factors do not appear correlated in any interpretable pattern and, in many cases, most factors are correlated with many variables which also makes it difficult the interpretation of the initial phase (the factor extraction phase) of factor analysis.

Norusis (1985, p.139) emphasizes that, since one of the goals of factor analysis is to identify factors that are substantively meaningful (in the sense that they summarize sets of closely related variables) the "rotation" phase of factor analysis attempts to transform the initial matrix into one that is easier to interpret. From the factor loadings, it is difficult to interpret any of the factors since the variables and factors are intertwined. The goal of rotation is to transform complicated matrices into a simpler one.

Norusis (1985, p.140) explains that, the purpose of rotation is to achieve a simple structure. That is, one would like the main factors or factor (preferably one) to have "high" loadings for only some of the variables. This permits the factors (and/or subgroups of variables within a variable group) to be differentiated from each other in order to be able to summarize a given set of variables into a single measure, namely a simple index (simple average) or any type of weighted index (weighted average). If several factors have high loadings on the same variables, it is difficult to ascertain how the factors differ.

A variety of algorithms are used for orthogonal rotation to a simple structure. The most commonly used method is the "varimax" method, which tries to minimize the number of variables that have high loadings on a factor (Norusis (1985, p.14)). In this dissertation the "varimax" rotation method will be used by means of the "ROTATE=VARIMAX" procedure, combined with the SAS´ "PROC FACTOR" procedure. More details about the "varimax" rotation method and a number of other methods ("promax", "quartimax", and "equamax") are given in Kim and Mueller (1978, p.29-41) and Norusis (1985, p. 141-148).

3.6.5. Index construction:

After examining factor analysis results and the respective rotation phase, one may construct factor indexes (also called factor scales). As explained by Kim and Mueller (1978, p.60), the researcher may want to use one or more indexes, "summarizing" a given set of (potentially) related variables, in order to use such index in other studies for estimation purposes, such as regression analysis.

Kim and Mueller (1978, p.60) explain that the main procedures for creating factor indexes suggested in the literature are:

1. Regression estimates.
2. Estimates based on ideal-variables, or the "least squares" criterion.
3. Bartlett´s method of minimizing the error variance.
4. Estimates with orthogonality constraints.
5. Simple average of variables with high factor loadings for one of the factors, or evidence of communality based in a rotated factor

pattern.

6. Creation of principal components scales.

For a number of reasons to be explained later, "procedure 5" will be used. For more details regarding the different procedures for creating factor indexes see Kim and Mueller (1978, p.66-70).

With the regression procedure ("procedure 1") the predicted index (also called scale or score) is given by estimating the regression equation (Kim and Mueller (1978, p.66-70))

$$F\text{-}HAT = X * INV(R) * B \tag{8}$$

where:

F-HAT = the estimated index value vector
B = the matrix of factor loadings
X = the vector of observed variables
INV(R) = the inverted correlation matrix for the "X´s".

Kim and Mueller (1978, p.69-70) provide several important considerations for index construction using factor analysis. They explain that there is usually a very high correlation among the indexes (or scales) produced by any of the six different scaling methods mentioned above. Therefore, for many research problems, the choice may be arbitrary. That is, one type of scale construction can serve as well as the other (regarding this statement, Kim and Mueller (1978, p.69) recommend to see Horn (1965) and Alwin (1973)).

Moreover, the choice is also dependent upon the specific research problem at hand. For example, the use of an index estimated by means of the regression method does not allow one to correctly estimate the underlying correlation between such index and the outside variables.

Another potential problem of using "complicated" (other than a simple average) indexes may be the difficult interpretation of the index and the difficulty in making the index itself (Kim and Muller (1978, p.71)). Furthermore, if the factor analysis is used only as a heuristic means of sorting out major clusters of variables in the data, all the fine points of the index-construction method become unimportant (Kim and Mueller (1978, p.69-70)).

Kim and Mueller (1978, p. 70) explain that one may consider creating indexes (or scales) utilizing only some of the information obtained from factor analysis, instead of relying on factor scales created by complicated methods. That is, one may ignore specific variations in the factor loadings and consider only one type of information as relevant: "either a variable loads high on a given factor or it does not". Consequently, an index may be built just using the average of all the variables with substantial loadings and ignoring the remaining variables with minor loadings. The scale created in this way is no longer a factor scale but merely factor-based. The rule of thumb often used in this context is to consider factor loadings less than .3 as not substantial" (Kim and Mueller (1978, p,70)). Other "rules of thumb" found in the literature for index construction using factor analysis are:

1. Kim and Mueller (1978, p.72) recommend not constructing an index combining variables with very high loadings "-say above .9-" with variables with very low loadings.

2. The greater the sample size, the better. Kim and Mueller (1978, p.76) state that Lawley and Maxwell (1971) suggest that ideally, the sample should contain at least 51 more cases (observations) than the number of variables under consideration in a given factor analysis. That is, "N - n > 50", where "N" is the sample size and "n" is the number of variables. "This is, of course, only a general rule-of-thumb" (Kim and Muller (1978, p.76)).

3. A commonly used rule-of-thumb is that there should be at least three variables per factor (SAS (1982, p.332), Kim and Mueller (1978, p.77)).

4. There should be at least twice as many variables as factors. That is, if two factors are selected, then at least four variables should be included in the factor analysis. In the same way, if three factors are selected, at least six variables should be included, and so on (Kim and Mueller (1978, p.77)).

3.6.6. Logistic regression analysis:

It is important to notice that the utility measure to be used in the statistical analysis (the dependent variable) is a categorical (discrete) variable with five response levels, which implies a multinomial distribution (Judge et al (1988, p.802), SPSS (1986, p.582)). Multinomial distributions can be seen as extensions of the Bernoulli and binomial distributions, when the response variable has more that two levels (Judge et al (1988, p.45), DeGroot (1987, p.298)). When the dependent (response) variable follows a multinomial distribution, the logistic estimation technique is recommended for model estimation (SAS (1990, p.1073), SPSS (1986, p.582)).

For multinomial distributions, the response, "Y", of an experimental unit or an individual can take on several (more than two) possible values (for the case of the utility measure it can take five possible values). Suppose "**x**" is a vector of explanatory variables and p = Pr(Y=1¦**x**) is the response probability to be modelled. The linear logistic model has the form

$$\text{logit}(p) = g(p) = \log(p/(1-p)) = a + B'x \qquad (9)$$

where "a" is the intercept parameter, and "B" is the vector of slope parameters (SAS (1990, p.1072)).

The logistic model shares a common feature with a more general class of linear models that a function g=g(u) of the mean of the response variable is assumed to be linearly related to the explanatory variables (SAS (1990, p.1072)). Since the mean "u" implicitly depends on the stochastic behavior of the response, and the explanatory variables are assumed fixed, the function "g" provides the link between the random (stochastic) component and the systematic (deterministic) component of the response variable "Y". For this reason, as explained in SAS (1990, p.1072), Nelder and Wedderburn (1972) refer to g(u) as a link function.

The logistic model estimation fits linear logistic regression models for binary or ordinal (multinomial) response variables by the method of maximum likelihood, using the logit link function (SAS (1990, p.1072)).

For multinomial (ordinal) dependent variables, the response levels may be written as

$$\text{"k+1"} \quad \text{where} \quad k >= 1. \qquad (10)$$

For the case of the utility measure (U) to be used in the statistical analysis in this study, which has five response levels, the response levels may be written as

$$\text{"k+1 = 4+1" or "1, ..., k, k+1 = 4+1 = 5".} \qquad (11)$$

In this case, the logistic procedure for a multinomial distribution fits a parallel lines regression model that is based on the cumulative distribution probabilities of the response categories, rather than on their individual probabilities (SAS (1990, p.1073)). In this way the model has the form g{probability(U <= i ¦ x)} = ai + Bx, for 1 <= i <= k (12)

where "a1, ..., ak" are "k" intercept parameters, and "B" is the vector of slope parameters (SAS (1990, p.1073)). Therefore, for the case of the utility measure (U), there will be four intercept terms, corresponding with the four parallel lines regression.

3.6.7. "Criteria for assessing model fit" in logistic estimation:

The "global score statistic", the "-2 LOG L", the "AIC", and the "SC" are criteria for assessing model fit in logistic estimation.

The logistic procedure calculates the global score statistic for testing the joint significance of all explanatory variables in the model statement (SAS (1990, p.1073-1074)).

To understand the general form of the score statistic, let "U(y)" be the vector of partial derivatives of the log likelihood with respect to the parameter vector "y", and let I(neg.y) be the inverse matrix of the negative second partial derivatives of the log likelihood with respect to "y". Under a hypothesized "y=yo", the chi-squared score statistic defined by

U´(yo) I(neg.y) U(yo) (13)

has an asymptotic chi-square distribution with "r" degrees of freedom, where "r" is the dimension of "y" (SAS (1990, p.1089)).

The "-2 LOG L", the "AIC", and the ˊSC" may be formulated as follows. Suppose the model contains "s" explanatory variables. Let "yi" be the response value of the "jth" observation. The estimate "p.hat.j" of "pj = P(Yj=yj)" is obtained by replacing the regression coefficients by their maximum likelihood estimates (MLEs). The three criteria printed by the "LOGISTIC" procedure using "PROC LOGISTIC" in "SAS" (SAS (1990, p.1088)) are calculated as follows:

-2 Log Likelihood = -2 Log L = -2 Sumj[wj*log(p.hat.j)] (14)

where "wj" is the weight of the "jth" observation.

Akaike Information Criterion = AIC = -2 Log L + 2(k+s) (15)

where "k" is the number of ordered values for the response, and "s" is the number of explanatory variables.

Schwartz Criterion = SC = -2 Log L + (k+s)log(N) (16)

where "k" and "s" are as defined above, and "N" is the number of observations (for the actual model syntax) or the total number of trials (for the events/trials model syntax).

The "-2 LOG L" statistic has a chi-square distribution under the null hypothesis (that all the explanatory variables in the model are zero), and the procedure in SAS prints a p-value for this statistic (SAS (1990, p.1089)). The "AIC" and "SC" statistics in "SAS" give different ways of adjusting the "-2 LOG L" statistic for the number of terms in the model and the number of observations used (SAS (1990, p.1089)). These statistics should be used when comparing different models for the same data, under the rule of thumb that lower values of the statistic indicate a more desirable model (SAS (1990, p.1089)).

3.6.8. Score test for testing the parallel lines assumption in logistic estimation:

Since for multinomial distribution (or ordinal response data) the "LOGISTIC" procedure fits a parallel lines regression model, a score test for testing the parallel lines assumption (also called proportional odds assumption or equal slopes assumption) may be formulated.

For the parallel lines assumption the number of response levels, "k+1", is assumed to be strictly greater than two (SAS (1990, p.1090)) and the parallel lines test can be formulated as follows. Suppose "s" explanatory variables are included in the model. Consider the multivariate response model g(Pr(Y<=i¦x)) = (1,x´)yi (17)

for "i = 1, ..., k", where "Y" is the response variable, and "yi = (yio, yi1, ..., yis)´" is a vector of unknown parameters consisting of an intercept "yio" and slope parameters. The parameter vector for this full model is

y = (y´1, ..., y´k)´. (18)

Under the parallel lines assumption,

y1m = y2m = ... = ykm (19)

for all "m=1, ..., s". Let "a1.hat, ..., ak.hat" and "B1.hat, ..., Bs.hat" be the MLEs of intercept parameters and the slope parameters, respectively, under the parallel lines assumption. Then, for all "i",

y.hat = (ai.hat, B1.hat, ..., Bs.hat)´. (20)

The chi-square score statistic is evaluated at

yo = (y1.hat, ..., yk.hat)´ (21)

and has an asymptotic chi-square distribution with "s*(k-1)" degrees of freedom. This test the parallel lines assumption (SAS (1990, p.1090)).

3.6.9. Measures of association of predicted probabilities and observed responses for logistic estimation:

The measures of association of predicted probabilities and observed responses for logistic estimation can be formulated as follows, following SAS (1990, p.1091). Let "N" be the total number of observations in the input data set (or the total number of trials for the events/trials models syntax). Suppose there is a total of "t" pairs with different responses, "nc" of them are concordant, "nd" of them are discordant, and "t-nc-nd" of them are tied. The logistic model estimation computes the following four indices of rank correlation for assessing the predictive ability of the model:

c	= (nc + 0.5(t-nc-nd)) / t	(22)
Somers´ D	= (nc-nd) / t	(23)
Goodman-Kruskal Gamma	= (nc-nd) / (nc + nd)	(24)
Kendall´s Tau-a	= (nc - nd) / (0.5N(N-1)).	(25)

3.6.10. Linear least-squares regression modeling:

When the dependent variable is a continuous variable, linear least-squares regression modeling can be used. Such model may be formulated in general terms as follows.

Suppose that a response variable "Y" can be predicted by a linear combination of some regressor variable "X1" and "X2", one can fit the "B" parameters in the equation

$$Yi = B0 + B1*X1 + B2*X2 + Ei \quad (26)$$

for the observations "i = 1, ..., n". Using the least squares, one obtains estimates that are the best linear unbiased estimates (BLUE) under classical statistical assumptions (SAS (1990, p.1354)).

3.7. Additional chapters of this study:

This study will contain "Chapter IV" ("Results and discussion: descriptive analysis") and "Chapter V" ("Results and discussion: inferential analysis"), which will narrate the developments in the statistical analysis and will comment upon the results. Finally, "Chapter VI" ("Summary and conclusions") will summarize the main findings of this study, will recognize limitations of this study, and will suggest further research.

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CHAPTER IV

RESULTS AND DISCUSSION: DESCRIPTIVE ANALYSIS

In this chapter ("Chapter IV") and the following ("Chapter V") the analysis of the data collected on Ohio Commercial Farmers will be done and the results will be discussed. "Chapter IV" deals mainly with descriptive analysis and "Chapter V" deals mainly with inferential analysis.

4.1. The data set:

As explained in "Chapter III", the data set used for the empirical analysis comes from the longitudinal survey of Ohio farm operator households for the years 1986, 1987, 1988, and 1990. The sample size for each year was about 950; however, for data merging purposes, the size of the usable sample consistent for all years studied was 401. This drop in sample size was due to the fact that for merging purposes, only the participants in all four years surveyed were considered (see: OSU- Ohio Agricultural Research and Development Center: Research Bulletin 1185 (1985, p.3-7).

Although there are no specific rules that define what a "large sample is", in general terms, the sample employed for the empirical analysis of this dissertation may be considered "a large sample". However, this statement should be considered (in strict terms) just as a personal opinion. In deed, as stated by Mood, Graybill and Boes (1974, p.358),

> "The use of the word "small" in "small-sample" is somewhat misleading since a small-sample property is really a property that is defined for a "fixed" sample size, which may be fixed to be either small or large. By a large-sample property, we mean a property that is defined in terms of the sample size increasing to infinity" (Mood, Graybill and Boes (1974, p.358)).

4.2. Sales class:

Each Ohio Commercial Farmer participating in the survey was asked the sales range in which he/she belong. The sales ranges (in dollars) were:

1. Less than 2,500
2. 2,500 - 4,999
3. 5,000 - 9,999
4. 10,000 - 19,999
5. 20,000 - 39,999
6. 40,000 - 99,999
7. 100,000 - 249,999
8. 250,000 - 499,999
9. 500,000 - and up

In order to have an idea of the distribution of farms in the sample, "Table 2" shows the frequency analysis for the respective ranges of sales listed above, for the year 1990. As "Table 2" shows, the most popular sales ranges were $40,000-$99,999 and $100,000-$249,999.

As it can be seen in "Table 2", the sales class decreases consistently from 1986 to 1990 which indicates that, on average, Ohio commercial farmers decrease on sales during the period, from an average of 40,000-99,999 to an average of 20,000-39,999. Moreover, the average sale class for the period is very close to the 1987 and 1988 sale class averages.

Table 2: Frequency analysis for the respective farm sales ranges for the year 1990.

	$´s range	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	< 2,500	24	6.0	24	6.0
2	2,500-4,999	22	5.5	46	11.5
3	5,000-9,999	43	10.7	89	22.2
4	10,000-19,999	46	11.5	135	33.7
5	20,000-39,999	51	12.7	186	46.4
6	40,000-99,999	74	18.5	260	64.8
7	100,000-249,999	86	21.4	346	86.3
8	250,000-499,999	40	10.0	386	96.3
9	> 500,000	15	3.7	401	100.0

4.3. Demographic characteristics:

As shown in "Table 3" the average Ohio commercial farmer can be described as a married, white male, about 50 years old, with high school completed (without university degree), who has been married for about 27 years to a white woman, who is about 3 years younger than he, with similar educational level. It is important to notice that since the variables "sex" and "origin" do not have any variability (98% male and 100% white), they should not be used as explanatory variables in any statistical model. More details are shown in "Table 3".

Table 3: Demographic characteristics for Ohio commercial farmers: averages for the period 1986-1990.

Variable	N	Mean	Std Dev
AGEX	395	51	12.4410
AGE86	400	49	12.7210
AGE87	401	50	12.9208
AGE88	399	51	12.9286
AGE90	398	53	12.9015
AGESPOX	360	48	11.7765
LONGMAX	360	27	12.8197

Other demographic variables:

SEX	98%	MALE
	2%	FEMALE
EDUX	8%	DID NOT COMPLETE 12TH GRADE
	62%	COMPLETED 12TH GRADE
	15%	DID 1-3 YEARS AFTER 12TH GRADE
	10%	DID 4 YEARS AFTER 12TH GRADE
	5%	DID MORE THAN 4 YEARS AFTER 12TH
MARISTX	89%	MARRIED
	3%	WIDOWED
	5%	SINGLE
	3%	DIVORCED OR SEPARATED
ORIGIN	100%	WHITE
	0%	BLACK
	0%	HISPANIC

4.4. Time worked in the farm:

As shown in "Table 4", the average Ohio commercial farmer worked 2217 hours per year or 554 hours per season, for the period 1986-1990. Assuming that he/she worked every week of the year (52 weeks), including Easter, Thanksgiving, and Christmas, it is the case that he/she worked 43 hours per week, which is more than full time. The conclusion from this finding is either that the average Ohio commercial farmer works a lot or that he/she exaggerated the time worked at the farm when asked in the survey. Another possibility is that he/she counts the "family and social time" (time spent with the wife, parents, children, etc.) as worked time. "Table 4" provides more details about the time worked at the farm by the average Ohio commercial farmer.

Table 4: Time worked in the farm by the average Ohio commercial farm operator (week per season, hours per week in each season), for the period 1986-1990.

	Variable	N	Mean	Std Dev
Hours in 86	HOURIN86	401	2348	1323
Hours in 87	HOURIN87	401	2273	1235
Hours in 88	HOURIN88	401	2114	1285
Hours in 90	HOURIN90	401	2133	1219
Averages (86-90):				
Hours in Spring	HOSPX	401	627	277
Hours in Summer	HOSUX	401	564	274
Hours in Fall	HOFAX	401	601	283
Hours in Winter	HOWIX	401	425	274
Hours per season	HOSSFWX	401	554	13
Hours per year	HOURINX	401	2217	1054

4.5. Land owned, rented-in, rented-out, and operated:

The farmers in the study were asked to indicate the number of acres owned, rented-in, rented-out, and operated (including all cropland, woodland, and all other land associated with the farm operation). As shown in "Table 5", on average, for the period 1986-1990, each farmer in the study owned 219 acres, rented-in 258 acres, rented out 3 acres, and operated 468 acres, with no statistical significant changes from year to year.

Moreover, from the standard deviation for operated acres in "Table 5" (515 acres) and applying the central limit theorem (implying that averages tend to have a normal distribution about the mean), it can be inferred that about 68% of the Ohio commercial farms operate less than 983 acres (mean + one standard deviation = 468 + 551), that about 95% of the Ohio commercial farms operate less than 1,498 acres (mean + two standard deviations), and that about all (99.74%) of the farms operate less than 2,013 acres (mean + three standard deviations).

As also shown in "Table 5", on average, less than half (47%) of the land operated was owned by the farmer although almost all the farmers (95%) owned some land. As expected (from the low fraction of the operated land actually owned), more than half (55%) of the operated land was rented-in (probably from non-active farmland owners) and even a higher fraction (65%) of farmers rented-in land. Therefore, the average farmer who rents-in land, rents almost 400 acres (258/.65 = 397). Moreover, a very small fraction (1%) of the operated land was rented-out and of the operating farmers only 5% of the farmers rented land out. It may be important to point out that the maximum area for land owned, rented-in, rented-out, and operated (not appearing in "Table 5") were 2,000, 2516, 200, and 3025 acres, respectively, which seem small absolute amounts, compared with the large farms in the other states in the USA-West.

Table 5: Land owned, rented-out, rented-in, and operated. Averages in acres for the period 1986-1990.

Type	N	Mean	%(*a)	%(*b)	Sum	Std Dev
owned	401	219.028	47	95	87830	257.2202
rented-in	401	257.583	55	65	103291	386.9840
rented-out	401	3.385	1	5	1357	17.4990
operated	401	467.657	100	100	187530	514.6979

(*a) Percentage of acres operated.
(*b) Percentage of farmers in the study.

The relationships between land owned, rented-in, rented-out, and operated are as expected, as shown in "Table 6". That is, farmers who operated more land, also owned and rented-in more land. Moreover, farmers who rented-out more land, also operated and rented-in less land. The statistics in "Table 6" are correlations measuring the closeness of a linear relationship between two variables.

The relationship among different variables (including correlation coefficients) may be important in order to choose variables for regression analysis. For example, since acres operated, owned, and rented-in are positively, highly, and significantly correlated among themselves ("Table 6"), if more than one of this variables is introduced as explanatory variable in a regression model, then multicollinearity is likely to appear, which would distort the estimation. Therefore, in case of multicorrelation, unless an index be used by means of factor analysis, the best option may be to choose only one of the candidate variable.

For example, in the case of acres operated, owned, and rented-in, one is usually more interested in the operated land; therefore, only this variable should be used as a potential explanatory variable.

Table 6: Pearson Correlation Coefficients for the average owned, rented-in, rented-out, and operated land, for Ohio commercial farms for the period 1986-1990. (*a).

	Owned	Rented-in	Rented-out	Operated
Owned	1.00000 0.0	0.26363 0.0001	0.12858 0.0099	0.69281 0.0001
Rented-in	0.26363 0.0001	1.00000 0.0	-0.11203 0.0249	0.87418 0.0001
Rented-out	0.12858 0.0099	-0.11203 0.0249	1.00000 0.0	-0.03978 0.4270
Operated	0.69281 0.0001	0.87418 0.0001	-0.03978 0.4270	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0, N = 401.

4.6. Use of marketing strategies:

The farmers in the study were asked if they had used any of the following marketing strategies:

1. Forward contracting (FOCOXMS)
2. Minimum (floor price) price contracts (MIPCXMS)
3. Delay pricing (DEPRXMS)
4. Trade in futures contracts for hedging (TFHEXMS)
5. Trade in futures contracts for speculation (TFSPXMS)
6. Trade option contracts for hedging (TOHEXMS)
7. Trade option contracts for speculation (TOSPXMS)
8. Stored unpriced grain for later resale (SUGLXMS)
9. "Pick and roll" (PIROXMS)

Moreover, the farmers were asked what net gains (or losses) were incurred in trading futures and options contracts in the year before ("GAFOXMS"). As shown in "Table 7", for the period 1986-1990, on average, each farmer lost "-$249" per year from trading in futures and options contracts.

"Table 7" also shows the average percentage and standard deviations of farmers who **did not** used each of the marketing strategies listed above (from 1 to 9). A total average of usage of each marketing strategy was created ("INDEX1MS"). The value of INDEX1MS (as shown in "Table 7") is 84%, with a standard deviation of 16%. That is, on average, 84% of the farmers did not use any of the marketing strategies analyzed.

Invoking the implications of the standard deviation in probabilistic theory explained by DeGroot (1987, p.269-270), the results in "Table 7" mean that, in theory, a given marketing strategy is not used, on average, by 84% of the

Ohio commercial farmers and that most times a marketing strategy will not be used by an average farmer in a range of 68% and 100% (given a standard deviation of 16%: "84% - 16% = 68%" and "84% + 16% = 100%").

It is interesting to notice that this statistical (theoretical) interpretation (DeGroot (1987, p.270)) of the value of "INDEX1MS" can be empirically confirmed by observing the other values of "Table 7", whose range goes from 68% (FOCOXMS) to 97% (TOSPXMS).

The situation illustrated above is important because (at least in this case) it shows how statistical theory and empirical evidence converge to (about) the same results, given the large sample properties assumed for the data set. Theoretically, all the variables in "Table 7" are constant and with normal distribution, since all of them are averages over a large sample. This follows from a basic application of the "central limit theorem" (DeGroot (1987, p.274-6), Judge et al (1988, p. 86, 268-9), Mood, Graybill, and Boes (1974, p. 111, 195, 233-4), and Neter, Wasserman, and Kutner, (1989, p.6)).

Table 7: Means and standard deviations for the use of different marketing strategies (% of farmers who did not use the respective marketing strategy), and for gains (losses) of the use of trade in futures and option contracts (in dollars), for the period 1986-1990.

Variable	N	Mean	Std Dev
FOCOXMS	379	68.14 %	38.78 %
MIPCXMS	370	96.15 %	11.66 %
DEPRXMS	371	75.07 %	33.01 %
TFHEXMS	371	91.71 %	23.55 %
TFSPXMS	351	95.73 %	15.34 %
TOHEXMS	371	94.68 %	17.35 %
TOSPXMS	347	97.62 %	9.86 %
SUGLXMS (*a)	374	68.81 %	34.19 %
PIROXMS (*b)	374	69.92 %	39.57 %
INDEX1MS	342	84.49 %	16.41 %
GAFOXMS	401	-$248.6783	$2850.7099

(*a): Not measured in 1986.
(*b): Not measured in 1986 and 1990.

4.7. Correlation analysis for marketing strategies:

In order to analyze the relationship among the usage of all these marketing strategies among themselves and with the gains (losses) incurred in futures and options contracts, a correlation analysis was performed and its results are shown in "Table 8".

From "Table 8" it can be noticed that the use of all marketing strategies (marketing strategies besides cash sales) is positively and highly significant (p=0.01) correlated among themselves. That is, farmers who use one of the marketing strategies studied, also tend to use the others.

The positive and highly significant correlation among all marketing strategies suggests a rationality to use a measure of "marketing strategy" such as an average or index (as "INDEX1MS), as a potential variable to be used for estimation purposes.

In general, gains in futures and options contracts did not have high absolute values of correlation coefficients with the use of marketing strategies, with negative values and with statistical insignificant coefficients for some marketing strategies. In other words, in general, the use of more marketing strategies do not improve the gains in the futures and options markets. This result is somehow surprising given that one would expect, from economic theory, some type of learning process (specialization) and scale economies in the collection of marketing information.

Table 8: Correlation analysis for the use different marketing strategies and for the gains (losses) from trading in futures and options contracts. (*a).

	INDEX1MS	FOCOXMS	MIPCXMS	DEPRXMS	TFHEXMS	TFSPXMS
INDEX1MS	1.00000 0.0	0.80202 0.0001	0.44332 0.0001	0.63601 0.0001	0.69178 0.0001	0.61220 0.0001
FOCOXMS	0.80202 0.0001	1.00000 0.0	0.38516 0.0001	0.48564 0.0001	0.45283 0.0001	0.37097 0.0001
MIPCXMS	0.44332 0.0001	0.38516 0.0001	1.00000 0.0	0.21290 0.000	0.30607 0.0001	0.29360 0.0001
DEPRXMS	0.63601 0.0001	0.48564 0.0001	0.21290 0.0001	1.00000 0.0	0.26587 0.0001	0.19526 0.0002
TFHEXMS	0.69178 0.0001	0.45283 0.0001	0.30607 0.0001	0.26587 0.0001	1.00000 0.0	0.79430 0.0001
TFSPXMS	0.61220 0.0001	0.37097 0.0001	0.29360 0.0001	0.19526 0.0002	0.79430 0.0001	1.00000 0.0
TOHEXMS	0.66054 0.0001	0.42090 0.0001	0.24795 0.0001	0.28971 0.0001	0.78488 0.0001	0.66173 0.0001
TOSPXMS	0.56303 0.0001	0.31570 0.0001	0.18544 0.0005	0.23254 0.0001	0.65798 0.0001	0.73082 0.0001
SUGLXMS	0.68304 0.0001	0.47271 0.0001	0.24768 0.0001	0.45659 0.0001	0.32699 0.0001	0.23150 0.0001
PIROXMS	0.71660 0.0001	0.54145 0.0001	0.24795 0.0001	0.28559 0.0001	0.38514 0.0001	0.33878 0.0001
GAFOXMS	0.15440 0.0042	0.10152 0.0483	-0.06841 0.1892	-0.04836 0.3530	0.24731 0.0001	0.07287 0.1731

Table 8: Continued:

	TOHEXMS	TOSPXMS	SUGLXMS	PIROXMS	GAFOXMS
TOHEXMS	1.00000 0.0	0.76043 0.0001	0.31673 0.0001	0.38363 0.0001	0.20674 0.0001
TOSPXMS	0.76043 0.0001	1.00000 0.0	0.24085 0.0001	0.31169 0.0001	0.13048 0.0150
SUGLXMS	0.31673 0.0001	0.24085 0.0001	1.00000 0.0	0.39774 0.0001	0.11491 0.0263
PIROXMS	0.38363 0.0001	0.31169 0.0001	0.39774 0.0001	1.00000 0.0	0.12891 0.0126
GAFOXMS	0.20674 0.0001	0.13048 0.0150	0.11491 0.0263	0.12891 0.0126	1.00000 0.0

(*a): Correlation Analysis: Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations). N >= 342

4.8. Use of information services:

The farmers in the study were asked whether or not they had purchased or used several information services from outside the farm operation. Specifically, the farmers were asked whether or not they had used:

1. Bookkeeper/accountant (BOOKXIS)
2. Lawyer (LAWYXIS)
3. Farm management consultant (pest scout, fertilizer consultant, marketing consultant) (CONSXIS)
4. Computers (including micro computers used in business) (COMPXIS)
5. Satellite dish (for news and marketing information) (SATEXIS)
6. Financial manager consultant (FINAXIS)
7. Other (other than cash sales) (OTHEXIS).

"Table 9" shows the average percentage of Ohio commercial farmers who did not used the respective information service for the period 1986-1990.

In general, the average Ohio commercial farmer does not use information services from outside, except for bookkeeper/accountant, which is used by about half of the farmers, as shown in "Table 9". Specifically, as shown in "Table 9", the information service most commonly used by Ohio commercial farmers is bookkeeper/accountant with 50% of the farmers using it. On the other hand, satellite dish (for news and marketing information), financial management consultant, and other services were not used for over 90% of the farmers. Lawyers, farm management consultant and computers were not used for 72%, 86%, and 81% of the farmers, respectively. On average, 82% of the farmers did not used any of the information services studied, as shown by the variable "ISXXXIS", which is the total average.

In general, the correlation coefficients among the use of different (outside) information services (not shown) was positive and significant (p=0.05). That is, farmers who use a given (outside) information service tend to use the others also.

Table 9: Average percentage of Ohio commercial farmers who did not used the respective information service for the period 1986-1990.

Variable	N	Mean	Std Dev
BOOKXIS	400	49.62	0.3969
LAWYXIS	399	71.68	0.3272
CONSXIS	398	86.31	0.2288
COMPXIS	397	81.05	0.2986
SATEXIS (*a)	399	95.07	0.1673
FINAXIS (*a)	399	93.98	0.1576
OTHEXIS (*a)	331	92.85	0.1796
ISXXXIS (*b)	329	82.02	0.1249

(*a): Not measured in 1986.
(*b): This is the average for the use of the seven information services analyzed.

4.9. Hired labor:

"Table 10" shows the number of full-time hired workers employed on the farm -not including operator or household members- ("HIREDXF") and the number of days of work that part-time hired workers performed on the farm ("DAYSHXP").

As "Table 10" shows, on average, only 0.47 full-time hired workers per farmer were employed for the period 1986-1990. From the small standard deviation (1.01), it can be inferred, under normal distribution assumptions (see DeGroot (1987, p.270)), that about 68% of the Ohio commercial farmers hire less than 1.5 full-time workers. In the same way, about 95% and more than 99% of the farmers hire less than 2.5 and 3.4 full-time workers, respectively.

"Table 10" also shows that only 40 days per year (or about 1.5 months) of part-time hired workers were hired by the average Ohio commercial farmer, with a relatively small standard deviation (64 days). From these results, it can be concluded that the Ohio commercial farm operations are mainly family operated, with basically no hired labor.

Table 10: Number of full-time hired workers employed on the farm (not including operator or household members) and number of days of work that part-time hired workers performed, on the average Ohio commercial farm, for the period 1986-1990.

	Variable	N	Mean	Std Dev
Full-time:	HIREDXF	399	0.4681	1.0117
Part-time:	DAYSHXP	381	39.8472	63.5375

"Table 11" shows the correlation analysis for the use of full-time hired workers (HIREDXF) and the number of days of work that part-time and seasonal workers performed (DAYSHXP). The correlation analysis in "Table 11" shows that the association between the two variables is highly significant (p=0.01) and of a "respectable" size (0.45). This suggests that farmers who hire more full-time workers also tend to hire more part-time and seasonal workers, which may be interpreted as a size effect. That is, larger farm operations tend to hired more outside labor, as generally expected. This result will be confirmed when other potential indicators of enterprise size be analyzed by means of correlation analysis.

Table 11: Correlation analysis for the use of full-time hired workers (HIREDXF) and the number of days of work that part-time and seasonal workers performed (DAYSHXP). (*a).

	HIREDXF	DAYSHXP
HIREDXF	1.00000 0.0	0.45244 0.0001

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 381.

4.10. Interest rates on liabilities:

"Table 12" shows the average interest rates on the different sources of debt for Ohio commercial farmers for the year 1986 (such information was not available for the other years in the study). This may be important as an indicator of the opportunity cost of capital.

As shown in "Table 12", the 1986's average interest rate for farm debt was 9.25%, for non-farm debt was 10.69%, and for total debts was 9.87%, which may indicate at least one of the following possibilities: that farm credit is somehow subsidized; that there exists scale economies in credit usage since farm debt cover 96% of total debts (impact of collateral on farm real state); that non-farm activities are more profitable than farm activities and, therefore, a rational (profit maximizer) individual is willing to pay higher interest rate on non-farm credit; or that individuals are less risk averse in non-farm activities and, therefore, they are willing to pay higher interest rate on non-farm credit.

*Table 12: Average annual interest rate on total liabilities and its component items for Ohio commercial farmers, for the year 1986. (*a).*

	Variable	N	Mean	Std Dev
Farm debt:	FDTOT86I	386	9.2544	13.2083
Non-farm debt:	PDTOT86I	398	10.6877	62.3751
Total debt:	TDTOT86I	383	9.8683	32.3635

*(*a): Information for 1987-1990 was not available.*

4.11. Balance sheet:

"Table 13" defines all the components (variables) contained in the balance sheet, which appears in "Table 14".

Table 13: Notation and description for each of the components of the balance sheet (also called statement of financial position) appearing in "Table 14", for the average Ohio commercial farmer (notation quoted and in capital letters).

Assets:		
1.	"FATOXCU":	Total farm current assets.
2.	"FATOXNC":	Total farm non-current assets.
3.	"FATOXAS":	Total farm assets.
4.	"PETOXCU":	Total non-farm current assets.
5.	"PETOXNC":	Total non-farm non-current assets
6.	"PETOXAS":	Total non-farm assets
7.	"TOTOXAS":	Total assets (Farm plus non-farm assets)
Liabilities:		
1.	"FDTOTXD":	Total farm debt.
2.	"PDTOTXD":	Total non-farm debt (personal/household).
3.	"TDTOTXD":	Total debt (farm plus non-farm debt).
Equity:		
1.	"FETOXEQ":	Total farm equity.
2.	"PETOXEQ":	Total non-farm (personal/household) equity.
3.	"TETOXEQ":	Total equity (farm plus nonfarm equity).
7.	"TOTOXAS":	Total assets (Farm plus non-farm assets)

As shown in "Table 14" (the average balance sheet) most of the assets (90.10%), liabilities (95.90%), and equity (88.89%) come from the farm enterprise, which pictures the great importance of the farm on the financial position of the Ohio commercial farmers. Most of the assets were farm non-current assets (71% of total assets) and its main components (not shown in "Table 14") were farm real state assets and farm machinery, with 56% and 19% of total assets, respectively. Farm current assets accounted for 19% of total assets. Non-farm assets were distributed evenly, half current (5% of total assets) and half non-current (5% of total assets).

As shown in "Table 14", total liabilities (current and long-term) for Ohio commercial farmers, for the period 1986-1990, had a value of $88,752, of which 96% or $85,114 come from farm-debt and 4% or $3,637 come from non-farm (personal) debt. This result indicates that Ohio commercial farmers have, by far, most of their debts as part of the farm operation. Moreover, (not shown in "Table 14") the two main credit sources for Ohio commercial farmers (accounting for 66% of total liabilities) were commercial banks and Farm Credit System, with 35% and 31% of total liabilities, respectively.

Furthermore, from "Table 14, it can be inferred that total debt (current and non-current debts) covers only 17% of the value of total assets ($514,732) and 71% of the value of total current assets ($124,630), which is the sum of total farm current assets ($99,154) and total non-farm current assets ($25,476)). This result indicates that most of the assets of the average Ohio commercial farmer are held as equity (83%). In other words, the result indicates a low leverage level, which, according with standard financial theory (Brigham (1992, p.447-453, 454-455), Brigham and Gapenski (1993, p.385, 392, 404)), indicates a low financial risk (risk of bank-ruptcy). This result may also indicate that Ohio commercial farmers have low tolerance toward risk (they have a high level of risk aversion).

*Table 14: Average balance sheet (also called statement of financial position) for Ohio commercial farmers for the period 1986-1990. (*a), (*b).*

Variable	N	Mean	% (*c)	Std Dev	
Assets:					
FATOXCU	401	99154	19.26	129742	
FATOXNC	401	364607	70.83	333136	
FATOXAS	401	463761	90.10	424199	
PETOXCU	401	25476	4.95	59982	
PETOXNC	401	25495	4.95	59205	
PETOXAS	401	50971	9.90	92888	
TOTOXAS	401	514732	100.00	448409	
Liabilities:					% (*d)
FDTOTXD	401	85114	16.54	140345	95.90
PDTOTXD	401	3638	.71	11150	4.10
TDTOTXD	401	88752	17.24	141005	100.00
Equity:					% (*e)
FETOXEQ	401	378647	73.56	358997	88.89
PETOXEQ	401	47334	9.20	93028	11.11
TETOXEQ	401	425981	82.76	392177	100.00

(*a): Average for the period 1986-1990.
(*b): See the explanation for the notation used in this table in "Table 13".
(*c): Percentage of total assets.
(*d): Percentage of total liabilities.
(*e): Percentage of total equity.

*4.12. **Income statement:***

"Table 15" defines the notation for the variables appearing in the average income statement ("Table 16"). The income statement constructed in this study is in a "before (income) taxes basis", since no information about income taxes was available.

As shown in "Table 16" total earnings before taxes is shared about equal between farm income before taxes ($14,940 or 45%) and non-farm income before taxes ($18,439 or 55%), with non-farm income before taxes having a share 5% higher. Although this result is relatively normal for farmers in the USA and other parts of the World, the result is certainly surprising given the high percentage of economic resources devoted to the farming activity (as shown in the balance sheet in "Table 14", the farm business covers 71% of total assets, 96% of total liabilities, and 89% of total equity).

The main revenue sources of Ohio commercial farmers (not shown in "Table 16") are livestock sales ("LIVSXGR") and crops sales ("CROPSXGR"), with 53% and 32% of total farm gross revenues, respectively. Thus, livestock sales and crop sales represent 85% of total farm revenues. In a general sense, besides livestock and crop sales, the only item with some significance as a source of farm gross revenues is government payments ("GOVPXGR"), with 9% of total farm revenues. Government payments, together with livestock and crop sales, sum up 94% of the farm's total *revenues.*

Thus, it can be concluded that most of the economic activities depend on the farmer's ability to produce and market outputs (livestock and crops sales), instead of depending mainly on government-sources (direct government payments), which is expected in a market economy such as the one in the USA. However, the validity of this proposition depends on the amount of indirect-government-sources (for example, the significance of government intervention in price fixing such as subsides, price floors and price ceilings), which is not analyzed in this study.

Total earnings before taxes (EBT) from off-farm activities for the period 1986-1990 was $24,877. The main off-farm income sources (not shown in "Table 16") were the operator's main off-farm job, family members off-farm jobs, and benefits and other payments, with 32%, 26%, and 23% of total off-farm income. These three off-farm revenue sources accounted for 81% of the total off-farm EBT.

Table 15: Notation and description of each of the components of the income statement (also called statement of earnings and comprehensive income) appearing in "Table 16", for the Ohio commercial farmers (notation quoted and in capital letters).

1. "GROSXGR": Total farm revenues.
2. "TOTAXEX": Total farm expenses.
3. "TBAXNFI": Total net farm income before adjustments.
4. "FAARXCU": Change in farm's accounts receivable.
5. "EBTXNFI": Net farm income before taxes or farm-earnings before taxes.
6. "TOTAXOF": Total off-farm income before adjustments.
7. "PEARCCU": Change in non-farm's accounts receivable.
8. "EBTXOFF": Net off-farm income before taxes or off-farm-earnings before taxes.
9. "EBTXTOT": Total income before taxes.

Table 16: Average income statement (also called statement of earnings and comprehensive income) for Ohio commercial farmers for the period 1986-1990. (*a), (*b).

Variable	N	Mean	% (*c)	Std Dev
GROSXGR	401	114278		150799
TOTAXEX	401	99499		131902
TBAXNFI	401	14779		45132
FAARCCU	401	161		4297
EBTXNFI	401	14940	45%	45585
TOTAXOF	400	24877		22639
PEARCCU	401	-6422		18550
EBTXOFF	400	18439	55%	25137
EBTXTOT	400	33410	100%	46912

(*a): Average for the period 1986-1990.
(*b): See the explanation for the notation used in this table in "Table 15".
(*c): Percentage of total earnings before taxes.

4.13. Measure of utility:

Several variables related with different (potential) attributes of the utility level for Ohio commercial farmers were measured for the years 1988 and 1990. The definition and notation of such variables appear in "Table 17". Such variables were measured for each year on a scale one to three (one for the "negative" outcome, two for the "neutral" outcome, and three for the "good" outcome). An exemption to this structure was the measure of stress level ("STREXUT") which was measured on a scale of one to four (one for "a great deal" of stress, two for "some" stress, three for "a little" stress, and four for "no" stress).

Table 17: Notation and description for several variables related with different (potential) attributes of utility level, for the Ohio commercial farmers (notation quoted and in capital letters).

1. "FIIMXUT": Sense of financial improvement.
   How does your financial situation compare with 5 years ago?
   1 = worse, 2 = same, 3 = better.

2. "QLIMXUT": Sense of quality of life improvement.
   How does the quality of life compare with 5 years ago?
   1 = worse, 2 = same, 3 = better.

3. "FICOXUT": Sense of financial situation compared with others.
   Compared to other farmers in your area, do you feel that your financial situation is:
   1 = below average, 2 = about the same, 3 = above average.

4. "SEFAXUT": Sense of continuation in farming.
   Do you think that you will be able to farm in the next five years? 1 = no, 2 = unsure, 3 = yes.

5. "JOSAXUT": Farmer´s satisfaction/Job satisfaction.
   How satisfied are you with farming at the present time?
   1 = dissatisfied, 2 = neither satisfied nor dissatisfied, 3 = satisfied.

6. "STREXUT": Stress level.
   On a day-to-day basis, how much stress do you experience?
   1 = a great deal, 2 = some, 3 = a little, 4 = none.

7. "STDEXUT": Sense of decreasing stress level.
   During your farming career, how much would you say the level of stress has changed in your family?
   1 = increased, 2 = same, 3 = decreased.

"Table 18" shows the means and standard deviation of each of the variables defined in "Table 17", for the period 1988-1990. As shown in "Table 18", except for the measure of "sense of decreasing stress level" ("STDEXUT"), and stress level in a day-to-day basis ("STREXUT"), which had a "neutral" value of "two" and "2.5", respectively, all the variables were on the "positive" side on the tacit utility scale. In other words, Ohio commercial farmers sense financial improvement, quality of life improvement, better financial situation compared with others, security as to farming in the future, high personal satisfaction/high job satisfaction, and little stress level.

Table 18: Means of each of the variables describing some aspect of utility, for Ohio commercial farmers, for the period 1988-1990 (*a).

Variable	N	Mean	Std Dev
FIIMXUT	399	2.3058	0.6265
QLIMXUT	399	2.2506	0.5291
FICOXUT	394	2.2703	0.5131
SEFAXUT	398	2.7437	0.4443
JOSAXUT	397	2.4547	0.6478
STREXUT	397	2.4950	0.7291
STDEXUT	397	1.9987	0.6201

(*a): The definition and explanation of the notation in this table appears in "Table 17".

"Table 19" shows the frequencies for each of the variables defined in "Table 17" for the period 1988-1990. For practical purposes, the information provided in "Table 19" is basically the same as the information already provided by "Table 18" (the means). However, the frequencies help to visualize the distribution of the categories. Obviously, since "Table 19" results from the average for 1988 and 1990, there are five categories in the frequency analysis (1, 1.5, 2, 2.5, and 3). This reflects that some farmers changed category from one year to the next. Note that, for estimation purposes, these five categories can be translated, by means of the monotonic transformation "U1 = (Uo*2)-1", to a scale from one to five (1, 2, 3, 4, 5).

Table 19: Frequencies for each of the variables defined in "Table 17", for Ohio commercial farmers, for the period 1988-1990.

FIIMXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	27	6.8	27	6.8
1.5	56	14.0	83	20.8
2	90	22.6	173	43.4
2.5	98	24.6	271	67.9
3	128	32.1	399	100.0

Frequency Missing = 2

QLIMXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	15	3.8	15	3.8
1.5	43	10.8	58	14.5
2	153	38.3	211	52.9
2.5	103	25.8	314	78.7
3	85	21.3	399	100.0

Frequency Missing = 2

FICOXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	13	3.3	13	3.3
1.5	29	7.4	42	10.7
2	174	44.2	216	54.8
2.5	88	22.3	304	77.2
3	90	22.8	394	100.0

Frequency Missing = 7

SEFAXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	4	1.0	4	1.0
1.5	15	3.8	19	4.8
2	38	9.5	57	14.3
2.5	67	16.8	124	31.2
3	274	68.8	398	100.0

Frequency Missing = 3

Table 19: Continued:

JOSAXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	28	7.1	28	7.1
1.5	39	9.8	67	16.9
2	67	16.9	134	33.8
2.5	70	17.6	204	51.4
3	193	48.6	397	100.0

Frequency Missing = 4

STREXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	20	5.0	20	5.0
1.5	38	9.6	58	14.6
2	99	24.9	157	39.5
2.5	85	21.4	242	61.0
3	93	23.4	335	84.4
3.5	48	12.1	383	96.5
4	14	3.5	397	100.0

Frequency Missing = 4

STDEXUT	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	54	13.6	54	13.6
1.5	94	23.7	148	37.3
2	97	24.4	245	61.7
2.5	103	25.9	348	87.7
3	49	12.3	397	100.0

Frequency Missing = 4

In order to come up with a single measure of utility from the seven variables studied in this section, there are two general alternatives. The first alternative is to choose one single variable which represent the "best" measure of utility, based on recommendations from the literature, on statistical analysis, and on common sense. The second alternative is to make an index which joins all or a few of the seven variables studied in this section.

Such an index should be form only if a correlation and factor analysis suggest rational for it. Obviously, if an index cannot be justified, the first alternative (choosing one single variable) becomes the only alternative.

4.14. Utility measured by a single variable:

It seems reasonable to agree that among the potential proxies of utility (the seven variables studied in this section), if one had to be chosen as a single measure of utility, personal satisfaction/job satisfaction ("JOSAXUT") should be such measure. Such variable is the only one directly related with the individual´s activity, it directly measures the level of satisfaction, and it is easy to interpret. Moreover, from the literature, one finds that satisfaction is the classic proxy of utility (Takayama (1985, p.187), Tweeten and Mylay (1986, p.1), Randall (1987, p.64, 33)).

Takayama (1985, p.187) defines a "rational" individual as he/she who maximizes "his satisfaction". Moreover, Tweeten and Mylay (1986, p.1) explain that the following terms have been used in the literature to express the same concept: happiness, utility, satisfaction, well-being, quality of life.

On the same line of thought, Randall (1987, p. 64) explains that

> "The consumer's problem is to maximize satisfaction by selecting from his or her opportunity set the most preferred attainable bundle of commodities (that is, goods, services, and amenities)...The ideas of satisfaction and preferences are represented by utility" (p.64). Moreover, Randall (1987, p.33) states that "The challenge of humankind is to manage effectively the resources of the planet so as to maximize the satisfaction derived from them" (p.33).

4.15. Utility measured by an index:

Given a satisfactory correlation and factor analysis, utility could be measured by an index, which may have the advantage of making the utility measure continuous, which could facilitate certain statistical manipulations.

However, an index may present several important problems: first, the different variables included in the index may not be comparable due to different scaling used for each variable. Second, an index weights each component in a (some how) arbitrary way. Third, the interpretation of an index may be conflictive. However, even though all these problems may occur, it seems worthy to evaluate the possibility of an index to measure the utility level. In this section, the seven variables defined in "Table 17" are analyzed using correlation and factor analysis.

"Table 20" shows the correlation analysis for the seven variables defined in "Table 17". As it can be observed in "Table 20", all the variables were positively and significantly correlated with each other except the pairs "FICOXUT"-"STREXUT", "SEFAXUT"-"STREXUT", and "SEFAXUT"-

"STDEXUT". This result suggests that at least two of these variables should be dropped in order to make any meaningful index. That is why, a factor analysis was done excluding the variables "FICOXUT" and "SEFAXUT" (notice that both of this variables may be difficult to interpret and their relationship with utility seems unclear), and including the remaining five variables.

"Table 21" shows the rotated factor pattern for a factor analysis on the five variables positively and significantly correlated that follow a similar correlation pattern. This was done using the method "Varimax" with the computer package "SAS" (SAS (1982, p.309-345)). As it can be seen in "Table 21", on one hand, sense of financial improvement ("FIIMXUT") and sense of quality of life improvement ("QLIMXUT") were grouped together, on the other hand, stress level ("STREXUT") and sense of decreasing stress level ("STDEXUT") were also grouped together. However, the direct measure of satisfaction or job satisfaction ("JOSAXUT") was kept alone, having some value of communality with both groups of variables, but not enough as to be grouped with any group.

It is important to point out that this result (the rotated factor pattern in "Table 21") shows two main things: first, the infeasibility of grouping all these variables

Table 20: Correlation analysis for the seven variables defined in "Table 17", for Ohio commercial farmers, for the period 1988-1990. (*a), (*b).

	FIIMXUT	QLIMXUT	FICOXUT	SEFAXUT
FIIMXUT	1.00000 0.0	0.53189 0.0001	0.20048 0.0001	0.21595 0.0001
QLIMXUT	0.5318 0.0001	1.00000 0.0	0.18727 0.0002	0.21409 0.0001
FICOXUT	0.20048 0.0001	0.18727 0.0002	1.00000 0.0	0.17476 0.0005
SEFAXUT	0.21595 0.0001	0.21409 0.0001	0.17476 0.0005	1.00000 0.0
JOSAXUT	0.32387 0.0001	0.28867 0.0001	0.16109 0.0014	0.14471 0.0039
STREXUT	0.17359 0.0005	0.12438 0.0131	0.07385 0.1444	-0.1161 0.0208
STDEXUT	0.29020 0.0001	0.25445 0.0001	0.15783 0.0017	0.00452 0.9286

	JOSAXUT	STREXUT	STDEXUT
JOSAXUT	1.00000 0.0	0.23764 0.0001	0.30829 0.0001
STREXUT	0.23764 0.0001	1.00000 0.0	0.54637 0.0001
STDEXUT	0.30829 0.0001	0.54637 0.0001	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 392.
(*b): See notation in "Table 17".

Table 21: Rotated factor pattern for a factor analysis on five variables with a similar correlation pattern, using the method "Varimax", for Ohio commercial farmers, for the period 1988-1990. (*a), (*b), (*c).

	FACTOR1	FACTOR2
FIIMXUT	64 *	18
QLIMXUT	63 *	12
JOSAXUT	38	30
STDEXUT	26	64 *
STREXUT	11	63 *

(*a): Printed values are multiplied by 100 and rounded to the nearest integer.
(*b): Values greater than 0.446474 have been flagged by an ´*´ using the rotation method varimax.
(*c): See notation in "Table 17".

into a single index, and second, the ability of the variable satisfaction ("JOSAXUT") to represent all groups of variables. Therefore, from this empirical result, it makes statistical sense to measure utility using just the variable (job) satisfaction ("JOSAXUT").

4.16. Implicit wage per hour by working at the farm:

The implicit wage per hour worked at the farm by the farm operator ("EFHINXLE") was obtained by dividing the farm´s earnings before taxes ("EBTXNFI") by the number of hours worked at the farm ("HOURINX"). As "Table 22" shows, on average, this measure is $3.25 per hour (it may be important to notice that this measure would have been even lower if the opportunity cost of equity capital had been deducted).

This result compares lower to the wage obtained at the main off-farm job ("EFH1OFX") which was $14.31 per hour. This finding may indicate, that, besides money, farmers obtain some other benefits by working in the farm (positive externalities, which compensate the apparent lower economic return per hour worked at the farm.

Another possibility is that farmers overestimated the number of hours worked at the farm, which may have considerable decreased the apparent wage per hour worked at the farm. This may have occurred if, for example, the farmers counted the time they were awake in a normal day as the time they worked at the farm. That is, they may be counting the time they use to have the meals, a shower, and family and social time as time worked on the farm.

Table 22: Labor efficiency measures: in the farm and in the main off farm job. (*a).

Variable	N	Mean	Std Dev	Minimum	Maximum
EFH1OFX	102	14.7674	9.6408	4.4507	87.4647
EFHINXLE	401	3.2502	19.5275	-23.9387	105.5208

(*a): Notation:
"EFH1OFX" = earnings before taxes per hour worked at the main off-farm job.
"EFHINXLE"= earnings before taxed per hour worked at the farm enterprise.

4.17. Profitability measures:

"Profitability" measures the extent to which a business generates a profit from the use of land, labor, management, and capital (FFSTF (1991, p.39)). Bodie, Kane, and Marcus (1992, p.344) explain that a given profitability measure is an indicator of a firm´s overall financial health.

As explained by the FFSTF (1991, p.41-42), net farm income, the rate of return on farm assets, and other financial measures are considered profitability measures; however, these or any other financial measure "are not a substitute for informed judgement" (FFSTF (1991, p.41)).

Therefore, it seems a little adventurous to state that one or another profitability measure is "the best". Nonetheless, Bodie, Kane, and Marcus (1992, p.344) state that profits and "return on assets" (earnings before interest and taxes divided by total assets) are the most popular of these measures (the profitability measures). This statement needs to be taken cautiously because one would expect that "all" profitability measures should be positively and highly correlated, which would make the issue of choosing a profitability measure a matter of taste and/or a matter of statistical simplicity and statistical feasibility.

In a commercial farming context, the FFSTF (1991, p.42, 49, 52) explains that profits and the "rate of return on farm assets are often used as overall measures of profitability. The FFSTF (1991, p.49) recommends to measure return on farm assets as: (net farm income + farm interest expense - value of operator and unpaid family labor and management) divided by total farm assets.

"Table 23" shows the definition and notation of several profitability measures used in "Table 24". "Table 24" shows the means of such profitability measures and "Table 25" shows the correlation analysis among the profitability measures studied.

As shown in "Table 24" the return on farm assets (market value) varies from 1.29% to 4.09% depending on the measure used. However, as expected, all these measures of return on assets are positively, highly, and significantly correlated among themselves, as shown in "Table 25".

Buckley (1988, p.84) reported that, for a sample of industrial firms, the mean return on assets for the period 1979-1985 varied from 5.5% to 9.13% (p.84). Taking year-by-year data, the return on net asset varied from 2.13% to 11.3% (p.85). This result seems to compare higher than the return on assets found for the Ohio commercial farmers, which suggests that, in general, farming is less profitable than most other types of industries.

However, it is likely that Buckley (1988, p.84) used book values, which may explain part of the lower return on assets for Ohio commercial farmers (whose values are market values, which are usually higher than book values).

The correlation analysis in "Table 25" shows, also as expected, positively and highly significant correlation between net farm income and all the other profitability measures, except off-farm earnings before taxes, with whom the correlation coefficient is negative, low, and significant. This result suggests that off-farm EBT may be consider as a separate variable in the rest of the analysis, for estimation purposes. This leads one to chose as the farm´s profitability measure any of the variables involving somehow farm´s earnings before taxes.

From these statistical results, there is not clear evidence about which single farm profitability measure should be used since all of them are positively, highly, and significant correlated, as expected. However, following the recommendations from the Farm Financial Standard Task Force (FFSTF, 1991, p.49), the rate of return on farm assets, as defined by the FFSTF (1991, p.49) could be the selected financial ratio measuring profitability for further analysis in this study.

However, since farm´s earnings before taxes is a single measure, it may be better for estimation purposes in order to avoid potential interactions between the components of the rate of return on farm assets and other variables. Moreover, the interpretation of a single measure, such farm earnings before taxes, may be easier than the interpretation of a ratio, which is compound by several measures.

Table 23: Definition and notation of several profitability measures used in "Table 24".

Absolute measures:

1. "EBTXNFI": farm's earnings before taxes (net farm income)
2. "EBTXOFF": off-farm's earnings before taxes.
3. "EBTXTOT": total earnings before taxes (farm + off-farm).

Relative amounts (financial ratios):

4. "RASFAXFA": return on farm assets as measured by the standard financial accounting literature (Brigham (1992, p. 59), Brigham and Gapenski (1993, p.689)): farm's earnings before taxes (or net farm income) divided by total farm assets).
5. "RAFFSXFA": return on assets as measured by Bodie, Kane, and Marcus (1992, p.344): earnings before interest and taxes divided by total assets.
6. "PROFITX": return on farm assets measured as recommended by the FFSTF (1991, p. 49): (net farm income + farm interest expense - value of operator and unpaid family labor and management) divided by (total farm assets). The value of operator and unpaid family labor and management was measure as the number of hours worked by each individual times an approximate minimum wage of $5 for 1986-1988 and $6 for 1990.

Table 24: Means of the profitability measures defined in "Table 23", for Ohio commercial farmers for the period 1986-1990. (*a).

		Variable	N	Mean	Std Dev
Absolute measures:					
	1.	EBTXNFI	401	14939.7997	45585.1766
	2.	EBTXOFF	400	18439.1550	25137.0249
	3.	EBTXTOT	400	33409.5849	46912.4667
Financial ratios:					
	4.	RASFAXFA	401	0.0232	0.0871
	5.	RAFFSXFA	401	0.0409	0.0925
	6.	PROFITX	397	0.0129	0.1436

(*a): The explanation of the notation for this table appears in "Table 23".

Table 25: Correlation analysis for the profitability measures defined in "Table 23". (*a), (*b).

	EBTXNFI	RASFAXFA	RAFFSXFA	PROFITX	EBTXOFF	EBTXTOT
EBTXNFI	1.00000 0.0	0.72739 0.0001	0.69250 0.0001	0.48144 0.0001	-0.22399 0.0001	0.85281 0.0001
RASFAXFA	0.72739 0.0001	1.00000 0.0	0.96963 0.0001	0.63384 0.0001	-0.21036 0.0001	0.59488 0.0001
RAFFSXFA	0.69250 0.0001	0.96963 0.0001	1.00000 0.0	0.65505 0.0001	-0.17580 0.0004	0.57942 0.0001
PROFITX	0.48144 0.0001	0.63384 0.0001	0.65505 0.0001	1.00000 0.0	-0.06006 0.2331	0.43695 0.0001
EBTXOFF	-0.22399 0.0001	-0.21036 0.0001	-0.17580 0.0004	-0.06006 0.2331	1.00000 0.0	0.31792 0.0001
EBTXTOT	0.85281 0.0001	0.59488 0.0001	0.57942 0.0001	0.43695 0.0001	0.31792 0.0001	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 396.
(*b): The explanation of the notation for this table appears in "Table 23".

4.18. Growth measures:

In the financial management literature (Brigham (1992, p.62), Brigham and Gapenski (1993, p. 120-122, 192-195)), growth is defined as growth in earnings. However, it may be interesting to analyze also growth in the value of assets. "Table 26" shows the average annual growth rate in farm earnings ("GROXNFI") and the average annual growth rate in farm assets ("GROXFAA"), for the Ohio commercial farmers for the period 1986-1990. As "Table 26" shows, farm´s earnings before taxes grew at a rate of 23% per year, while farm assets grew a rate of 8% per year.

"Table 27" shows that these two growth measures are uncorrelated, with a very small positive (insignificant) correlation coefficient. This suggests that this two variables may be used separately in order to measure different aspects of growth. Nonetheless, it should be kept in mind that the standard financial management literature (Brigham (1992, p.62), Brigham and Gapenski (1993, p. 120-122, 192-195)) uses mainly the growth in earnings (in this case "GROXNFI") as the single growth measure.

Table 26: Annual farm earnings before taxes growth and annual farm assets growth, for Ohio commercial farmers for the period 1986-1990.

Variable	N	Mean	Std Dev
GROXFAA	401	0.0754	0.1465
GROXNFI	401	0.2275	6.5806

Table 27: Correlation analysis for farm earnings and farm assets growth, for Ohio commercial farmers for the period 1986-1990. (*a).

	GROXFAA	GROXNFI
GROXFAA	1.00000 0.0	0.01451 0.7720

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / N = 401

4.19. General risk measures (variability measures):

As stated by Brigham (1992, p.152), in economics as in financial management and other fields,

> "risk is a difficult concept to grasp, and a great deal of controversy has surrounded attempts to define and measure it" (p.152).

However, standard literature in financial management (Brigham (1992, p.152-157), Brigham and Gapenski (1993, 40-43), Bodie, Kane, and Marcus (1992, p.4-5)), and in economic theory (Varian, 1990, p.232-233) measures risk in terms of the variability of a set of observations. That is, the probability distribution of the profit, returns on assets, or whatever profitability measure used. In this context, the tighter the probability distribution, the smaller the variability and, therefore, the smaller the risk (Brigham (1992, p.152)).

Brigham (1992, p.152) explains that in order to be useful, any measure of risk (any measure of the tightness of the probability distribution) should have a definite value, such as the variance ("var"), standard deviation ("std"), or coefficient of variation ("cv"). The variance can be measure as the sum of the squared deviations, divided by the sample size ("n"). That is, the variance of a variable "xi" is:

Var (xi) = Sum of {(xi-xbar)*(xi-xbar)}/n. (27)

As explained by Brigham and Gapenski (1993, p.41), since it is difficult to attach meaning to a squared number, the standard deviation (std) is often used as an alternative measure of the dispersion (variability or risk) about the mean. The standard deviation of a given variable "xi" is found by taking the square root of the variance:

Std (xi) = Square root of {"Var (xi)"}. (28)

As explained before, using standard deviation as the measure of dispersion (variability or risk), one can draw some useful conclusions about the distribution of outcomes. Indeed, assuming a continuous and approximately normal distribution, one can state that 68.3 percent of the outcomes will fall within one standard deviation of the mean, that 95.5 percent will fall within two standard deviations, ant that virtually all outcomes (99.7 percent) will fall within three standard deviations (DeGroot (1987, p.270), Brigham and Gapenski (1993, p.41)). Regarding this point, it is important to note that even if a distribution is not close to normal, one can invoke Tchebysheff´s theorem (Brigham and Gapenski (1993, p.41)) and state that "for any distribution, at least 89 percent of all outcomes will lie within three standard deviations of the expected value" (p.41).

By definition, the variance and standard deviation are highly, positively, and significant correlated. Therefore, for estimation purposes, only one of them should be used, in order to avoid multicollinearity problems. Among these two variability measures, the standard deviation may be chosen since its interpretation seems to be more meaningful than the variance´s.

As explained by Brigham and Gapenski (1993, p.41) in order to measure risk per unit of return (or unit or profit), one can standardize the standard deviation and calculate the risk per unit of return. This is obtained by using the coefficient of variation (CV), which, for practical purposes, is defined as the standard deviation divided by the mean:

$$CV(xi) = Std(xi) / xbar. \qquad (29)$$

Since Ohio commercial farmers obtain earnings from the farm business (farm's earnings before taxes: "EBTXNFI") and from off-farm activities (off-farm's earnings before taxes: "EBTXOFF"), there are two potential sources of income variability or risk. Moreover, if, besides "EBTXNFI", return on farm assets ("PROFITX") is also consider as a measure of farm profitability, the variability of "PROFITX" should also be studied.

"Table 28" shows the means and standard deviation for the standard deviation ("STD...") and the coefficient of variation ("CV...") for "EBTXNFI", "EBTXOFF", and "PROFITX", for Ohio commercial farmers for the period 1986-1990. "Table 28" also shows the respective variability measures for total (farm's plus off-farm's) earnings before taxes ("EBTXTOT").

Brigham and Gapenski (1993, p.43) explain that "as a general rule", the higher the profitability measure (rate of return on assets, net earnings, or whatever profitability measure used), the higher the standard deviation (variability or risk). Therefore, if the general financial management theory and economic theory is correct, the profitability measure (in the case of this study the farm's rate of return on assets and the farm's and off-farm's earnings before taxes) should be positively and significantly correlated with its respective standard deviation. This proposition is empirically verified by the correlation analysis in "Table 29", which shows that the standard deviation of the four measures studied is highly, positively and significantly correlated with its respective measure.

This makes sense given that a, let´s say, 10% variation in an income of $100,000 is $10,000, while the same 10% in an income of $10,000 is only $1,000. This result, although quite obvious, is important because: using the standard deviation (or the variance) as a measure of risk (or variability) for estimation purposes may be conceptually incorrect and redundant (it should be seen as a fact that the higher the income the higher the standard deviation). Moreover, potential multicollinearity problems may arrive, in situations in which the income itself is a explanatory variable, along with the risk measure.

Nonetheless, many researchers use standard deviation of income along with income itself as explanatory variables in different models (Bodie, Kane, and Marcus (1992, p.187)), which may show ignorance or intentional depart from truth searching since the conclusions from such estimation may be misleading.

A more sound measure of "real" variability or risk is the coefficient of variation, which measures the standard deviation per unit of earnings. As shown in "Table 29", for all the profitability measures studied, the coefficient of variation is negatively but insignificantly uncorrelated with the respective profitability measure, and insignificantly correlated with the respective standard deviation. This result is important because it justifies the use of the coefficients of variation as measures of risk for estimation purposes along with the respective profitability measures, as explanatory variables, with unlikely multicollinearity problems.

Table 28: Average standard deviation and coefficient of variation for farm´s earnings before taxes, off farm´s earnings before taxes, total earnings before taxes, and farm´s rate of return on assets, for Ohio commercial farmers for the period 1986-1990. (*a).

Variable	N	Mean	Std Dev	Minimum	Maximum
EBTXNFI	401	14939.8	45585.2	-164907	287506
STDXNFI1	401	35139.3	49884.6	596.7	370021
CVXNFI2	401	6.9516	80.4576	0.1151	1609.2
EBTXOFF	400	18439.2	25137.0	-89578.5	166307
STDXOFF1	400	11965.0	13193.8	866.8	110855
CVXOFF2	400	2.0759	15.4521	0.0316	260.6
PROFITX	397	0.0129	0.1436	-0.7461	1.5444
STDXFRA1	397	0.1147	0.2023	0.00431	2.6488
CVXFRA2	397	9.6464	102.2	0.0909	2007.3
EBTXTOT	400	33409.6	46912.5	-192234	289202
STDXTOT1	400	40091.5	49471.2	1327.5	384512
CVXTOT2	400	3.5850	16.1016	0.1123	227.8

(*a): Notation:
"EBTXNFI" = farm´s earnings before taxes.
"STDXNFI1" = standard deviation of farm´s earnings before taxes,
"CVXNFI2" = coefficient of variation of farm´s earnings before taxes.
"EBTXOFF" = off-farm earnings before taxes.
"STDXOFF1" = standard deviation of off-farm´s earnings before taxes,
"CVXOFF2" = coefficient of variation of off-farm´s earnings before taxes.
"PROFITX" = farm´s rate of return on assets (FFSTF´s version),
"STDXFRA1" = standard deviation of farm´s rate of return on assets (FFSTF´s version),
"CVXFRA2" = coefficient of variation of farm´s return on assets (FFSTF´s version).
"EBTXTOT" = total (farm´s plus off-farm) earnings before taxes.
"STDXTOT1" = standard deviation of total earnings before taxes,
"CVXTOT2" = coefficient of variation of total earnings before taxes.

Table 29: Correlation analysis for profitability measures and their respective variability measures (standard deviation and coefficient of variation) for Ohio commercial farmers, for the period 1986-1990. (*a), (*b).

	EBTXOFF	STDXOFF1	CVXOFF2	PROFITX	STDXFRA1	CVXFRA2
EBTXOFF	1.00000	0.50235	-0.07321	-0.06006	0.01387	-0.01960
	0.0	0.0001	0.1438	0.2331	0.7832	0.6974
STDXOFF1	0.50235	1.00000	-0.01565	-0.01833	-0.00364	-0.02435
	0.0001	0.0	0.7550	0.7161	0.9424	0.6290
CVXOFF2	-0.07321	-0.01565	1.00000	0.02771	-0.01245	-0.00631
	0.1438	0.7550	0.0	0.5824	0.8050	0.9004
PROFITX	-0.06006	-0.01833	0.02771	1.00000	0.25006	-0.00762
	0.2331	0.7161	0.5824	0.0	0.0001	0.8797
STDXFRA1	0.01387	-0.00364	-0.01245	0.25006	1.00000	-0.01836
	0.7832	0.9424	0.8050	0.0001	0.0	0.7153
CVXFRA2	-0.01960	-0.02435	-0.00631	-0.00762	-0.01836	1.00000
	0.6974	0.6290	0.9004	0.8797	0.7153	0.0

	EBTXTOT	STDXTOT1	CVXTOT2	EBTXNFI	STDXNFI1	CVXNFI2
EBTXTOT	1.00000	0.36333	-0.12538	0.85281	0.32817	-0.01709
	0.0	0.0001	0.0121	0.0001	0.0001	0.7333
STDXTOT1	0.36333	1.00000	0.01862	0.42638	0.97192	0.09005
	0.0001	0.0	0.7105	0.0001	0.0001	0.0720
CVXTOT2	-0.12538	0.01862	1.00000	-0.08374	0.02410	0.01617
	0.0121	0.7105	0.0	0.0944	0.6308	0.7471
EBTXNFI	0.85281	0.42638	-0.08374	1.00000	0.45222	-0.02475
	0.0001	0.0001	0.0944	0.0	0.0001	0.6212
STDXNFI	0.32817	0.97192	0.02410	0.45222	1.00000	0.08800
	0.0001	0.0001	0.6308	0.0001	0.0	0.0784
CVXNFI2	-0.01709	0.09005	0.01617	-0.02475	0.08800	1.00000
	0.7333	0.0720	0.7471	0.6212	0.0784	0.0
EBTXOFF	0.31792	-0.09605	-0.08195	-0.22399	-0.20831	0.01311
	0.0001	0.0549	0.1017	0.0001	0.0001	0.7938

Table 29: Continued:

STDXOFF	0.18908	0.12957	-0.04065	-0.08233	-0.04166	-0.00639
	0.0001	0.0095	0.4175	0.1001	0.4060	0.8987
CVXOFF2	0.00753	-0.02683	0.26741	0.04806	-0.01916	-0.00363
	0.8807	0.5927	0.0001	0.3377	0.7025	0.9424
PROFITX	0.43695	0.27717	-0.05738	0.48144	0.30214	0.02755
	0.0001	0.0001	0.2546	0.0001	0.0001	0.5842
STDXFRA1	0.09531	0.29874	-0.00620	0.09047	0.31342	0.05677
	0.0581	0.0001	0.9022	0.0718	0.0001	0.2591
CVXFRA2	-0.04023	-0.04049	-0.00378	-0.03047	-0.03366	-0.00124
	0.4246	0.4217	0.9402	0.5450	0.5036	0.9804

(*a): Notation is defined in "Table 60".
(*b): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 396.

4.20. Financial risk measures:

As explained in "Chapter II" ("Literature review"), besides the general risk measures (which deal explicitly with the variability of income (Brigham (1992, p.152-157), Brigham and Gapenski (1993, 40-43), Bodie, Kane, and Marcus (1992, p.4-5), Varian (1990, p.232-233))), there is another risk measure which deals with the debt level an entity has (Brigham (1992, p.447-455)).

Such a risk measure is denominated financial risk and it can be seen as the additional risk placed on a firm as a result of the entity´s decision to use debt (Brigham (1992, p.447), Brigham and Gapenski (1993, p.385, 392)).

In the standard financial management literature (Brigham (1992, p.56), Brigham and Gapenski (1993, p.686)), financial risk is generally measured by a financial ratio called "debt ratio" or "total debt to total assets ratio". This is the ratio of total debt to total assets and it can be formulated as:

Debt-to-assets ratio = (Total debt) / (Total assets). (30)

In this context, debt is defined to include both current and long-term liabilities (Brigham (1992, p.56), Brigham and Gapenski (1993, p.686)).

Since Ohio commercial farmers generally have two sources of income (farm´s and off-farm´s), the respective debt ratios will be studied. "Table 30" shows the mean and standard deviation of the debt ratios for the farm, non-farm, and total (farm plus non-farm) assets.

As it can be seen in "Table 30", debt covers 17.36% of the farm´s total assets, 26.53% of the off-farm´s total assets, and 17.38% of the total (farm plus off-farm) household´s assets. The similarity between the farm´s and total´s "debt ratio" is due to the fact that most of the household´s debt and assets are held as part of the farm business, as it was shown in "Table 14" (the average balance sheet).

As explained by Horngren and Sundem (1990, p.394), in the USA, debt ratios "that were thought to be too high a few years ago are becoming commonplace today" (p.394).

Moreover, Horngren and Sundem (1990, p.394) explain that the debt burden varies greatly from industry to industry. For example, retailing companies, utilities, and transportation companies tend to have total debt to total assets ratios of more than 60%, while computer companies and textile firms have an average total debt to assets ratio of about 45% (Horngren and Sundem (1990, p.394)).

Therefore, based on the results for other industries in the USA (Horngren and Sundem (1990, p.394)), it can be inferred, from "Table 30", that, in general, Ohio commercial farmers have relatively low debt burdens (low financial risk) with a total debt to total assets ratio of only about 17%.

However, the low debt to assets ratios (low financial risk) experienced by Ohio commercial farmers may be due to the fact that these ratios were calculated using market values of assets (which are usually larger than book values), while other industries tend to report book value of assets.

Table 30: Mean and standard deviation for the financial risk measures (total debt to total assets ratio) for farm, off-farm, and total, for Ohio commercial farmers for the period 1986-1990. (*a).

Variable	N	Mean	Std Dev
DETOASXF	401	0.1736	0.2179
DETOASXP	400	0.2653	1.1902
DETOASXT	401	0.1738	0.2086
EBTXNFI	401	14939.8	45585.2
EBTXOFF	400	18439.2	25137.0
EBTXTOT	400	33409.6	46912.5
UTILIX1	397	3.9093	1.2956

(*a): Notation:
"DETOASXF" = farm´s total debt to total assets ratio;
"DETOASXP" = off-farm´s total debt to total assets ratio;
"DETOASXP" = total´s total debt to total assets ratio;
"EBTXNFI" = farm´s earnings before taxes;
"EBTXOFF" = off-farm´s earnings before taxes;
"EBTXTOT" = total´s earnings before taxes;
"UTILIX1" = utility measure.

"Table 31" shows the correlation analysis among the financial risk measures described in "Table 30" and the utility measure to be used for estimation purposes. Moreover, farm´s, off-farm´s, and total´s earning before taxes are included in this correlation analysis in order to be able to make some inferences about the relationship between financial risk and income (profitability) measures.

As it can be observed in "Table 31", all the financial risk measures (debt ratios for the farm, off-farm, and total) were negatively and significantly (p=0.003) correlated with utility. This implies that empirical evidence has been found for the assumption that humans are risk averse. That is, the higher the financial risk, the lower the utility level.

In addition, this implies that hypothesis "Ho.3", stated as

"Ho.3: Financial risk is negatively and significantly correlated with utility",

may be accepted, along with its respective implications, as explained in the above paragraph.

Moreover, "Table 31" shows that none of the financial risk measures is significantly correlated (p=0.05) with the respective income measure (farm´s, off-farm´s, or total), with positive and very small correlation coefficients for all cases. This result seems to contradict the standard believe that a higher financial risk generally increases the entity´s income, as explained by Brigham and Gapenski (1993, p.395).

In addition, this implies that hypothesis "Ho.4", stated as

"Ho.4: Financial risk is statistically independent from profitability measures",

may be accepted, along with its respective implications, as explained in the above paragraph.

It seems interesting to point out that the correlation coefficient between the farm's debt ratio and the off-farm's debt ratio is positive and "almost" significant, with a p-value of 0.0515. However, the correlation coefficient has a relatively (very) low value (0.097), which could invalidate any conclusion obtained from such relationship. That is why, the following two paragraphs should be taken with some caution.

That is, "Table 31" seems to imply that Ohio commercial farmers who have higher farm's debt ratios tend to have also higher off-farm's debt ratios. In other words, individuals with higher farm's financial risk tend to have also higher off-farm financial risk. This finding suggests that financial risk (risk aversion/seeking attitude) is a "personal" characteristic, instead of a general behavior.

This result is also supported by the finding mentioned above that the farm's and off-farm's debt ratios were uncorrelated with the respective source of income,. That is, there is not relationship between a profit maximizing behavior and a risk aversion behavior. This finding seems to contradict the belief that there is a trade-off between profits and risk. That is, risk aversion/seeking behavior does not seem to be influenced by any profitability or risk level situation (post-state or state-seeking).

Although not shown in "Table 31", just for reference, it may be relevant to point out that the same pattern of correlation observed for the debt to assets ratio was observed for the respective debt to equity ratios. This make sense given that the debt level for the average Ohio commercial farmer is relatively low compared with both equity and total assets, as shown in the average balance sheet, which appears in "Table 14".

Table 31: Correlation analysis for the financial risk measures described in "Table 30", for Ohio commercial farmers for the period 1986-1990. (*a), (*b).

	DETOASXF	DETOASXP	DETOASXT	EBTXNFI
DETOASXF	1.00000 0.0	0.09743 0.0515	0.98494 0.0001	0.03775 0.4509
DETOASXP	0.09743 0.0515	1.00000 0.0	0.17650 0.0004	-0.00587 0.9069
DETOASXT	0.98494 0.0001	0.17650 0.0004	1.00000 0.0	0.03150 0.5294
EBTXNFI	0.03775 0.4509	-0.00587 0.9069	0.03150 0.5294	1.00000 0.0
EBTXOFF	0.09690 0.0528	0.06406 0.2017	0.10306 0.0394	-0.22399 0.0001
EBTXTOT	0.08815 0.0782	0.02846 0.5709	0.08534 0.0883	0.85281 0.0001
UTILIX1	-0.18512 0.0002	-0.15143 0.0025	-0.19468 0.0001	0.09472 0.0594

	EBTXOFF	EBTXTOT	UTILIX1
DETOASXF	0.09690 0.0528	0.08815 0.0782	-0.18512 0.0002
DETOASXP	0.06406 0.2017	0.02846 0.5709	-0.15143 0.0025
DETOASXT	0.10306 0.0394	0.08534 0.0883	-0.19468 0.0001
EBTXNFI	-0.22399 0.0001	0.85281 0.0001	0.09472 0.0594
EBTXOFF	1.00000 0.0	0.31792 0.0001	-0.12233 0.0149
EBTXTOT	0.31792 0.0001	1.00000 0.0	0.02774 0.5821
UTILIX1	-0.12233 0.0149	0.02774 0.5821	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N = 396.
(*b): The notation for this table is defined in "Table 30".

4.21. Diversification measures:

The number of crop activities and the number of livestock activities in which a farmer is commercially involved was used as a proxy of commercial diversification. As "Table 32" shows, on average, each farmer is commercially involved with about three cropping activities, which makes sense given that (as explained before) corn, soybeans, and wheat are clearly the three main crops for the average Ohio commercial farmer. Moreover, from the standard deviation of the variable "DINUCROP" in "Table 32", it can be inferred that about 68% of the farmers are involved with no more than four cropping activities, as the standard deviation suggests.

The variable "DINULIVS", in "Table 32", indicates that, on average, a farmer is commercially involved only with one type of livestock. Moreover, the standard deviation of this variable (.73) indicates that about 68% of the farmers have less than two livestock-types and that close to 100% of the farmers have less than three livestock-types. That is, it seems clear that the average Ohio commercial farm does not have a diversified livestock. If farmers are rational profit maximizers, this result may imply the absence of economies of scope for livestock operations.

The correlation analysis in "Table 33" shows that cropping and livestock activities are negatively and significant correlated. That is, farmers who are commercially involved with crop activities tend to not be involved with livestock activities, and vise versa. Such result makes sense given that each activity may require certain special skills, which would be an example of the concept of specialization of labor manifested. Moreover, the results suggests the absence of economies of scope regarding crop plus livestock activities and within livestock types.

Table 32: Diversification measures: average number of crop activities ("DINUCROP") and livestock activities ("DINULIVS"), for Ohio commercial farmers for the period 1986-1990. (*a), (*b).

Variable	N	Mean	Std Dev	Maximum
DINUCROP	401	2.6883	1.3379	5.0000
DINULIVS	401	0.9551	0.7339	4.0000

Table 33: Correlation analysis for the diversification measures described in "Table 32", for Ohio commercial farmers for the period 1986-1990. (*a).

	DINUCROP	DINULIVS
DINUCROP	1.00000 0.0	-0.14413 0.0038

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N = 401.

CHAPTER V

RESULTS AND DISCUSSION: INFERENTIAL ANALYSIS

5.1. Variables to be included in the estimation:

Although, a number of important variables have been defined and described so far in this study (using mainly central tendency measures such as means), not all these variables will be used in the estimation of farmer's satisfaction (the proxy of the farmer's utility level) or other estimations. This is so in order to avoid "redundant" measures (measuring the same concept more than once), in order to avoid potential undesirable interactions (multicollinearity) of related explanatory variables, and in order to simplify the models.

Therefore, in this section of the study, a scanning of "potential relevant" variables will be done, starting from the first variables that were defined at the beginning of "Chapter IV". Moreover, subgroups of related variables will be made and a final selection of variables will be done in order to be studied with more detail by means of correlation and regression analysis.

In order to keep things in order, the following information will be included for each variable: variable name, notation, table(s) of reference (where the description was done), and type of variable (that is, what it measures). This is important in order to form subgroups of related variables for further (re)selection.

1. Farm business size measures:

1.1. Sales class; notation: "SCLASSX"; reference: "Table 2"; type of measure: entity size. Comment: this variable measures the farmer´s own perception of the size of farm sales he/she has. However, a more accurate measure of the actual farm business size may be "farm earnings before taxes", which will be mention latter on, as a profitability measure.

1.2. Acres operated; notation: "OPACREX"; reference: "Table 5" and "Table 6"; type of measure: entity size.

1.3. Number of full-time hired workers; notation: "HIREDXF"; reference: "Table 10" and "Table 11" type of measure: entity size.

1.4. Farm business total assets, notation: "FATOXAS"; reference: "Table 13", "Table 14"; type of measure: entity size.

1.5. Total farm expenses; notation: "TOTAXEX"; reference: "Table 15", "Table 16"; type of measure: entity size.

2. Demographic variables:

2.1. Farm operator´s age; notation: "AGEX"; reference: "Table 3"; type of measure: demographic.

2.2. Years of formal education; notation: "EDUX"; reference: "Table 3"; type of measure: demographic.

3. Hours worked at the farm:

3.1. Hours worked at the farm per year; notation: "HOURINX"; reference: "Table 4"; type of measure: "special", it´s useful to obtain the implicit wage rate per hour of work at the farm. Also, it may be an entity size measure.

4. Off-farm's activities:

4.1. Total non-farm earnings before taxes; notation: "EBTXOFF"; reference: "Table 15", "Table 16"; type of variable: importance of off-farm activities. Also, it may be a measure of profit maximizing attitude.

4.2. Total non-farm assets; notation: "PETOXCU"; reference: "Table 13", "Table 14"; type of variable: importance of off-farm activities.

4.3. Number of hours worked at the main-off-farm job; notation: "HOU1OFX"; type of variable: importance of off-farm activities.

5. Government payments:

5.1. Government payments (from any acres in the operation set aside under the Feed Grain and Wheat programs or Conservation Reserve Program); notation: "GOVPAYX"; type of variable: government payments. It also may be an entity size measure.

6. Not using marketing strategies:

6.1. Not usage of several marketing strategies; notation "FACTO2MS"; reference: "Table 7"; type of variable: usage of several marketing strategies.

7. Not using information services:

7.1. Not use of information services; notation: "ISXXXIS"; reference: "Table 9"; type of variable: usage of information services.

8. Growth measures:

8.1. Average annual growth rate in farm earnings before taxes; notation: "GROXNFI"; reference: "Table 26", "Table 27"; type of variable: growth measure. Note that "GROXNFI" and "GROXFAA" are uncorrelated (positive but insignificant and very small correlation coefficient) as shown in "Table 27".

8.2 Average annual growth rate in farm assets; notation: "GROXFAA"; reference: "Table 26", "Table 27"; type of variable: growth measure.

9. Opportunity cost of capital:

9.1. Interest rate paid on farm debt; notation: "FDTOT86I"; reference: "Table 12"; type of variable: opportunity cost of capital or cost of capital.

9.2. Interest rate paid on nonfarm debt; notation: "PDTOT86I"; reference: "Table 12"; type of variable: opportunity cost of capital or cost of capital. Note: this variable may not be relevant in a general context because the amount of nonfarm debt is very small as mentioned before.

10. Profitability measures:

10.1. Farm´s earnings before taxes (net farm income); notation: "EBTXNFI"; reference: "Table 15", "Table 16", "Table 23", "Table 24", "Table 25"; type of variable: profitability measure.

10.2. Return on farm assets measure as recommended by the FFSTF (1991, p. 49); notation: "PROFITX"; reference: "Table 23", "Table 24", "Table 25"; type of variable: profitability measure.

10.3. Total (farm´s plus off-farm´s) earnings before taxes; notation "EBTXTOT"; reference: "Table 15", "Table 16", "Table 23", "Table 24", "Table 25"; type of variable: profitability measure.

11. Utility measure:

11.1. Farmer´s satisfaction/Job satisfaction; notation: "JOSAXUT" or "UTILIX1" or "UTILITYX" (a categorical/discrete variable with five categories); reference: "Table 17", "Table 18", "Table 19"; type of variable: measure of utility. Note:
The utility measure to be used for estimation purposes will be personal satisfaction, as recommended in the literature and explained before. The relationship of personal satisfaction and other aspects of utility (or well being) was explained before, in "Chapter IV".

12. Diversification measures:

12.1. Livestock diversification; notation: "DINULIVS" (it measures the number of different types of livestock in the farm business); reference: "Table 30", "Table 31"; type of variable: diversification measure.

12.2. Crop diversification; notation "DINUCROP" (it measures the number of different types of crops in the farm business); reference: "Table 30", "Table 31"; type of variable: diversification measure.

13. Farmer's labor efficiency (in "$'s per hour"):

13.1. Implicit wage per hour of work at the farm by the farm operator; notation: "EFHINXLE"; reference: "Table 22"; type of variable: farmer's labor efficiency.

14. Income variability measures (general risk measures):

14.1. Coefficient of variation on farm's earnings before taxes; notation: "CVXNFI2"; reference: "Table 28", "Table 29"; type of variable: general risk measure.

14.2. Coefficient of variation on nonfarm's earnings before taxes; notation: "CVXOFF2"; reference: "Table 28", "Table 29"; type of variable: general risk measure.

14.3. Coefficient of variation of farm's return on assets (FFSTF's version); notation: "CVXFRA2"; reference: "Table 28", "Table 29"; type of variable: general risk measure.

14.4. Coefficient of variation of total (farm's and off-farm's) earnings before taxes; notation: "CVXTOT2"; reference: "Table 28", "Table 29"; type of variable: general risk measure.

15. Financial risk measures:

15.1. Total farm liabilities; notation: "FDTOTXD"; reference: "Table 13", "Table 14"; type of variable: financial risk measure (risk loving attitude: a potential indicator of risk aversion).

15.2. Total nonfarm liabilities; notation: "PDTOTXD"; reference: "Table 13", "Table 14"; type of variable: financial risk measure (risk loving attitude: a potential indicator of risk aversion).

15.3. Farm's total debt to farm's total assets ratio; notation: "DETOASXF"; reference: "Table 30", "Table 31; type of variable: financial risk measure (risk loving attitude: a potential indicator of risk aversion).

15.3. Off-farm's total debt to off-farm's total assets ratio; notation: "DETOASXP"; reference: "Table 30", "Table 31"; type of variable: financial risk measure (risk loving attitude: a potential indicator of risk aversion).

5.2. Analysis of correlation among the preselected variables and further selection:

After studying the correlation analysis among the variables mentioned above, it was found that some of these variables are highly and significantly correlated among themselves and their general (correlation) pattern is very similar, which is a potential source of multicollinearity problems and redundant estimations. For that reason, several of the preselected variables in the above section will be dropped as justified in the next paragraphs, following the correlation analysis performed. At the same time, several important findings will be stated regarding the relationships among different variables.

As it was shown in "Table 25" and "Table 29", "Table 34" shows that both farm profitability measures (farm´s earnings before taxes ("EBTXNFI") and farm´s rate of return on farm assets ("PROFITX")) are positively, highly, and significantly correlated, as expected. This suggests that one or the other, but not both measures should be included in the model as explanatory variables for utility, in order to avoid potential multicollinearity problems. Moreover, the respective variability/risk measure (coefficient of variation) may be included ("CVXNFI2" or "CVXFRA2").

As also shown in "Table 34", all farm business size measures (sales class, operated acres, number of full-time hired workers, total farm expenses, and farm business total assets) along with government payments, farm´s total debt, and hours worked at the farm by the farm operator were positively and significantly correlated among themselves and, in general, they follow a similar (correlation) pattern. Moreover, all these variables were also positively and significantly correlated with the profitability measures, which (as clearly noted and expected in the case of farm´s earnings before taxes) are themselves size measures.

A number of studies (see: Farrimond (1989, p.38-39)) found evidence that suggest the presence of scale economies in a number of industries. This finding agrees with the findings in this study showing a strong relationship between profitability and size measures.

Using different samples of 30 to 80 farmers in Nigeria, Olatunbosun (1967, p.67, 117, 122-1236) ran several regressions of farm´s gross margin (as a proxy of farm profitability) as the dependent variable. In general, he found that hired labor was negative and significantly related with farm´s gross margin. That is, hired labor had been used beyond the most profitable level of production by the Nigerian farmers in the samples (p.130). Olatunbosun´s (1967, p.67, p.117, 122-123) finding disagrees with the findings in this study, which showed a strong relationship between profitability, size, and hired labor (which may be seen as a size measure in itself). Therefore, assuming scale economies and that hired labor is an indicator of enterprise size in itself, the results in this study seem to make more sense than the results in Olatunbosun's (1967, p.67, 117, 122-123) study.

This finding seems very important at least on two grounds. First, from the statistical point of view, the importance of such finding is that some of these variables (strictly, all except one) should be dropped for estimation purposes, in order to avoid obvious multicollinearity problems.

Second, from the economic theory point of view, this suggests that there are clear scale economies for Ohio commercial farms. That is, larger farm enterprises (as explicitly measured by sales class, acres operated, number of full time workers, farm's total assets, and farm's total expenses) tend to obtain more government payments, have more debt, receive more time worked by the farm operator, and (obviously, given all else equal) have more farm's earnings before taxes and more farm's return on assets.

This may suggest a "synergetic" pattern provoking scale economies. All these makes it evident that all these variables can be seen just as measures of farm business size and that there exist scale economies. Hopefully, this finding, not only will ("wisely") guide the analysis in this study, but also will guide other researchers faced with a similar set of variables.

Naively, one could introduce several of this measures in a model and obtain "good" fit and high significance of their parameter estimates, even if there is not direct multicollinearity (no "pure" linear relationship among the variables). However, such model will "shadow" any other variable outside the stated group, which is statistically and conceptually wrong.

Moreover, such model will not add any real information to the analysis since it has been explained that the variables have a similar correlation pattern and behave similarly. Finally, such model could provide misleading information, which could provoke untruthful conclusions.

Therefore, given that the profitability measure is very relevant from the economic point of view, it contains information from the other (size) variables at issue, and it seems easy to interpret, all the other mentioned variables will be dropped for estimation purposes in order to avoid potential multicollinearity problems, arising from interactions between the farm size measures and the profitability measures. These (dropped) variables are:

1. Farm´s sales class ("SCLASSX"),
2. Operated acres ("OPACREX"),
3. Hired full time workers ("HIREDXF"),
4. Total farm expenses ("TOTAXEX"),
5. Total farm assets ("FATOXAS"),
6. Government payments ("GOVPAYX"),
7. Total farm´s debt ("FDTOTXD"),
8. Hours worked at the farm by the farm operator ("HOURINX").

As "Table 34" also shows, the farm operator´s labor efficiency measure or implicit wage per hour worked at the farm ("EFHINXLE") is positively and significant correlated with the profitability measures and with the farm business size measures and, in general, follow the same correlation pattern as the other dropped variables. Therefore, this variable also should be dropped from the model for the same potential multicollinearity problems explained above. This result also suggests scale economies in the use of farm operator´s labor, which is expected given the scale economies suggested by the explicit farm business size measures and their relationship with the profitability measures.

"Table 34" also shows that farm´s cost of capital (or average interest rate paid on farm debt ("FDTOT86I")) follows the same correlation pattern that the profitability, farm business size, and labor efficiency measures follow. Therefore, this variable also should be dropped from the model for the same potential multicollinearity problems explained above. This result also suggests scale economies in the use of debt which is not surprising given the scale economies suggested by the farm business size measures.

Furthermore, "Table 34" also shows that the crop diversification measure ("DINUCROP") and the livestock diversification measure ("DINULIVS") follow almost the same correlation pattern as the other variables dropped so far.

This makes sense assuming that large farms enterprises tend to be more diversified. This result also justify dropping these two variables for similar reasons.

During the 1970's and 1980's, several authors (see: Buckley (1990, p.45) reported a strong positive relationship between financial performance (profitability) and related diversification strategies. This finding agrees with the findings in this study, which showed a common correlation pattern between the profitability measures and the diversification and size measures.

In addition, as shown in "Table 34", not using information services ("ISXXXIS") and not using different marketing strategies ("FACTO2MS") is negatively and significantly correlated with profitability and size measures (and the rest of the variables dropped so far). In other words, larger farm businesses tend to use more information services and more marketing strategies, which makes sense given scale economies in collecting information. Therefore, these two variables should also be dropped in order to avoid the potential multicollinearity problems explained earlier.

Also, as shown in "Table 34", nonfarm debt ("PDTOTXD"), hours worked at the main off-farm job ("HOU1OFX"), and off-farm earnings before taxes ("EBTXOFF") follow a similar correlation pattern and they are positively and significantly correlated among themselves, which makes sense given that these three variables suppose to measure the importance of off-farm activities. Since off-farm earnings before taxes ("EBTXOFF") seems easier to interpret, more relevant from the economic point of view, and more representative of the importance of nonfarm activities, it will be kept for estimation purposes and the other two variables will be dropped.

Moreover, the correlation analysis in "Table 34" does not show a clear relationship between utility and farm enterprise characteristics such as entity size, use of marketing strategies, and use of information services. Most of the correlation coefficients were small (less than .09) and statistically insignificant (p=.1), with mixed signs (negative and positive). This suggest that hypothesis "Ho.6", stated as

Ho.6: Farm enterprise characteristics are important variables affecting utility,

may be rejected. In other words, "Table 34" suggests that there is not strong empirical evidence that farm enterprise characteristics affect utility.

Table 34: Correlation analysis for several variables dropped for estimation purposes, for Ohio commercial farmers for the period 1986-1990. (*a).

	SCLASSX	OPACREX	HIREDXF	TOTAXEX	FATOXAS
SCLASSX	1.00000 0.0	0.55609 0.0001	0.33087 0.0001	0.54267 0.0001	0.50119 0.0001
OPACREX	0.55609 0.0001	1.00000 0.0	0.45149 0.0001	0.66205 0.0001	0.65467 0.0001
HIREDXF	0.33087 0.0001	0.45149 0.0001	1.00000 0.0	0.57282 0.0001	0.57507 0.0001
TOTAXEX	0.54267 0.0001	0.66205 0.0001	0.57282 0.0001	1.00000 0.0	0.72188 0.0001
FATOXAS	0.50119 0.0001	0.65467 0.0001	0.57507 0.0001	0.72188 0.0001	1.00000 0.0
GOVPAYX	0.48867 0.0001	0.82911 0.0001	0.36841 0.0001	0.67851 0.0001	0.58357 0.0001
FDTOTXD	0.43595 0.0001	0.54984 0.0001	0.32019 0.0001	0.74170 0.0001	0.59430 0.0001
HOURINX	0.51535 0.0001	0.43851 0.0001	0.29589 0.0001	0.49244 0.0001	0.46303 0.0001
EFHINXLE	0.36530 0.0001	0.29227 0.0001	0.24176 0.0001	0.24146 0.0001	0.32298 0.0001
FDTOT86I	0.26067 0.0001	0.26615 0.0001	0.09287 0.0687	0.30887 0.0001	0.16981 0.0008
DINUCROP	0.21990 0.0001	0.29467 0.0001	0.08401 0.0938	0.18832 0.0001	0.20906 0.0001
DINULIVS	0.21313 0.0001	0.06530 0.1919	0.14376 0.0040	0.21207 0.0001	0.15677 0.0016
PDTOTXD	-0.01833 0.7145	0.05643 0.2596	-0.00439 0.9304	-0.02233 0.6557	-0.08609 0.0851
HOU1OFX	-0.28474 0.0001	-0.29648 0.0001	-0.17037 0.0006	-0.29356 0.0001	-0.33319 0.0001

Table 34: Continued:

ISXXXIS	-0.39200	-0.38945	-0.36408	-0.53513	-0.45092
	0.0001	0.0001	0.0001	0.0001	0.0001
FACTO2MS	-0.33298	-0.50987	-0.06611	-0.37082	-0.27498
	0.0001	0.0001	0.2070	0.0001	0.0001
EBTXNFI	0.33724	0.31704	0.28483	0.26873	0.37700
	0.0001	0.0001	0.0001	0.0001	0.0001
PROFITX	0.27799	0.21812	0.10211	0.19976	0.14458
	0.0001	0.0001	0.0425	0.0001	0.0039
EBTXOFF	-0.16390	-0.17512	-0.20502	-0.15795	-0.27566
	0.0010	0.0004	0.0001	0.0015	0.0001
UTILIX1	0.01693	0.06705	0.10697	0.07887	0.05942
	0.7366	0.1825	0.0336	0.1166	0.2375

	GOVPAYX	FDTOTXD	HOURINX	EFHINXLE	FDTOT86I
GOVPAYX	1.00000	0.62545	0.34233	0.27763	0.28174
	0.0	0.0001	0.0001	0.0001	0.0001
FDTOTXD	0.62545	1.00000	0.35301	0.14444	0.44307
	0.0001	0.0	0.0001	0.0037	0.0001
HOURINX	0.34233	0.35301	1.00000	0.37677	0.16871
	0.0001	0.0001	0.0	0.0001	0.0009
EFHINXLE	0.27763	0.14444	0.37677	1.00000	0.12403
	0.0001	0.0037	0.0001	0.0	0.0148
FDTOT86I	0.28174	0.44307	0.16871	0.12403	1.00000
	0.0001	0.0001	0.0009	0.0148	0.0
DINUCROP	0.29939	0.22546	0.12266	0.12668	0.22834
	0.0001	0.0001	0.0140	0.0111	0.0001
DINULIVS	-0.07288	0.08483	0.39395	0.16297	0.10530
	0.1452	0.0898	0.0001	0.0011	0.0386
PDTOTXD	0.01493	0.01959	-0.09003	-0.06127	0.13525
	0.7657	0.6958	0.0717	0.2208	0.0078
HOU1OFX	-0.25208	-0.19001	-0.56822	-0.26064	-0.00961
	0.0001	0.0001	0.0001	0.0001	0.8507
ISXXXIS	-0.38565	-0.44121	-0.37336	-0.27333	-0.22896
	0.0001	0.0001	0.0001	0.0001	0.0001

Table 34: Continued:

FACTO2MS	-0.51997	-0.32665	-0.20139	-0.19314	-0.31617
	0.0001	0.0001	0.0001	0.0002	0.0001
EBTXNFI	0.28615	0.16445	0.34473	0.87771	0.11299
	0.0001	0.0009	0.0001	0.0001	0.0264
PROFITX	0.22592	0.20269	0.17094	0.45059	0.15803
	0.0001	0.0001	0.0006	0.0001	0.0019
EBTXOFF	-0.09167	-0.00993	-0.42037	-0.21329	0.04894
	0.0670	0.8431	0.0001	0.0001	0.3382
UTILIX1	0.04157	-0.04182	-0.00298	0.05426	-0.18681
	0.4088	0.4060	0.9528	0.2808	0.0002

	DINUCROP	DINULIVS	PDTOTXD	HOU1OFX	ISXXXIS
DINUCROP	1.00000	-0.14413	0.05606	-0.05429	-0.15265
	0.0	0.0038	0.2628	0.2781	0.0023
DINULIVS	-0.14413	1.00000	-0.07231	-0.13444	-0.01089
	0.0038	0.0	0.1483	0.0070	0.8288
PDTOTXD	0.05606	-0.07231	1.00000	0.18624	-0.05027
	0.2628	0.1483	0.0	0.0002	0.3177
HOU1OFX	-0.05429	-0.13444	0.18624	1.00000	0.19203
	0.2781	0.0070	0.0002	0.0	0.0001
ISXXXIS	-0.15265	-0.01089	-0.05027	0.19203	1.00000
	0.0023	0.8288	0.3177	0.0001	0.0
FACTO2MS	-0.48742	0.20719	-0.08851	0.12738	0.29639
	0.0001	0.0001	0.0900	0.0145	0.0001
EBTXNFI	0.06268	0.16729	-0.04251	-0.22416	-0.30569
	0.2104	0.0008	0.3958	0.0001	0.0001
PROFITX	0.09511	0.03668	0.01161	-0.04018	-0.23044
	0.0583	0.4661	0.8176	0.4246	0.0001
EBTXOFF	-0.00730	-0.13882	0.13441	0.51682	0.09397
	0.8843	0.0054	0.0071	0.0001	0.0617
UTILIX1	-0.07215	0.06484	-0.06353	-0.07889	-0.03158
	0.1513	0.1974	0.2065	0.1166	0.5320

Table 34: Continued:

	FACTO2MS	EBTXNFI	PROFITX	EBTXOFF	UTILIX1
FACTO2MS	1.00000 0.0	-0.13742 0.0083	-0.24708 0.0001	0.05954 0.2553	0.02962 0.5722
EBTXNFI	-0.13742 0.0083	1.00000 0.0	0.48144 0.0001	-0.22399 0.0001	0.09472 0.0594
PROFITX	-0.24708 0.0001	0.48144 0.0001	1.00000 0.0	-0.06006 0.2331	0.06546 0.1942
EBTXOFF	0.05954 0.2553	-0.22399 0.0001	-0.06006 0.2331	1.00000 0.0	-0.12233 0.0149
UTILIX1	0.02962 0.5722	0.09472 0.0594	0.06546 0.1942	-0.12233 0.0149	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 366.

5.3. Selected variables for estimation purposes:

Therefore, after dropping a number of variables, as explained above, the following variables will be considered for estimation purposes:

Utility measure:

1. "UTILITYX": Farmer's satisfaction as proxy of utility level.

Profitability measures:

1. "EBTXNFI" : Farm's earnings before taxes.
2. "PROFITX" : Rate of return on farm assets (measured as recommended by the FFSTF).
3. "EBTXOFF" : Off-farm earnings before taxes. Besides the information contained about (off-farm) profit maximizing attitude, this variable also measures the importance of off-farm activities for Ohio commercial farmers.

4. "EBTXTOT" : Total (farm's plus off-farm's) earnings before taxes. This variable may be considered just for curiosity since more relevant and detailed information is contained in the variables "EBTXNFI" and "EBTXOFF".

Variability (general risk measures):

1. "CVXNFI2" : Coefficient of variation of "EBTXNFI", which is the variability or risk measure corresponding to "EBTXNFI".

2. "CVXFRA2" : Coefficient of variation of "PROFITX", which is the variability or risk measure corresponding to "PROFITX".

3. "CVXOFF2" : Coefficient of variation of "EBTXOFF", which is the variability or risk measure corresponding to "EBTXOFF".

4. "CVXTOT2" : Coefficient of variation of "EBTXTOT", which is the variability or risk measure corresponding to "EBTXTOT".

Financial risk measures:

1. "DETOASXF": Farm's total debt to farm's total assets ratio.

2. "DETOASXP": Off-farm's total debt to off-farm's total assets ratio.

Growth measures:

1. "GROXNFI" : Annual growth in farm's earnings before taxes.

2. "GROXFAA" : Annual growth in farm's assets.

Non-farm assets:

1. "PETOXAS" : Nonfarm assets.

Demographic variables:

1. "AGEX" : Farm operator's years of age.

2. "EDUX" : Farm operator's years of formal education.

Given these potential 16 variables to be used for estimation purposes, it is important to notice that for any given model, only one of the farm profitability measures should be used (either "EBTXNFI" or "PROFITX" and its corresponding variability measure). This will avoid potential multicollinearity problems (both profitability measures follow the same correlation pattern) and redundant conclusions.

5.4. Further considerations regarding the variables to be used for estimation purposes:

"Table 35" shows the correlation analysis for the preselected variables for estimation purposes. This correlation analysis is important in order to cross examine the results from the regression analysis. Moreover, it can be seen that both farm profitability measures considered (farm's earnings before taxes ("EBTXNFI") and rate of return on farm assets ("PROFITX")) and total earnings before taxes ("EBTXTOT") are positively correlated with utility, but only farm's earnings before taxes is significantly correlated with utility.

From economic theory, which assumes that (rational) individuals are utility maximizers (Randall (1987, p. 33, 132), Russell and Wilkinson (1979, p.36-37), Varian (1984, p.1)), it makes sense to choose the measure of profitability which is significantly correlated with utility (in this case, farm´s earnings before taxes ("EBTXNFI")). In this way, the assumptions of utility maximization and profit maximization are conciliated.

Therefore, the profitability measure to be considered for estimation purposes is farm´s earnings before taxes ("EBTXNFI") since only this profitability measure was positively and significantly correlated with utility. Moreover, farm´s earnings before taxes is measured in simple dollars and it may be easier to interpret than a ratio (being a ratio, the rate of return on farm assets contains a mix of measures, which may create undesirable interactions when used for estimation purposes).

Regarding the relationship between farm earnings before taxes ("EBTXNFI") and off-farm earnings before taxes ("EBTXNFI"), they are negatively and significantly correlated. However, the correlation coefficient is relatively low (0.22), so that multicollinearity problems are not likely to occur. Therefore, both sources of income (farm´s and off-farm´s) may be kept as explanatory variables in the same model. This is specially important, given that both variables are significantly correlated with utility: farm´s earnings before taxes with a positive sign and off-farm´s earnings before taxes with a negative sign, which may allow important conclusions.

Indeed, this suggests that hypothesis "Ho.1", stated as

> "Ho.1: Profitability measures are positively and significantly correlated with utility",

may not be accepted, nor may it be rejected, which may imply a conflict with the assumptions of utility maximization and profit maximization. More details about the implications of this finding will be provided latter on, when regression analysis be used in order to study with more detail the relationship between utility and a number of selected variables for estimation purposes.

Furthermore, "Table 35" shows that none of the growth measures affects utility. Indeed, growth in farm earning ("GROXNFI") is insignificantly correlated (p=.14) with utility, with a small coefficient (.07) and with a negative sign. Growth in farm assets ("GROXFAA") is also insignificantly correlated (p=.31) with utility, with a also small coefficient (.05) and with a positive sign. This suggest that hypothesis "Ho.2", stated as

> "Ho.2: Growth measures are positively and significantly correlated with utility",

may be rejected.

In addition, "Table 35" shows that at least one of the two demographic characteristics of the farm household studied is an important variable affecting utility. Indeed, education level ("EDUX") is positively and significantly correlated (p=.03) with utility. Age ("AGEX") is positive but insignificantly correlated (p=.11) with utility. This suggests that hypothesis "Ho.5", stated as

> "Ho.5: Demographic characteristics of the farm household may be important variables affecting utility",

may be accepted. This implies that policy makers may favor education programs as a sound policy.

The financial risk measures were not included in the correlation analysis of "Table 35"; however, "Table 31" contains the correlation analysis between the financial risk measures along with the utility and profitability measures. As explained in "Chapter IV", the correlation analysis in "Table 31" suggested the acceptance of hypothesis "Ho.3" and "Ho.4".

Table 35: Correlation analysis for selected potential variables for estimation purposes, for Ohio commercial farmers for the period 1986-1990. (*a).

	UTILIX1	EBTXNFI	PROFITX	EBTXOFF	EBTXTOT
UTILIX1	1.00000 0.0	0.09472 0.0594	0.06546 0.1942	-0.12233 0.0149	0.02774 0.5821
EBTXNFI	0.09472 0.0594	1.00000 0.0	0.48144 0.0001	-0.22399 0.0001	0.85281 0.0001
PROFITX	0.06546 0.1942	0.48144 0.0001	1.00000 0.0	-0.06006 0.2331	0.43695 0.0001
EBTXOFF	-0.12233 0.0149	-0.22399 0.0001	-0.06006 0.2331	1.00000 0.0	0.31792 0.0001
EBTXTOT	0.02774 0.5821	0.85281 0.0001	0.43695 0.0001	0.31792 0.0001	1.00000 0.0
CVXNFI2	0.03813 0.4486	-0.02475 0.6212	0.02755 0.5842	0.01311 0.7938	-0.01709 0.7333
CVXFRA2	0.04196 0.4056	-0.03047 0.5450	-0.00762 0.8797	-0.01960 0.6974	-0.04023 0.4246
CVXOFF2	0.06339 0.2081	0.04806 0.3377	0.02771 0.5824	-0.07321 0.1438	0.00753 0.8807
CVXTOT2	0.00155 0.9755	-0.08374 0.0944	-0.05738 0.2546	-0.08195 0.1017	-0.12538 0.0121
GROXNFI	-0.07329 0.1449	0.01554 0.7564	-0.11671 0.0200	0.00329 0.9478	0.01691 0.7360
GROXFAA	0.05100 0.3108	0.13366 0.0074	0.00834 0.8684	0.02585 0.6062	0.14363 0.0040
PETOXAS	0.03852 0.4440	-0.03034 0.5447	-0.02851 0.5711	-0.22011 0.0001	-0.14783 0.0030
AGEX	0.08164 0.1061	-0.10308 0.0406	-0.16649 0.0009	-0.15643 0.0018	-0.18335 0.0003
EDUX	0.11086 0.0282	-0.08973 0.0752	-0.01878 0.7109	0.20363 0.0001	0.02000 0.6927

Table 35: Continued:

	CVXNFI2	CVXFRA2	CVXOFF2	CVXTOT2	GROXNFI
CVXNFI2	1.00000 0.0	-0.00124 0.9804	-0.00363 0.9424	0.01617 0.7471	-0.02208 0.6594
CVXFRA2	-0.00124 0.9804	1.00000 0.0	-0.00631 0.9004	-0.00378 0.9402	0.00612 0.9032
CVXOFF2	-0.00363 0.9424	-0.00631 0.9004	1.00000 0.0	0.26741 0.0001	0.02618 0.6016
CVXTOT2	0.01617 0.7471	-0.00378 0.9402	0.26741 0.0001	1.00000 0.0	-0.01337 0.7898
GROXNFI	-0.02208 0.6594	0.00612 0.9032	0.02618 0.6016	-0.01337 0.7898	1.00000 0.0
GROXFAA	0.06651 0.1838	-0.01551 0.7580	0.03781 0.4507	-0.01355 0.7870	0.01451 0.7720
PETOXAS	0.05391 0.2815	-0.01608 0.7494	-0.01721 0.7315	-0.02961 0.5549	0.01026 0.8378
AGEX	-0.06932 0.1691	0.07121 0.1588	-0.01791 0.7231	0.03001 0.5526	0.05951 0.2380
EDUX	0.09094 0.0714	-0.03273 0.5182	-0.03602 0.4764	-0.04497 0.3739	-0.04454 0.3780

	GROXFAA	PETOXAS	AGEX	EDUX
GROXFAA	1.00000 0.0	0.01370 0.7844	-0.08806 0.0805	0.02818 0.5770
PETOXAS	0.01370 0.7844	1.00000 0.0	0.15592 0.0019	0.13388 0.0078
AGEX	-0.08806 0.0805	0.15592 0.0019	1.00000 0.0	-0.18084 0.0003
EDUX	0.02818 0.5770	0.13388 0.0078	-0.18084 0.0003	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 392.

Regression analysis may provide with more information about the relationship between utility and a number of relevant variables. Therefore, after doing the respective selection of variables, the relevant variables to be considered for estimation purposes are:

Utility measure:

1. "UTILITYX": Utility measure.

Profitability measures:

2. "EBTXNFI" : Farm´s earnings before taxes.
3. "EBTXOFF" : Off-farm´s earnings before taxes.

Income variability measures (general risk measures):

4. "CVXNFI2" : Coefficient of variation of "EBTXNFI".
5. "CVXOFF2" : Coefficient of variation of "EBTXOFF".

Financial risk measures:

6. "DETOASXF": Farm´s total debt to farm´s total assets ratio.
7. "DETOASXP": Off-farm´s total debt to off-farm´s total assets ratio.

Growth measures:

8. "GROXNFI" : Annual growth in farm´s earnings before taxes.
9. "GROXFAA" : Annual growth in farm´s assets.

Off-farm assets:

10. "PETOXAS" : Nonfarm assets (personal assets).

Demographic variables:

11. "AGEX" : Farm operator´s age, in years.
12. "EDUX" : Farm operator´s years of formal education.

5.5. Utility estimation:

Since the utility measure (the dependent variable) is a categorical (discrete) variable with five response levels, which implies a multinomial distribution (Judge et al (1988, p.802), SPSS (1986, p.582)), the logistic estimation technique is recommended for this type of model estimation (SAS (1990, p.1073), SPSS (1986, p.582)).

The first logistic model to be estimated will be the following:

UTILITYX = F(EBTXNFI, EBTXOFF, CVXNFI2, CVXNFI2, GROXNFI, GROXFAA, PETOXAS, AGEX, EDUX, DETOASXF, DETOASXP). (31)

As mention above, it does not seem reasonable the inclusion of the variable total earnings before taxes

(EBTXTOT = EBTXNFI + EBTXOFF) (32)

as explanatory variable. Instead, as it was discussed before, it makes more sense the inclusion of farm´s earnings before taxes ("EBTXNFI") and off-farm´s earnings before taxes ("EBTXOFF"). Specifically, a) these two variables contain more and more detailed information than "EBTXTOT"; b) "EBTXTOT" is not significantly correlated with utility;

c) if "EBTXTOT" is included in the estimation, the other two profitability measures cannot be included due to obvious multicollinearity problems.

Indeed, just to prove the last point exposed in the above paragraph and for curiosity, the three variables were included in the model as explanatory variables of utility and, as expected, the model was not full rank (solutions for the parameters were not unique and the statistics will be misleading) and the variables were a linear combination among themselves as shown:

$$EBTXTOT = 1 * EBTXNFI + 1 * EBTXOFF. \qquad (33)$$

In the same way, also for "curiosity", a logistic model was fit including "EBTXTOT" and its respective variability/risk measure "CVXTOT2" and dropping "EBTXNFI", "EBTXOFF", and their respective variability/risk measures ("CVXNFI2" and "CVXOFF2"). According with the criteria for assessing model fit (significance of "-2 log likelihood", etc.) the model did not have good fit. Moreover, the coefficient (or parameter estimated) for "EBTXTOT" was positive but not significant (p=0.2878). Therefore, this result confirms the justification for using "EBTXNFI" and "EBTXOFF" as profitability measures, instead of "EBTXTOT".

5.6. Logistic estimation of "Model 1":

Given the selected variables for estimation purposes, the next step is to make the logistic estimation of "Model 1", as defined below.

```
Model 1: UTILITYX = F(EBTXNFI, EBTXOFF, CVXNFI2,          (34)
                     CVXNFI2, GROXNFI, GROXFAA,
                     PETOXAS, AGEX, EDUX, DETOASXF,
                     DETOASXP).
```

"Table 36" shows the "criteria for assessing model fit" for "Model 1". As explained in SAS (1990, p.1075), the "score" statistic (see "Table 36") gives a test for the joint significance of the explanatory variables (sometimes called the independent variables or covariates) in the model.

In this way, it is concluded that the combined effect of the nine explanatory variables in "Model 1" is significant with a p-value of 0.0001 ("Table 36"). This test considers only the independent variables, so no test is given for the columns for "intercept only" and "intercept and covariates" (SAS (1990, p.1075)).

In "Table 36", the "-2 LOG L" (-2 logarithm of the likelihood function) row gives statistics and a test for the effect of the independent variables based on "-2 LOG L". As with the score statistic, from the "-2 LOG L", it is concluded that the combined effects of the nine explanatory variables in "Model 1" are significant, with p=0.0001 (SAS (1990, p.1075)).

The Akaike Information Criterion (AIC) and Schwartz Criterion (SC) statistics are primary used for comparing different models for the same data. In general, when comparing models, lower values of these two statistics indicate a better model (SAS (1990, p.1075)).

Since for multinomial distribution (or ordinal response data) the "LOGISTIC" procedure fits a parallel lines regression model, a score test for testing the parallel lines assumption (also called proportional odds assumption or equal slopes assumption) is included in "Table 36". As shown in "Table 36", the score chi-square for testing the parallel lines assumption is 37.7651, which is not significant with respect to a chi-square distribution with 33 degrees of freedom, with a p-value of 0.2605. In this case the degrees of freedom (DF) are determined as: DF = (number of response levels minus two)*(number of explanatory variables) = (3)*(11) = 33). This indicates that the parallel lines model is appropriate for the data (SAS (1990, p.1101)). In other words, the null hypothesis that at least one line is not parallel (at least one line does not have the same slope) or that all lines are parallel is not rejected.

Table 36: "Criteria for Assessing Model Fit" and "score test of the parallel lines assumption (also called proportional odds assumption or equal slopes assumption)" for "Model 1", for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d), (*e).

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1072.377	1050.493	.
SC	1088.221	1109.908	.
-2 LOG L	1064.377	1020.493	43.885 with 11 DF (p=0.0001)
Score	.	.	38.088 with 11 DF (p=0.0001)

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 388.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).
(*e): Score Test for the Proportional Odds Assumption: Chi-Square = 37.7651 with 33 DF (p=0.2605)

"Table 37" shows the maximum likelihood estimates (MLEs) of the regression parameters for "Model 1". Such parameters were computed using the "iteratively reweighed least squares" (IRLS) algorithm by means of "PROC LOGISTIC" using "SAS" (SAS (1990, p.1073)). The estimated covariance matrix of the MLEs was obtained by inverting the expected value of the hessian matrix for the last iteration (SAS (1990, p.1073.1074)). "Table 37" also contains univariate tests based on these estimates. Moreover, "Table 37" contains standardized estimates for each slope parameter.

Following the explanations in SAS (1990, p.1097), the columns of "Table 37" can be described as follows. The third column of "Table 37" contains the maximum likelihood estimates of the parameters. The fourth column contains the estimated standard error of the parameter estimate, computed as the square root of the corresponding diagonal element of the estimated covariance matrix. The fifth column shows the Wald chi-square statistic, computed as the square of the parameter estimated divided by its standard error estimate. The sixth column shows the p-value of the Wald chi-squared statistic with respect to a chi-squared distribution with one degree of freedom. The seventh column contains the standardized estimate for the slope parameter, computed by dividing the slope parameter estimate by the ratio of the standard deviation of the underlying distribution, which is the inverse of the link function, to the sample standard deviation of the explanatory variable. The standardized estimates of the intercept parameters are set to missing value (SAS (1990, p.1097)).

Therefore, as "Table 37" shows, for "Model 1", farm operator´s years of formal education ("EDUX"), farm´s financial risk or farm´s total debt to total assets ratio ("DETOASXF"), off-farm´s financial risk or off-farm´s total debt to total assets ratio ("DETOASXP"), off-farm earnings before taxes ("EBTXOFF"), and farm´s earnings before taxes were significant at p=0.05. Indeed, the other variables were not significant, even at a critical level of p=0.10.

The signs of the parameter estimates in "Table 37" agree with the signs of the correlation analysis in "Table 31" and "Table 35", as expected. From the signs of the parameter estimates, it can be inferred that the level of utility increases with education, which confirms the acceptance of hypothesis "Ho.5", as explained before.

This seems to agree with the findings of Tweeten and Mylay (1986, p.9-13), who used interview surveys in 1976 and 1980, of persons 18 years of age or over, living within the continental United States. Moreover, Tweeten and Mylay (1986, p.9-13) found that the parameter estimate for age was positive and significant at p=0.05, which seems to disagree with the findings in this study since the parameter estimate for age in "Model 1" was positive but insignificant at p=0.05, as shown in "Table 37".

In addition, from "Table 37" it can be inferred that utility decreases as both farm´s and off-farm´s financial risk increases. That is the parameter estimates for farm´s total debt to total assets ratio ("DETOASXF") and off-farm´s total debt to total assets ratio ("DETOASXP") had negative and significant signs, with a p-value of 0.0033 and 0.0139, respectively. This confirms the acceptance of hypothesis "Ho.3", as explained before.

Indeed, this finding can be seen as an empirical evidence that, humans are risk averse, as the standard financial management and economic theory usually assumes (Brigham (1992, p.156), Brigham and Gapenski (1993, p.60, 84)). However, standard literature usually focus in the concept of risk aversion as a trade-off between risk and profits, while, in the case of the results in "Table 37", the focus is in a trade-off between risk and utility, which seems to be the correct way to analyze risk if the assumption of utility maximization is taken really seriously.

This statement does not necessarily contradicts the rational for a trade-off between risk and profits, it just analyzes risk focusing on the core assumption of economic theory, which is utility maximization, as mentioned by Randall (1987, p.33,64), Takayama (1985, p.187), and Tweeten and Mylay (1986, p.1).

Moreover, utility decreases as off-farm's earnings before taxes increases, while it increases as farm's earnings increases. That is, marginal utility of income is negative for off-farm income, but positive for farm income. This finding confirms statements made before implying that there is not empirical evidence to reject or accept hypothesis "Ho.1".

Tweeten and Mylay (1986, p.9-13) found (with significant statistical basis (p=0.05)) a positive marginal utility of income, but in their study they did not divide income into its components, which seems to make the results, regarding this aspect, incomparable. In addition, it is important to notice that, for Ohio commercial farmers, total income (farm plus off-farm) was positively but insignificantly (p=0.5821) correlated with utility and the parameter or coefficient estimate (when fit in the utility estimation, as explained before) was also positive but insignificant (p=0.2878).

This result (positive marginal utility of farm income and negative marginal utility of off-farm income) is quite interesting. However, the explanation for such result does not seem evident. This issue will be analyzed with more detail latter in this study, when a model (specifically, "Model 2") for utility be estimated including only "significant" explanatory variables. Such model will be (partially) selected by means of "backward" and "stepwise" statistical criteria.

The rest of the parameter estimates of "Model 1" (six in total) were not significant at all (not even at a p=0.10) which may indicates that these variables does not affect utility. Although it may be adventurous to make any further conclusions about the effect of these five variables on the utility level, just for reference, it may be worthy to mention the following: the two variability of income measures (coefficients of variation for farm and off-farm income, which are general risk measures) had a positive sign, farm's earnings growth had a negative sign, farm's assets growth had a positive sign, and nonfarm (personal) assets had a negative sign. All this signs agree with the correlation analysis of "Table 35".

Table 37: Maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 1", for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d).

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Sq.	Standardized Estimate
INTERCP1	1	-2.0151	0.8967	5.0502	0.0246	.
INTERCP2	1	-1.2330	0.8929	1.9068	0.1673	.
INTERCP3	1	-0.2081	0.8932	0.0543	0.8157	.
INTERCP4	1	0.8940	0.9055	0.9748	0.3235	.
EBTXNFI	1	4.885E-6	2.452E-6	3.9683	0.0464	0.124212
EBTXOFF	1	-9.63E-6	4.253E-6	5.1330	0.0235	-0.133569
CVXNFI2	1	0.00355	0.00914	0.1505	0.6981	0.159886
CVXOFF2	1	0.0248	0.0342	0.5248	0.4688	0.214532
GROXNFI	1	-0.0233	0.0172	1.8306	0.1761	-0.084185
GROXFAA	1	0.4672	0.6679	0.4893	0.4842	0.037729
PETOXAS	1	-1.06E-6	1.083E-6	0.9533	0.3289	-0.054861
AGEX	1	0.00462	0.00908	0.2585	0.6111	0.031525
EDUX	1	0.1625	0.0523	9.6446	0.0019	0.181103
DETOASXF	1	-1.4424	0.4911	8.6272	0.0033	-0.171684
DETOASXP	1	-0.2112	0.0858	6.0523	0.0139	-0.139841

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 388.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).

"Table 38" shows the association of predicted probabilities and observed responses for logistic estimation of "Model 1". Four measures of association for assessing the predictive ability of a model are calculated.

They are based on the number of pairs of observations with different response values, the number of concordant pairs, and the number of discordant pairs (SAS (1990, p.1074)).

The interpretation and relevance of "Table 38" is a little unclear since there is not clear criteria to interpret the association of predicted probabilities and observed responses. Moreover, "Table 38" may be relevant only when comparing different models for the same data. In general, the higher the concordant percentage of predicted probabilities and the higher the four measures of association ("Somers´D", "Gamma", "Tau-a", and "c") the higher the predictive ability of the model.

The ambiguity arrives from the fact that, everything else equal, the larger the number of response levels, the lower these measures are, regardless of the real predictive ability of the model at issue. In the case of the utility measure, which has five response levels, it could be the case that a high portion of the discordant pairs are due to a (miss)prediction of level (let´s say) four instead of the observed level (let´s say) five. With a smaller number of response levels, let´s say two (where levels four and five belong to the same category) these model predictive ability measures would be much higher even though the model is actually providing less information. In general, and based on well fitted sample models (see SAS (1990, p.1099-1101) and McCullagh and Nelder (1989, p.175)), values over 50% of concordant pairs seem to be acceptable. Under such criteria the predictive ability of "Model 1" would be acceptable, as "Table 38" shows.

Table 38: Association of predicted probabilities and observed responses for logistic estimation of "Model 1", for Ohio commercial farmers for the period 1986-1990.

Concordant	= 62.6%	Somers' D	= 0.256
Discordant	= 37.0%	Gamma	= 0.257
Tied	= 0.4%	Tau-a	= 0.177
(51945 pairs)		c	= 0.628

A logistic procedure with a backward fitting option was computed for "Model 1", in order to have a statistical guide to remove the statistically irrelevant variables for estimation purposes and to leave the statistically relevant ones. The critical level used was p=0.05. The order in which the variables were removed (step by step) was as follows:

Step 0. The following variables were entered:
INTERCP1 INTERCP2 INTERCP3 INTERCP4
EBTXNFI EBTXOFF CVXNFI2 CVXOFF2 GROXNFI
GROXFAA PETOXAS AGEX EDUX
DETOASXF DETOASXP

Step 1. Variable CVXNFI2 is removed:
Step 2. Variable AGEX is removed:
Step 3. Variable GROXFAA is removed:
Step 4. Variable CVXOFF2 is removed:
Step 5. Variable PETOXAS is removed:
Step 6. Variable GROXNFI is removed:

Note: After drooping GROXNFI no (additional) variables met the 0.05 significance level for entry into the model. That is, at a significance level of p=0.05, only the variables EDUX, DETOASXF, DETOASXP, EBTXOFF, and EBTXNFI were left in the model. The dropped variables not even met the 0.10 significance level for entry into the model.

In order to cross examine the results from the backward selection procedure, a stepwise (forward) procedure was executed. As expected, only the five variables selected by the backward procedure were entered into the model. The order in which the variables were entered into the model was: DETOASXF, DETOASXP, EDUX, EBTXOFF, and EBTXNFI. No (additional) variables met the 0.05 significance level for entry into the model.

5.7. Estimation of "Model 2":

Following the natural steps for model selection, "Model 2" is estimated below. "Model 2" includes only the five variables selected (with a p-value of 0.05) by the backward and stepwise procedures. In this case, such variables were the same five variables with significant parameter estimates (with a p-value of 0.05) in the original model ("Model 1"), which included "all" the eleven variables analyzed by means of logistic regression analysis. However, this is not always the case due to interactions among the "dropped" variables and the "chosen" variables. That is why, backward and/or stepwise selection procedures may be a useful statistical tool in order to guide the variable selection process.

In this way, "Model 2" is defined as:

Model 2: UTILITYX = f(EBTXNFI, EBTXOFF, EDUX, DETOASXF, DETOASXP). (35)

As it can be seen in "Table 39", both the "criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2" are statistically satisfactory.

Table 39: "Criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2", for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d), (*e).

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1075.265	1049.265	.
SC	1091.129	1084.960	.
-2 LOG L	1067.265	1031.265	36.000 with 5 DF (p=0.0001)
Score	.	.	32.223 with 5 DF (p=0.0001)

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 389.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).
(*e): Score Test for the Proportional Odds Assumption: Chi-Square = 18.5191 with 15 DF (p=0.2364)

"Table 40" shows the maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2". As shown in "Table 40", all the five parameter estimates for the variables included as explanatory variables for utility estimation (EBTXNFI, EBTXOFF, EDUX, DETOASXF, and DETOASXP) in "Model 2" were significant at a p.value of 0.05. Specifically, the significance level of the parameter estimate for DETOASXF was 0.0015, for EDUX was 0.0020, for DETOASXP was 0.0166, for EBTXOFF was 0.0182, and for EBTXNFI was 0.0335.

Table 40: Maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2", for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d).

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Sq.	Standardized Estimate
INTERCP1	1	-1.6729	0.6411	6.8104	0.0091	.
INTERCP2	1	-0.9049	0.6371	2.0170	0.1555	.
INTERCP3	1	0.1059	0.6384	0.0275	0.8683	.
INTERCP4	1	1.1992	0.6549	3.3526	0.0671	.
EBTXNFI	1	5.048E-6	2.374E-6	4.5218	0.0335	0.128194
EBTXOFF	1	-9.86E-6	4.177E-6	5.5725	0.0182	-0.136420
EDUX	1	0.1564	0.0507	9.5353	0.0020	0.174107
DETOASXF	1	-1.3820	0.4357	10.0628	0.0015	-0.165119
DETOASXP	1	-0.1968	0.0822	5.7402	0.0166	-0.130706

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 389.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).

"Table 41" shows the association of predicted probabilities and observed responses for logistic estimation of "Model 2". As "Table 41" shows, the association of predicted probabilities and observed responses for logistic estimation of "Model 2" is 61% which is statistically satisfactory, as explained above.

Table 41: Association of predicted probabilities and observed responses for logistic estimation of "Model 2", for Ohio commercial farmers for the period 1986-1990.

Concordant	= 60.9%	Somers´ D	= 0.223
Discordant	= 38.6%	Gamma	= 0.224
Tied	= 0.5%	Tau-a	= 0.154
(52345 pairs)		c	= 0.611

5.8. Implications from "Model 2":

"Model 2" (and therefore "Model 1") seems very relevant both from the statistical point of view and from the practical (policy making) point of view. That is, "Model 2" may have very important implications, specially in the context in which the main goal of economics as a social science is to maximize the utility of the individual and promote corresponding policy making recommendations. In this way, following the results in "Table 40",the following implications from "Model 2" may be stated:

1. Implication 1 from "Model 2":

Marginal utility of education is positive, which confirms the acceptance of hypothesis "Ho.5". That is, the more years of formal education an individual has, the higher his/her utility level is. This result suggests that policy makers should devote efforts in order to increase the education level of the population.

2. Implication 2 from "Model 2":

Marginal utility of off-farm income is negative, which suggest the rejection of hypothesis "Ho.1". This finding implicitly contradicts the believe/assumption of most economist (and probable of most people in general) that marginal utility of income is always positive.

3. Implication 3 from "Model 2":

Marginal utility of farm income is positive, which suggest the acceptance of hypothesis "Ho.1". This finding implicitly agrees with the believe/assumption of most economists (and most people in general) that marginal utility of income is always positive. From the contradictory results stated in the above two paragraphs, it can be concluded that there is not empirical evidence for accepting or rejecting hypothesis "Ho.1".

4. Implication 4 from "Model 2":

Another implication of the finding of negative marginal utility for off-farm income and positive marginal utility of farm income may be that the assumption of "fungibility of money" is invalidated since the finding at issue implies that it is not true that a dollar has the same value and potential multiple uses under any circumstances (Hyman (1993, p.616). That is, it seems that a dollar obtained from the farm business may be used to increase utility, while a dollar obtained from off-farm activities may not be used to increase utility.

5. Implication 5 from "Model 2":

As the level of (both) farm´s and off-farm´s financial risk increases, the utility level decreases, which confirms the acceptance of hypothesis "Ho.3". This finding agrees with the assumption of most standard financial literature that humans are risk averse (Brigham (1992, p.156), Brigham and Gapenski (1993, p.60, 84)).

5.9. Off-farm work and utility:

It could be the case that the time worked off the farm is larger as off-farm income increases, which actually could imply negative marginal utility of off-farm work, instead of negative marginal utility of off-farm income. In order to test this proposition, "Model 2" was run including the variable "hours worked in the main off-farm job" ("HOU1OFX") as an "extra" explanatory variable.

As it can be seen in "Table 42", both the "criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2" are statistically satisfactory.

Table 42: "Criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2", including the variable "hours worked in the main off-farm job" ("HOU1OFX"), for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d), (*e).

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1075.265	1051.106	.
SC	1091.129	1090.767	.
-2 LOG L	1067.265	1031.106	36.159 with 6 DF (p=0.0001)
Score	.	.	32.433 with 6 DF (p=0.0001)

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 390.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).
(*e): Score Test for the Proportional Odds Assumption: Chi-Square = 22.5460 with 18 DF (p=0.2086).

As "Table 43" shows, the variable "HOU1OFX" did not have a significant coefficient in the logistic estimation, while the other variables were still significant. That is, the results for "Model 2" did not change, which implies that there is not empirical evidence for the proposition that there exists negative marginal utility of off-farm work, instead of negative marginal utility of off-farm income.

Table 43: Maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2", including the variable "hours worked in the main off-farm job ("HOU1OFX"), for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d).

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Sq.	Standardized Estimate
INTERCP1	1	-1.6644	0.6411	6.7404	0.0094	.
INTERCP2	1	-0.8961	0.6372	1.9778	0.1596	.
INTERCP3	1	0.1146	0.6385	0.0322	0.8575	.
INTERCP4	1	1.2079	0.6550	3.4009	0.0652	.
EBTXNFI	1	4.937E-6	2.388E-6	4.2739	0.0387	0.125380
EBTXOFF	1	-9.01E-6	4.746E-6	3.6036	0.0577	-0.124661
EDUX	1	0.1569	0.0507	9.5705	0.0020	0.174621
DETOASXF	1	-1.3918	0.4364	10.1729	0.0014	-0.166284
DETOASXP	1	-0.1944	0.0624	5.5682	0.0183	-0.129112
HOU1OFX	1	-0.00005	0.000127	0.1525	0.6962	-0.024026

(*a): Response Variable: UTILITYX.
(*b): Response Levels: 5.
(*c): Number of Observations: 390.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).

"Table 44" shows the association of predicted probabilities and observed responses for logistic estimation of "Model 2", including the variable "HOU1OFX". As "Table 44" shows, the association of predicted probabilities and observed responses for logistic estimation of "Model 2" is 61% which is statistically satisfactory, as explained above.

Table 44: Association of predicted probabilities and observed responses for logistic estimation of "Model 2", including the variable "hours worked in the main off-farm job" ("HOU1OFX"), for Ohio commercial farmers for the period 1986-1990.

Concordant	= 61.0%	Somers' D	= 0.225
Discordant	= 38.5%	Gamma	= 0.226
Tied	= 0.5%	Tau-a	= 0.155
(52345 pairs)		c	= 0.612

5.10. A final reflection about the issue of "utility" and performance measurement in economic theory:

From the limited research performed in this study, at least two observations can be stated at this point about the issue of "utility" and performance measurement in economic theory. First, economist, agricultural economist, and other social scientist usually ignore (or do not like to deal with) the issue of utility, its measurement, and its relationship with other socioeconomic variables. As explained by Tweeten and Mylay (1986, p.1-3), usually, the assumption of utility maximization (the core of economic theory) is just substituted (for most purposes) by the assumptions of profit maximization and positive marginal utility of income. Then the issue of utility and utility maximization is forgotten.

Second, given the lack of consistency in the use of performance measures and the lack of seriousness with which a number of researchers deal with the issue of performance measurement, it may be proposed that economic theory and related fields may suffer of a crisis. This crisis is a crisis of the measurement system. It is time for researchers in economics and related fields to get serious about the way things are measured since depending on the measure used, anything can be proved (concluded), which may provoke misleading policy recommendations.

5.11. Macroeconomic implications from "Model 2":

The results obtained from "Model 1" and "Model 2" (specifically, negative marginal utility of off-farm income and positive marginal utility of farm income) may be applied in a macroeconomic context, given that macroeconomist usually rely on the assumption of positive marginal utility of income in order to design macroeconomic policy.

If, indeed, there exist situations (let´s say "situations A") in which more income may lower utility, then there may exist situations in which more percapita income (and more economic growth) may not be the "best" goal to achieve, even without distribution of wealth and social justice problems.

In the same lines of thought, assuming that under "situations A" more income was obtained by means of more time worked (which implies lower rate of unemployment), then (under "situations A") lower rate of unemployment may imply lower utility (at the personal level) and lower general welfare (at society level).

Such "situations A" could be instances in which individuals consume more goods (unnecessary or damaging goods), then need more money to obtain the "extra" goods, then need to work more time making more money (here it can be assumed that more time worked decreases utility but this assumption is not necessary to make the point), then have less time to do "positive" activities (whatever activities increasing their utility level), which decreases their utility (even assuming that more time worked does not decreases utility). This model may also worked under a number of scenarios or assumptions.

In general, it can be proposed that "situations A" may occur whenever the individual loses inter-strength and/or becomes more dependent on the outside world. This reasoning follows the "Potential explanations 2 and 3 for "Model 2"" noted above, in which utility is increased by means of focussing in self-dependency and in the natural power potentially existing within the individual.

The following example aims to picture a situation in which more percapita income (and more social economic growth) along with lower rate of unemployment may be worse-off than the initial situation.

Let the initial situation be "situation 0" ("s0"), occurring at "time 0" ("t0"). Under "s0" there exist two agents or individuals ("i1" and "i2") and two jobs ("j1" and "j2", which are "washing dishes once a year" and "drying dishes once a year", respectively). Just for formality, a arbitrary initial wealth level may be assumed. Let´s assume that both individuals receive $10 per year from a given (unknown) source and both individuals spend $10 a year in a given set of goods.

Under "s0" each individual washes and dries his/her own dishes whenever he/she wants or feels at his/her maximum efficiency. "i1" does not depend on "i2" to perform "j1" and "j2", which may be seen as enjoyment of freedom and independence.

Let the new situation or "situation 1" ("s1") be a situation in which "i1" "specializes" in washing dishes, "i2" "specializes" in drying dishes, each one pays $10 (from new money) to each other for performing i´s "specialization", and all else remains equal.

Under "s1" and under the standard (neoclassical) macroeconomic rationality, unemployment decreased by a given percentage, percapita income increased by $10 or 100%, and economic growth in the system went up by $20 or 100%.

However, now each individual must perform his/her task depending on the other individual, each one depends on the other, and some freedom and independence was lost. Moreover, because of such "specialization" of labor, "artificial" ignorance (know how) and dependency has been created. Indeed, there must be many situations in which more economic growth and less unemployment rate are the result of dependent, helpless, consumists, and controllable mentalities, popularized in a given culture, country, or region.

Therefore, more percapita income, more economic growth, and less unemployment is not necessarily better than otherwise. It is important to notice that the model proposed here does not include distribution of wealth issues. That is, the propositions of this model apply even without distribution of wealth and social justice problems.

The model could be complicated introducing a third individual or "i3" (an explicit "service" sector) who coordinates the activities of "i1" and "i2", however, the simple case pictured above should be enough in order to visualize the situation.

5.12. Modeling profitability: farm earnings before taxes:

Given that farm´s earnings before taxes ("EBTXNFI"), was shown to be positive related with utility, it seems relevant to analyze which variables influence "EBTXNFI". Since farm earnings before taxes is a continuous variable, linear least-squares regression modeling can be used.

5.13. Estimation of "Model 3":

In the case at issue, the following model will be estimated:

Model 3: EBTXNFI = F(EBTXOFF, CVXNFI2, CVXNFI2, GROXNFI, GROXFAA, PETOXAS, AGEX, EDUX, DETOASXF, DETOASXP). (36)

"Model 3" is a variation of "Model 1" with the modification that the response variable is farm´s earnings before taxes ("EBTXNFI"), instead of the proxy of utility ("UTILITYX").

"Table 45" shows the analysis of variance for the least squares estimation of "Model 3". The "F" statistic for the overall model is significant (p=0.0001), indicating that the model explains a significant portion of the variation in the data (SAS (1990, p.1356)). Even though there are not critical values to interpret the R-square of a given model, in general terms, one could say that the R-square for "Model 3" is relatively low (0.095). However, given the significant "F" statistic, the model is still satisfactory from the statistical point of view.

Table 45: Analysis of variance for the least squares estimation of "Model 3", for Ohio commercial farmers for the period 1986-1990.

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	10	78475133310	7847513331	3.979	0.0001
Error	379	747556256767	1972443949.3		
C Total	389	826031390077			
N (total)	390				

Root MSE	44412.20496	R-square	0.0950
Dep Mean	14932.32211	Adj R-sq	0.0711
C.V.	297.42330		

"Table 46" shows the parameter estimates for the least squares estimation of "Model 3" along with the "t" statistics and the corresponding significance probabilities to test if each parameter is significantly different from zero (SAS (1990, p.1356)). The significance probabilities, or p-values, indicate that the parameter estimates for the intercept, nonfarm income ("EBTXOFF"), annual growth on farm´s assets ("GROXFAA"), and farm operator´s age ("AGEX") were significant at the 95% significance level.

From the signs of these parameter estimates one may conclude that off-farm earnings before taxes (EBTXOFF) have a negative effect on farm´s earnings before taxes, which makes sense given that, generally, more time worked off the farm implies less time worked at the farm.

Moreover, growth on farm´s assets (GROXFAA) have a positive effect on EBTXNFI, which also makes sense given that, everything else equal, the larger the assets available the larger the income expected.

Finally, farm operator´s age (AGEX) have a negative effect on EBTXNFI, which (everything else equal) may reflect: that the older the individual, the less time he/she tends to work; or that the older the individual, the less economically productive he/she tends to be; or that the older the individual, the less interested in money (wealth) he/she becomes; or a combination of such possibilities. This result contradicts the findings of Tokle (1988, p.104), who found that operator´s age was positively related with farm´s income.

As Blue and Forster (1991, p.10) explain, the result that age negatively influence profits does not support the possibility that older operators are likely to have higher profits due to acquired skills and experience. However, the result "supports the notion that younger operators are likely to have higher profits because of faster adoption of new innovations" (p.10).

The significance level of the other seven variables in "Model 3" was so low that making any conclusion about such variables would be a little adventurous and conceptually misleading. However, under certain context, it may be important to notice that the coefficient of variation on farm's earnings (CVXNFI2) had a negative sign, the coefficient of variation on nonfarm income (CVXOFF2) had a positive sign, growth in farm's earning (GROXNFI) had a positive sign, nonfarm assets (PETOXAS) had a negative sign, educational level (EDUX) had a negative sign. Finally, farm's total debt to farm's total assets ratio (DETOASXF) had a negative sign and off-farm's total debt to off-farm's total assets ratio (DETOASXP) had a negative sign.

Tokle (1988, p.55, 104, 105) found that husband's and wife's schooling are shown to be positively and significantly related with total income. This result seems to disagree with the findings in this study.

Table 46: Parameter estimates for the least squares estimation of "Model 3", for Ohio commercial farmers for the period 1986-1990.

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob >|T|
INTERCEP	1	63663	20242.524946	3.145	0.0018
EBTXOFF	1	-0.447919	0.09514574	-4.708	0.0001
CVXNFI2	1	-17.632166	27.87439842	-0.633	0.5274
CVXOFF2	1	55.637545	144.82519817	0.384	0.7011
GROXNFI	1	101.526738	344.90296198	0.294	0.7686
GROXFAA	1	41472	15541.694753	2.668	0.0079
PETOXAS	1	-0.027242	0.02566855	-1.061	0.2892
AGEX	1	-505.834176	210.12125406	-2.407	0.0165
EDUX	1	-1282.638536	1185.6932173	-1.082	0.2800
DETOASXF	1	-294.712545	11810.546796	-0.025	0.9801
DETOASXP	1	-470.498310	1903.6577198	-0.247	0.8049

5.14. Estimation of "Model 4":

In order to have a more specific statistical tool to make the final model selection from "Model 3", a stepwise regression analysis (SAS (1990, p.1397.1398)) was performed on "Model 3". As expected (although theoretically there could have been some variations), the model selected by the stepwise technique ("Model 4") contained only the three variables with a significant parameter estimate in "Model 3". That is,

Model 4: EBTXNFI = F(EBTXOFF, GROXFAA, AGEX). (37)

"Table 47" shows the analysis of variance for the least squares estimation of "Model 4". The "F" statistic for the overall model is significant (p=0.0001), indicating that the model explains a significant portion of the variation in the data (SAS (1990, p.1356)). As with "Model 3", even though there are not critical values to interpret the R-square of a given model, in general terms, one could say that the R-square for "Model 4" is relatively low (0.086). However, given the significant "F" statistic the model is still satisfactory from the statistical point of view.

Table 47: Analysis of variance for the least squares estimation of "Model 4", for Ohio commercial farmers for the period 1986-1990.

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	3	71064265592	23688088531	12.206	0.0001
Error	390	756853354188	1940649626.1		
C Total	393	827917619780			
N (total	394				

Root MSE	44052.80497	R-square	0.0858
Dep Mean	14932.45138	Adj R-sq	0.0788
C.V.	295.01389		

"Table 48" shows the parameter estimates for the least squares estimation of "Model 4" along with the "t" statistics and the corresponding significance probabilities to test if each parameter is significantly different from zero (SAS (1990, p.1356)). The significance probabilities, or p-values, indicate that the intercept, EBTXOFF, GROXFAA, and AGEX parameter estimates are significant at the 95% significance level. The signs of such parameter estimates correspond with the respective signs obtained for "Model 3", as expected.

Table 48: Parameter estimates for the least squares estimation of "Model 4", for Ohio commercial farmers for the period 1986-1990.

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>¦T¦
INTERCEP	1	44780	10041.739358	4.459	0.0001
EBTXOFF	1	-0.451947	0.08914007	-5.070	0.0001
GROXFAA	1	39763	15266.934231	2.605	0.0096
AGEX	1	-481.790497	181.94784339	-2.648	0.0084

5.15. Variations of results using alternative utility measures and sub-samples:

As explained before, a number of researchers (Olatunbosun (1967, p.175), Datta, Rajagopalan, and Rasheed (1991, p.548), and Perrin (1968, p.55), among other authors), have suggested that satisfaction (as proxy of utility) should be the core of the firm performance definition and measurement, which agrees with the conceptualization of economics as a social science whose main goal (as the goal of humankind in general) is to maximize the utility (or satisfaction) of the individual, as explained by Datta, Rajagopalan, and Rasheed (1991, p.548), Randall (1987, p.33, 64), Russell and Wilkinson (1979, p.36), and Tweeten and Mylay (1986, p.1-3)).

Then, the measure of utility used before (satisfaction) seems to be sound, valid, and acceptable, at least on the ground of the literature review performed in this dissertation.

Moreover, it was shown that, based on correlation/factor statistical analysis ("Table 17" - "Table 21"), satisfaction seems to be a valid representative of a number of other utility-related aspects.

Then, there seems to be also statistical basis for the acceptance of satisfaction as a sound utility measure.

In addition, using the maximum amount of data (the four years of the survey and the whole cross-sectional sample for the merged data) seems to provide the most reliable statistical results, given that large numbers properties and the central limit theorem are likely to enhance the estimated parameters.

Then, analyzing the data using sub-samples (a single year or a cross-sectional subgroup) no necessarily would improve the estimation or the inferences performed. Indeed, if science aught to make inferences relevant for policy making purposes for the largest range of population, it may make more sense to make inferences based on the largest possible (finite) sample.

Therefore, at least from these three rationales (literature review, correlation/factor analysis, and sample size), it seems that "whole-sample" analysis and using satisfaction as the utility proxy may be satisfactory. However, "sub-sample" analysis and other utility proxies are likely to provide some additional information that may be useful under certain contexts.

In this way, in the following paragraphs, variations of results using alternative utility measures and sub-samples will be analyzed. First, the stability of a number of utility related measures will be checked by means of a correlation analysis between such measures, for the years 1988 and 1990. Second, a correlation analysis will be performed for the relevant selected variables for the years 1988 and 1990. Moreover, logistic estimation will be performed, using alternative utility measures.

5.15. 1. Checking the stability of the utility related variables for 1988-1990:

"Table 49" and "Table 50" show the means and the correlation analysis, respectively, for a number of utility related measures (as defined in "Table 17") between the years 1988 and 1990. Such measures are: satisfaction ("JOSAiiUT"), sense of quality of life improvement ("QLIMiiUT"), and stress level ("STDEiiUT").

As "Table 50" shows, all the respective pairs are highly and significantly ($p<0.0001$) correlated, which is not surprising given the similar mean values, as shown in "Table 49". Furthermore, even the "non-respective" pairs are significantly correlated ($p<0.06$) except the pairs "QLIM90UT" - "STRE88UT" and "QLIM90UT" - "STRE90UT", which is not surprising given the factor analysis performed before for the whole sample ("Table 21").

Therefore, it can be inferred ("Table 49", "Table 50") that the utility related measures may be considered stable for the years analyzed.

Table 49: Mean and standard deviation of a number of utility-related measures for the years 1988 and 1990.

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
QLIM88UT	400	2.3050	0.6308	922.0	1.0000	3.0000
QLIM90UT	400	2.1975	0.6477	879.0	1.0000	3.0000
JOSA88UT	399	2.5263	0.7392	1008.0	1.0000	3.0000
JOSA90UT	399	2.3835	0.8119	951.0	1.0000	3.0000
STRE88UT	400	2.4775	0.8374	991.0	1.0000	4.0000
STRE90UT	398	2.5050	0.8971	997.0	1.0000	4.0000

Table 50: Correlation analysis for a number of utility related variables for the years 1988 and 1990 (*a).

	QLIM88UT	QLIM90UT	JOSA88UT	JOSA90UT	STRE88UT	STRE90UT
QLIM88UT	1.00000	0.36976	0.18727	0.15615	0.13163	0.09362
	0.0	0.0001	0.0002	0.0018	0.0084	0.0624
QLIM90UT	0.36976	1.00000	0.16310	0.28018	0.04012	0.07630
	0.0001	0.0	0.0011	0.0001	0.4242	0.1286
JOSA88UT	0.18727	0.16310	1.00000	0.39699	0.17226	0.14918
	0.0002	0.0011	0.0	0.0001	0.0005	0.0029
JOSA90UT	0.15615	0.28018	0.39699	1.00000	0.17686	0.17365
	0.0018	0.0001	0.0001	0.0	0.0004	0.0005
STRE88UT	0.13163	0.04012	0.17226	0.17686	1.00000	0.41761
	0.0084	0.4242	0.0005	0.0004	0.0	0.0001
STRE90UT	0.09362	0.07630	0.14918	0.17365	0.41761	1.00000
	0.0624	0.1286	0.0029	0.0005	0.0001	0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 396.

5.15.2. Variations of results using sub-samples by year (1988 and 1990):

"Table 51" and "Table 52" show the correlation analysis for selected relevant variables, for the years 1988 and 1990, respectively.

As shown in "Table 51", the correlation pattern of the utility measure (satisfaction) for the year 1988 is very similar to the correlation pattern for such variable for the whole sample ("Table 35"). Specifically, for 1988, marginal utility of farm income was positive and significant (p=0.01), marginal utility of off-farm income was negative and significant (p=0.05), and marginal utility of education was positive and "relatively" significant (p=0.08). However, for 1988, age was positively and significantly correlated with utility, while, for the whole sample ("Table 35") age was positively but insignificantly correlated with utility.

As shown in "Table 52", the signs of the correlation coefficients for the utility measure for 1990 were the same as the 1988's ("Table 51") and the whole sample's ("Table 35"); however, none of them were statistically significant, except education (p=0.09). Therefore, there is only partial evidence (same coefficient signs, but insignificant) that the correlation tendencies do not change from year to year.

Table 51: Correlation analysis for selected relevant variables, for the year 1988 (*a).

	JOSA88UT	EBT88NFI	EBT88OFF	PETO88AS
JOSA88UT	1.00000 0.0	0.12797 0.0105	-0.09889 0.0484	0.03492 0.4867
EBT88NFI	0.12797 0.0105	1.00000 0.0	-0.14810 0.0030	-0.03400 0.4972
EBT88OFF	-0.09889 0.0484	-0.14810 0.0030	1.00000 0.0	-0.02707 0.5888
PETO88AS	0.03492 0.4867	-0.03400 0.4972	-0.02707 0.5888	1.00000 0.0
AGE88	0.12263 0.0144	-0.04074 0.4170	-0.11180 0.0255	0.10675 0.0330
EDU88	0.08949 0.0756	-0.05675 0.2599	0.17975 0.0003	0.09921 0.0485
HOU1OF88	-0.05927 0.2375	-0.05953 0.2342	0.53064 0.0001	0.00542 0.9138

	AGE88	EDU88	HOU1OF88
AGE88	1.00000 0.0	-0.14959 0.0028	-0.23436 0.0001
EDU88	-0.14959 0.0028	1.00000 0.0	0.12817 0.0107
HOU1OF88	-0.23436 0.0001	0.12817 0.0107	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 395.

Table 52: Correlation analysis for selected relevant variables, for the year 1990 (*a).

	JOSA9OUT	EBT9ONFI	EBT9OOFF	PETO9OAS
JOSA9OUT	1.00000 0.0	0.02463 0.6237	-0.07216 0.1502	0.03581 0.4757
EBT9ONFI	0.02463 0.6237	1.00000 0.0	-0.15170 0.0023	0.00467 0.9257
EBT9OOFF	-0.07216 0.1502	-0.15170 0.0023	1.00000 0.0	-0.18175 0.0003
PETO9OAS	0.03581 0.4757	0.00467 0.9257	-0.18175 0.0003	1.00000 0.0
AGE9O	0.02460 0.6250	-0.03242 0.5189	-0.18508 0.0002	0.19176 0.0001
EDU9O	0.08411 0.0934	-0.08746 0.0806	0.17907 0.0003	0.06947 0.1655
HOU1OF9O	-0.02021 0.6873	-0.12386 0.0131	0.39670 0.0001	-0.03222 0.5199

	AGE9O	EDU9O	HOU1OF9O
AGE9O	1.00000 0.0	-0.20874 0.0001	-0.25694 0.0001
EDU9O	-0.20874 0.0001	1.00000 0.0	0.16108 0.0012
HOU1OF9O	-0.25694 0.0001	0.16108 0.0012	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 397.

5.15.3. Variations of results using alternative utility measures:

"Table 53" shows the correlation coefficients for selected variables for the whole sample (1986-1990), including other utility proxies, as defined in "Table 17". The utility proxies examined in "Table 53" are job satisfaction ("JOSAXUT"), sense of quality of life improvement ("QLIMXUT"), stress level ("STREXUT"), and an average of these three measures ("UTI3XXX"). These utility proxies were chosen (among the set available, as defined in "Table 17") based on the easiness to be interpreted and on the rational suggested by the factor/correlation analysis performed ("Table 20", "Table 21").

From "Table 53", the following observations may be stated. Sense of quality of life improvement ("QLIMXUT") was positively and significantly correlated with growth in farm assets ("GROXFAA") (p=0.009) and education ("EDUX") (p=0.002), while it was negatively and significantly correlated with age ("AGEX") (p=0.007). Stress level ("STREXUT", note the inverse (decreasing) measuring scale, as defined in "Table 17") was positively and significantly correlated with age (p=0.0001), while it was negatively and significantly correlated with farm income (p=0.05) and farm´s financial risk ("DETOASXF") (p=0.0001). The average of the three individual utility proxies ("UTI3XXX") was positively and significantly correlated with age (p=0.005) and education (p=0.05), while negatively and significantly correlated with farm´s financial risk (p=0.0001) and off-farm´s financial risk ("DETOASXP") (p=0.006).

Thus, in none of the cases a utility proxy had positive and significant marginal utility of farm or off-farm income. Therefore, the finding that marginal utility of income may be negative under given circumstances seems to be confirmed by other proxies of utility. Moreover, the findings that marginal utility of education is positive and that marginal utility of financial risk is negative have also been confirmed by other proxies of utility.

Table 53: Correlation analysis for selected variables for the whole sample (1986-1990), including other utility proxies (*a).

	JOSAXUT	EBTXNFI	EBTXOFF	CVXNFI2	CVXOFF2	GROXNFI
JOSAXUT	1.00000 0.0	0.09472 0.0594	-0.12233 0.0149	0.03813 0.4486	0.06339 0.2081	-0.07329 0.1449
EBTXNFI	0.09472 0.0594	1.00000 0.0	-0.22399 0.0001	-0.02475 0.6212	0.04806 0.3377	0.01554 0.7564
EBTXOFF	-0.12233 0.0149	-0.22399 0.0001	1.00000 0.0	0.01311 0.7938	-0.07321 0.1438	0.00329 0.9478
CVXNFI2	0.03813 0.4486	-0.02475 0.6212	0.01311 0.7938	1.00000 0.0	-0.00363 0.9424	-0.02208 0.6594
CVXOFF2	0.06339 0.2081	0.04806 0.3377	-0.07321 0.1438	-0.00363 0.9424	1.00000 0.0	0.02618 0.6016
GROXNFI	-0.07329 0.1449	0.01554 0.7564	0.00329 0.9478	-0.02208 0.6594	0.02618 0.6016	1.00000 0.0
GROXFAA	0.05100 0.3108	0.13366 0.0074	0.02585 0.6062	0.06651 0.1838	0.03781 0.4507	0.01451 0.7720
PETOXAS	0.03852 0.4440	-0.03034 0.5447	-0.22011 0.0001	0.05391 0.2815	-0.01721 0.7315	0.01026 0.8378
AGEX	0.08164 0.1061	-0.10308 0.0406	-0.15643 0.0018	-0.06932 0.1691	-0.01791 0.7231	0.05951 0.2380
EDUX	0.11086 0.0282	-0.08973 0.0752	0.20363 0.0001	0.09094 0.0714	-0.03602 0.4764	-0.04454 0.3780
DETOASXF	-0.18512 0.0002	0.03775 0.4509	0.09690 0.0528	0.05218 0.2972	0.04739 0.3445	-0.01211 0.8089
DETOASXP	-0.15143 0.0025	-0.00587 0.9069	0.06406 0.2017	0.01208 0.8097	-0.02020 0.6874	-0.02460 0.6238
QLIMXUT	0.28867 0.0001	0.08436 0.0924	0.06473 0.1975	0.07289 0.1461	0.00886 0.8601	-0.00393 0.9377
STREXUT	0.23764 0.0001	-0.09864 0.0495	-0.03885 0.4407	-0.03740 0.4575	0.04304 0.3930	-0.07646 0.1283
UTI3XXX	0.73554 0.0001	0.02541 0.6142	-0.05457 0.2793	0.02751 0.5852	0.05862 0.2451	-0.07834 0.1196
HOU1OFX	-0.07889 0.1166	-0.22416 0.0001	0.51682 0.0001	-0.01806 0.7185	-0.06300 0.2086	0.00241 0.9617

Table 53: Continued:

	GROXFAA	PETOXAS	AGEX	EDUX	DETOASXF	DETOASXP
GROXFAA	1.00000 0.0	0.01370 0.7844	-0.08806 0.0805	0.02818 0.5770	-0.03254 0.5158	-0.01068 0.8314
PETOXAS	0.01370 0.7844	1.00000 0.0	0.15592 0.0019	0.13388 0.0078	-0.18209 0.0002	-0.08980 0.0728
AGEX	-0.08806 0.0805	0.15592 0.0019	1.00000 0.0	-0.18084 0.0003	-0.43626 0.0001	-0.12377 0.0140
EDUX	0.02818 0.5770	0.13388 0.0078	-0.18084 0.0003	1.00000 0.0	0.08382 0.0966	-0.02377 0.6386
DETOASXF	-0.03254 0.5158	-0.18209 0.0002	-0.43626 0.0001	0.08382 0.0966	1.00000 0.0	0.09743 0.0515
DETOASXP	-0.01068 0.8314	-0.08980 0.0728	-0.12377 0.0140	-0.02377 0.6386	0.09743 0.0515	1.00000 0.0
QLIMXUT	0.13026 0.0092	-0.00182 0.9711	-0.13528 0.0071	0.15988 0.0015	-0.02226 0.6576	-0.05711 0.2557
STREXUT	-0.04168 0.4076	-0.02118 0.6739	0.28800 0.0001	-0.03420 0.4995	-0.28609 0.0001	-0.07575 0.1324
UTI3XXX	0.04917 0.3291	0.00540 0.9148	0.14165 0.0050	0.10061 0.0468	-0.25690 0.0001	-0.13880 0.0057
HOU1OFX	0.00834 0.8677	0.00462 0.9265	-0.25189 0.0001	0.15593 0.0019	0.01884 0.7068	0.09294 0.0633

	QLIMXUT	STREXUT	UTI3XXX	HOU1OFX
QLIMXUT	1.00000 0.0	0.12438 0.0131	0.60918 0.0001	0.08573 0.0872
STREXUT	0.12438 0.0131	1.00000 0.0	0.71784 0.0001	0.00308 0.9512
UTI3XXX	0.60918 0.0001	0.71784 0.0001	1.00000 0.0	-0.00093 0.9852
HOU1OFX	0.08573 0.0872	0.00308 0.9512	-0.00093 0.9852	1.00000 0.0

(*a): Pearson Correlation Coefficients / Prob > ¦R¦ under Ho: Rho=0 / Number of Observations. N >= 391.

In addition, logistic estimation of "Model 2" was done using alternative utility measures: "sense of quality of life improvement" ("QLIM2UT") and "stress level" ("STRE2UT").

As it can be seen in "Table 54", both the "criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2", using "QLIM2UT" as the proxy of utility, are statistically satisfactory. However, the significance level of the "-2 LOG L" and the "score" statistics is lower (0.01 for both statistics) than the significance level for such statistics using satisfaction as the utility proxy (0.0001 for both statistics), which may decrease the reliability of the new model (when using "QLIM2UT" as the proxy of utility).

Table 54: "Criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2", using "sense of quality of life improvement" ("QLIM2UT") as the utility proxy, for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d), (*e).

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1115.216	1109.550	.
SC	1131.101	1145.291	.
-2 LOG L	1107.216	1091.550	15.666 with 5 DF (p=0.0079)
Score	.	.	15.467 with 5 DF (p=0.0085)

(*a): Response Variable: QLIM2UT.
(*b): Response Levels: 5.
(*c): Number of Observations: 392.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).
(*e): Score Test for the Proportional Odds Assumption: Chi-Square = 19.4132 with 15 DF (p=0.1956).

As "Table 55" shows, when "sense of quality of life improvement" ("QLIM2UT") is used as the proxy of utility only farm income ("EBTXNFI") and education ("EDUX") had a significant coefficient in the logistic estimation (with p=0.03 and p=0.004, respectively), both with positive signs. This agrees with the results obtained in the original "Model 2" (using satisfaction as the utility proxy). However, such result does not validate the inferences of negative marginal utility of off-farm income and risk aversion, as done when satisfaction was used as the utility proxy.

Table 55: Maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2", using "sense of quality of life improvement" ("QLIM2UT") as the proxy of utility, for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d).

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Sq.	Standardized Estimate
INTERCP1	1	-3.1742	0.6215	26.0870	0.0001	.
INTERCP2	1	-1.9430	0.6075	10.2288	0.0014	.
INTERCP3	1	-0.0271	0.6038	0.0020	0.9642	.
INTERCP4	1	1.4417	0.6400	5.0742	0.0243	.
EBTXNFI	1	4.452E-6	2.076E-6	4.6007	0.0320	0.112961
EBTXOFF	1	5.226E-6	3.842E-6	1.8506	0.1737	0.072495
EDUX	1	0.1355	0.0473	8.2222	0.0041	0.150503
DETOASXF	1	-0.2368	0.4298	0.3035	0.5817	-0.028250
DETOASXP	1	-0.0840	0.0775	1.1770	0.2780	-0.055662

(*a): Response Variable: QLIM2UT.
(*b): Response Levels: 5.
(*c): Number of Observations: 392.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).

"Table 56" shows the association of predicted probabilities and observed responses for logistic estimation of "Model 2", when using "QLIM2UT" as the utility proxy. As "Table 56" shows, the association of predicted probabilities and observed responses for logistic estimation of "Model 2" is 58% which is statistically satisfactory, as explained above.

Table 56: Association of predicted probabilities and observed responses for logistic estimation of "Model 2", using "sense of quality of life improvement" ("QLIM2UT") as the proxy of utility, for Ohio commercial farmers for the period 1986-1990.

Concordant	= 58.3%	Somers' D	= 0.178
Discordant	= 40.4%	Gamma	= 0.181
Tied	= 1.3%	Tau-a	= 0.130
(56007 pairs)		c	= 0.589

Moreover, as it can be seen in "Table 57", when "stress level" (STRE2UT") is used as the proxy of utility for "Model 2", the "criteria for assessing model fit" is satisfactory (p=0.0001 for "-2 LOG L"). However, the "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) is statistically unsatisfactory (p=0.01, which means that the null hypothesis of equal slopes cannot be accepted). This result may decrease the reliability of the model.

Table 57: "Criteria for assessing model fit" and "score test of the parallel lines assumption" (also called proportional odds assumption or equal slopes assumption) for "Model 2", using "stress level" ("STRE2UT") as the utility proxy, for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d), (*e).

Criteria for Assessing Model Fit

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	1384.698	1362.649	.
SC	1408.494	1406.277	.
-2 LOG L	1372.698	1340.649	32.049 with 5 DF (p=0.0001)
Score	.	.	31.330 with 5 DF (p=0.0001)

(*a): Response Variable: STRE2UT.
(*b): Response Levels: 7.
(*c): Number of Observations: 390.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).
(*e): Score Test for the Proportional Odds Assumption: Chi-Square = 44.0064 with 25 DF (p=0.0108).

As "Table 58" shows, when "stress level" ("STRE2UT") is used as the proxy of utility, farm income ("EBTXNFI") had a negative coefficient with a significance level of 0.09. Moreover, off-farm income was not statistically significant. This result seems to confirm the finding from the original "Model 2" (when satisfaction was used as the proxy of utility) that, under some circumstances, marginal utility of income may be negative. The other variables were not significant, except for farm financial risk ("DETOASXF"), which had a negative coefficient (p=0.0001), which seems to confirm the expected result of risk aversion.

Table 58: Maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2", using "stress level" ("STRE2UT") as the proxy of utility, for Ohio commercial farmers for the period 1986-1990. (*a), (*b), (*c), (*d).

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Sq.	Standardized Estimate
INTERCP1	1	-2.5626	0.6348	16.2955	0.0001	.
INTERCP2	1	-0.9207	0.5914	2.4241	0.1195	.
INTERCP3	1	0.3737	0.5873	0.4048	0.5246	.
INTERCP4	1	1.2909	0.5906	4.7766	0.0288	.
INTERCP5	1	2.7465	0.6053	20.5898	0.0001	.
INTERCP6	1	3.9500	0.6359	38.5890	0.0001	.
EBTXNFI	1	-3.38E-6	2.02E-6	2.8031	0.0941	-0.085902
EBTXOFF	1	9.094E-8	3.751E-6	0.0006	0.9807	0.001263
EDUX	1	-0.0305	0.0457	0.4456	0.5044	-0.033974
DETOASXF	1	-2.1383	0.4331	24.3792	0.0001	-0.255650
DETOASXP	1	-0.0719	0.0757	0.9019	0.3423	-0.047734

(*a): Response Variable: STRE2UT.
(*b): Response Levels: 7.
(*c): Number of Observations: 390.
(*d): Link Function: Logit: logit(p) = g(p) = log(p/(1-p)) = a + Bx (SAS (1990, p.1072, 1086)).

"Table 59" shows the association of predicted probabilities and observed responses for logistic estimation of "Model 2", when using "STRE2UT" as the utility proxy. As "Table 59" shows, the association of predicted probabilities and observed responses for logistic estimation is 60% which is statistically satisfactory, as explained above.

Table 59: Association of predicted probabilities and observed responses for logistic estimation of "Model 2", using "stress level" ("STRE2UT") as the proxy of utility, for Ohio commercial farmers for the period 1986-1990.

Concordant = 59.7%	Somers' D = 0.240
Discordant = 35.7%	Gamma = 0.251
Tied = 4.6%	Tau-a = 0.194
(61450 pairs)	c = 0.622

5.15.4. Final observations about the analysis performed:

In general, the statistical results obtained in this study confirmed the conventional wisdom that utility is positively related with education and farm income, while negatively related with financial risk. Moreover, the behavior of the variable "off-farm income" does not necessarily contradict general believes although mixed feelings resulted from the behavior of such variable.

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CHAPTER VI

SUMMARY AND CONCLUSION

The issue of firm performance definition and measurement has been studied by a number of researchers in different contexts. Although the literature is not consistent in the definition of firm performance or in the measure of firm performance used, several aspects of firm performance have been emphasized in different studies such as: profitability, risk, growth, production/technological efficiency, and personal satisfaction (utility measures).

The issue of performance is relevant because using a firm performance measure, let´s say "y1", may produce a model "y1 = f(x1, x2, ..., xn) = f(xi)", where the "xi´s" are socioeconomic variables affecting the outcome "y1". If "y1" is not a firm performance measure reflecting the real goals of an individual or a given population (such as commercial farmers), and if instead it is "y2" the measure which does it, then policy makers will be misled to influence the set of variables "xi" following the model "y1 = f(xi)", instead of the set of variables "xj", following the model "y2 = f(x1, x2, ..., xm) = f(xj)". This hypothetical example makes it obvious that the issue of firm performance measure has essential importance in policy making at all levels.

A number of researchers (Olatunbosun (1967, p.175), Datta, Rajagopalan, and Rasheed (1991, p.548), and Perrin (1968, p.55), among other authors), have suggested that satisfaction (as proxy of utility) should be the core of the firm performance definition and measurement, which agrees with the conceptualization of economics as a social science whose main goal (as the goal of humankind in general) is to maximize the utility (or satisfaction) of the individual, as explained by Datta, Rajagopalan, and Rasheed (1991, p.548), Randall (1987, p.33, 64), Russell and Wilkinson (1979, p.36), and Tweeten and Mylay (1986, p.1-3)).

Therefore, it seems reasonable to justify the use farmer´s satisfaction (utility) level (a "subjective" measure) as a firm performance measure to be compared with other firm performance measures ("objective" measures) found in the literature (such as profitability, risk, and growth).

6.1. Main goal of this study:

The main goal or objective of this study was stated as follows:

> To study the different firm performance measures used by different authors, including their relationship among themselves and with a number of socioeconomic variables. Specifically, utility was related with other performance measures and with a number of socioeconomic variables.

6.2. Hypothesis:

In line with the main goals and questions formulated in this dissertation, the main hypothesis were stated as follows:

Ho.1: Profitability measures are positively and significantly correlated with utility.

Ho.2: Growth measures are positively and significantly correlated with utility.

Ho.3: Financial risk is negatively and significantly correlated with utility.

Ho.4: Financial risk is statistically independent from profitability measures.

Ho.5: Demographic characteristics of the farm household may be important variables affecting utility. The demographic variables studied were: a. Household origin (white, black, hispanic), b. Farmer´s age, and c. Farmer´s education level.

Ho.6: Farm enterprise characteristics are important variables affecting utility. The farm enterprise characteristics variables studied were: a. Farm business (entity) size, b . Use of different marketing strategies, c. Use of a number of (outside) information services.

6.3. Data used for the empirical analysis:

The data used for the empirical analysis in this study comes from the longitudinal survey of Ohio farm operator households for the years 1986, 1987, 1988, and 1991 (no survey was conducted in 1989). Such survey is managed by the Department of Agricultural Economics and Rural Sociology at the Ohio State University together with the US Department of Agriculture or USDA (See: OSU-Ohio Agricultural Research and Development Center: Research Bulletin 1185 (1989, p.3-7)).

Each year, about 950 farm operator households were surveyed by phone; however, for data merging purposes, the size of the usable sample consistent for all years studied was about 400. This drop in sample size was due to the fact that for merging purposes, only the farm households participating in all four years surveyed were considered.

6.4. Information used from the longitudinal survey:

In order to measure the farmer's self-assessment of utility level (a "subjective" measure of farm performance) the last section of the longitudinal survey was used. Such section is titled "Opinion questions" and it contains a question asking the farmer his self-assessment about his level of satisfaction with farming in the present time.

Moreover, the survey provides information about profits, debts, assets, and other information useful in order to construct the main financial statements (the balance sheet and the income statement) and in order to measure profitability, growth, and financial risk. In addition, the survey provides information about demographic variables (such as education and age), and farm-enterprise characteristics such as farm-enterprise size, use of marketing strategies, and use of information services.

For estimation purposes, the profitability measures used were farm´s earnings before taxes and off-farm earnings before taxes, the financial risk measures used were farm´s total debt to farm´s total assets ratio and off-farm´s total debt to off-farm´s total assets ratio, the growth measures used were farm´s earnings annual growth and farm´s annual assets growth, the variability of profits measure used was the coefficient of variation of farm and off-farm earnings before taxes.

6.5. Method for testing hypothesis:

In order to test each of the hypothesis listed before, correlation and regression analysis was used. Specifically, "Ho.1" would be accepted if the profitability measures chosen were positively and significantly correlated with utility. "Ho.2" would be accepted if the growth-related measures chosen were positively and significantly correlated with the farmer´s utility level. "Ho.3" would be accepted if the financial risk measures chosen were negatively and significantly correlated with the farmer´s utility level.

In the same way, "Ho.4" would be accepted if the financial risk measures were statistically independent (uncorrelated) from the respective profitability measure. "Ho.5" would be accepted if any of the demographic characteristics of the farm household (education and age) were significantly correlated with utility. Finally, "Ho.6" would be accepted if any of the farm enterprise characteristics were significantly correlated with utility.

6.6. Variables selected for estimation purposes:

A number of variables were described (measured), as it is shown in "Chapter IV". The relationship among the variables studied was mainly done in "Chapter V". In this way, it was found that a number of variables (such as the farm-enterprise size measures and the other farm-enterprise variables) follow the same correlation pattern that the profitability measures follow, which implied scale economies. Moreover, such pattern of correlation provoked their dropping for estimation purposes in order to avoid potential multicolinearity problems.

After doing the respective selection of variables, the relevant variables considered for estimation purposes were:

Utility measure:

1. "UTILITYX": Utility measure.

Profitability measures:

2. "EBTXNFI" : Farm´s earnings before taxes.
3. "EBTXOFF" : Off farm´s earnings before taxes.

Risk measures:

4. "CVXNFI2" : Coefficient of variation of "EBTXNFI".
5. "CVXOFF2" : Coefficient of variation of "EBTXOFF".

Growth measures:

6. "GROXNFI" : Annual growth in farm´s earnings before taxes.
7. "GROXFAA" : Annual growth in farm´s assets.

Personal (off-farm) wealth or total nonfarm assets:

8. "PETOXAS" : Nonfarm assets (personal assets).

Demographic variables:

9. "AGEX" : Farm operator´s age, in years.
10. "EDUX" : Farm operator´s years of formal education.

6.7. Testing hypothesis:

As it can be observed in "Table 31", all the financial risk measures (debt ratios for the farm, off-farm, and total) were negatively and significantly ($p < 0.003$) correlated with utility. This implies that empirical evidence has been found for the assumption that humans are risk averse. That is, the higher the financial risk, the lower the utility level.

In addition, this implies that hypothesis "Ho.3", stated as

"Ho.3: Financial risk is negatively and significantly correlated with utility",

may be accepted, along with its respective implications, as explained in the above paragraph.

Moreover, "Table 31" shows that none of the financial risk measures is significantly correlated ($p=0.05$) with the respective income measure (farm´s, off-farm´s, or total), with positive and very small correlation coefficients for all cases. This result seems to contradict the standard believe that a higher financial risk generally increases the entity´s income, as explained by Brigham and Gapenski (1993, p.395).

In addition, this implies that hypothesis "Ho.4", stated as

> "Ho.4: Financial risk is statistically independent from profitability measures",

may be accepted, along with its respective implications, as explained in the above paragraph.

It seems interesting to point out that the correlation coefficient between the farm´s debt ratio and the off-farm´s debt ratio is positive and "almost" significant, with a p-value of 0.0515. However, the correlation coefficient has a relatively (very) low value of only 0.097, which may invalidate any conclusion obtained from such relationship. That is why, the following two paragraphs should be taken with some caution.

That is, "Table 31" seems to imply that Ohio commercial farmers who have higher farm debt ratios tend to have also higher off-farm debt ratios. In other words, individuals with higher farm´s financial risk tend to have also higher off-farm financial risk. This finding suggests that financial risk (risk aversion/seeking attitude) is a "personal" characteristic, instead of a general behavior.

This result is also supported by the finding mentioned above that the farm´s and off-farm´s debt ratios were uncorrelated with the respective source of income,. That is, there is not relationship between a profit maximizing behavior and a risk aversion behavior. This finding seems to contradict the believe that there is a trade-off between profits and risk. That is, risk aversion/seeking behavior does not seem to be influenced by any profitability or risk level situation (post-state or state-seeking).

Moreover, the correlation analysis in "Table 34" does not show a clear relationship between utility and farm enterprise characteristics such as entity size, use of marketing strategies, and use of information services. Most of the correlation coefficients were small (less than .09) and statistically insignificant (p=.1), with mixed signs (negative and positive). This suggest that hypothesis "Ho.6", stated as

> Ho.6: Farm enterprise characteristics are important variables affecting utility,

may be rejected. In other words, "Table 34" suggests that there is not strong empirical evidence that farm enterprise characteristics affect utility.

Regarding the relationship between farm earnings before taxes ("EBTXNFI") and off-farm earnings before taxes ("EBTXNFI"), they are negatively and significantly correlated. However, the correlation coefficient is relatively low (0.22), so that multicollinearity problems are not likely to occur. Therefore, both sources of income (farm´s and off-farm´s) may be kept as explanatory variables in the same model. This is specially important, given that both variables are significantly correlated with utility: farm´s earnings before taxes with a positive sign and off-farm´s earnings before taxes with a negative sign, which may allow important conclusions.

Indeed, this suggests that hypothesis "Ho.1", stated as

"Ho.1: Profitability measures are positively and significantly correlated with utility",

may not be accepted, nor may it be rejected, which may imply a conflict with the assumptions of utility maximization and profit maximization. More details about the implications of this finding will be provided latter on, when regression analysis be used in order to study with more detail the relationship between utility and a number of selected variables for estimation purposes.

Furthermore, "Table 35" shows that none of the growth measures affects utility. Indeed, growth in farm earning ("GROXNFI") is insignificantly correlated ($p=.14$) with utility, with a small coefficient (.07) and with a negative sign. Growth in farm assets ("GROXFAA") is also insignificantly correlated ($p=.31$) with utility, with an also small coefficient (.05) and with a positive sign. This suggest that hypothesis "Ho.2", stated as

"Ho.2: Growth measures are positively and significantly correlated with utility",

may be rejected.

In addition, "Table 35" shows that at least one of the two demographic characteristics of the farm household studied is an important variable affecting utility. Indeed, education level ("EDUX") is positively and significantly correlated (p=.03) with utility. Age ("AGEX") is positive but insignificantly correlated (p=.11) with utility. This suggests that hypothesis "Ho.5", stated as

"Ho.5: Demographic characteristics of the farm household may be important variables affecting utility",

may be accepted. This implies that policy makers may favor education programs as a sound policy.

6.8. Utility estimation:

It is important to notice that the utility measure (the dependent variable) is a categorical (ordinal discrete) variable with five response levels, which implies a multinomial distribution (Judge et al (1988, p.802), SPSS (1986, p.582)). Multinomial distributions can be seen as extensions of the Bernoulli and binomial distributions, when the response variable has more that two levels (Judge et al (1988, p.45), DeGroot (1987, p.298)). When the dependent (response) variable follows a multinomial distribution, the logistic estimation technique is recommended for model estimation (SAS (1990, p.1073), SPSS (1986, p.582)).

6.9. Logistic estimation of "Model 1":

Given the selected variables for estimation purposes, the next step was to make the logistic estimation of "Model 1", as defined below.

Model 1: UTILITYX = F(EBTXNFI, EBTXOFF, CVXNFI2, CVXNFI2, GROXNFI, GROXFAA, PETOXAS, AGEX, EDUX, DETOASXF, DETOASXP). (34)

As "Table 37" shows, for "Model 1", farm operator´s years of formal education ("EDUX"), farm´s financial risk or farm´s total debt to total assets ratio ("DETOASXF"), off-farm´s financial risk or off-farm´s total debt to off-farm´s total assets ratio ("DETOASXP"), off-farm earnings before taxes ("EBTXOFF"), and farm´s earnings before taxes were significant at p=0.05. Indeed, the other variables were not significant, even at a critical level of p=0.10.

The signs of the parameter estimates in "Table 37" agree with the signs of the correlation analysis in "Table 31" and "Table 35", as expected. From the signs of the parameter estimates, it can be inferred that the level of utility increases with education, which confirms the acceptance of hypothesis "Ho.5", as explained before.

In addition, from "Table 37" it can be inferred that utility decreases as both farm´s and off-farm´s financial risk increases. That is, the parameter estimates for farm's total debt to farm's total assets ratio ("DETOASXF") and off-farm's total debt to off-farm's total assets ratio ("DETOASXP") were negative and significant, with a p-value of 0.0033 and 0.0139, respectively. This confirms the acceptance of hypothesis "Ho.3", as explained before.

Indeed, this finding can be seen as an empirical evidence that, humans are risk averse, as the standard financial management and economic theory usually assumes (Brigham (1992, p.156), Brigham and Gapenski (1993, p.60, 84)).

Moreover, utility decreases as off-farm's earnings before taxes increases, while it increases as farm's earnings increases. That is, marginal utility of income is negative for off-farm income, but positive for farm income. This finding confirms statements made before implying that there is not empirical evidence to reject or accept hypothesis "Ho.1".

Tweeten and Mylay (1986, p.9-13) found (with significant statistical basis (p=0.05)) a positive marginal utility of income, but in their study they did not divide income into its components, which seems to make the results, regarding this aspect, incomparable. In addition, it is important to notice that, for Ohio commercial farmers, total income (farm plus off-farm) was positively but insignificantly (p=0.5821) correlated with utility and the parameter or coefficient estimate (when fit in the utility estimation, as explained before) was also positive but insignificant (p=0.2878).

The rest of the parameter estimates of "Model 1" (six in total) were not significant at all (not even at a p=0.10) which may indicates that these variables do not affect utility. Although it may be adventurous to make any further conclusions about the effect of these five variables on utility, just for reference, it may be worthy to mention the following: the two variability of income measures (coefficients of variation for farm and off-farm income, which are general risk measures) had a positive sign, farm´s earnings growth had a negative sign, farm´s assets growth had a positive sign, and nonfarm (personal) assets had a negative sign. All this signs agree with the correlation analysis of "Table 35".

6.10. Estimation of "Model 2":

"Model 2" was defined as:

Model 2: UTILITYX = f(EBTXNFI, EBTXOFF, EDUX, DETOASXF, DETOASXP). (35)

"Table 40" shows the maximum likelihood estimates (MLEs) of the regression parameters for logistic estimation of "Model 2". As shown in "Table 40", all the five parameter estimates for the variables included as explanatory variables for utility estimation (EBTXNFI, EBTXOFF, EDUX, DETOASXF, and DETOASXP) in "Model 2" were significant at a p.value of 0.05. Specifically, the significance level of the parameter estimate for DETOASXF was 0.0015, for EDUX was 0.0020, for DETOASXP was 0.0166, for EBTXOFF was 0.0182, and for EBTXNFI was 0.0335.

6.11. Implications from "Model 2":

"Model 2" (and therefore "Model 1") seems very relevant both from the statistical point of view and from the practical (policy making) point of view. That is, "Model 2" may have very important implications, specially in the context in which the main goal of economics as a social science is to maximize the utility of the individual and promote corresponding policy making recommendations. In this way, following the results in "Table 40",the following implications from "Model 2" may be stated:

1. Implication 1 from "Model 2":

Marginal utility of education is positive, which confirms the acceptance of hypothesis "Ho.5". That is, the more years of formal education an individual has, the higher his/her utility level is. This result suggests that policy makers should devote efforts in order to increase the education level of the population.

2. Implication 2 from "Model 2":

Marginal utility of off-farm income is negative, which suggest the rejection of hypothesis "Ho.1". This finding implicitly contradicts the believe/assumption of most economist (and probable of most people in general) that marginal utility of income is always positive.

3. Implication 3 from "Model 2":

Marginal utility of farm income is positive, which suggest the acceptance of hypothesis "Ho.1". This finding implicitly agrees with the believe/assumption of most economist (and most people in general) that marginal utility of income is always positive. From the contradictory results stated in the above two paragraphs, it can be concluded that there is not empirical evidence for accepting or rejecting hypothesis "Ho.1".

4. Implication 4 from "Model 2":

Another implication of the finding of negative marginal utility for off-farm income and positive marginal utility of farm income may be that the assumption of "fungibility of money" is invalidated since the finding at issue implies that it is not true that a dollar has the same value and potential multiple uses under any circumstances (Hyman (1993, p.616). That is, it seems that a dollar obtained from the farm business may be used to increase utility, while a dollar obtained from off-farm activities may not be used to increase utility.

5. Implication 5 from "Model 2":

As the level of (both) farm´s and off-farm´s financial risk increases, the utility level decreases, which confirms the acceptance of hypothesis "Ho.3". This finding agrees with the assumption of most standard financial literature that humans are risk averse (Brigham (1992, p.156), Brigham and Gapenski (1993, p.60, 84)).

6.12. Macroeconomic implications from "Model 2":

The results obtained from "Model 1" and "Model 2" (specifically, negative marginal utility of off-farm income and positive marginal utility of farm income) may be applied in a macroeconomic context, given that macroeconomist usually rely on the assumption of positive marginal utility of income in order to design macroeconomic policy.

If, indeed, there exist situations (let´s say "situations A") in which more income may lower utility, then there may exist situations in which more percapita income (and more economic growth) may not be the "best" goal to achieve, even without distribution of wealth and social justice problems.

In the same lines of thought, assuming that under "situations A" more income was obtained by means of more time worked (which implies lower rate of unemployment), then (under "situations A") lower rate of unemployment may imply lower utility (at the personal level) and lower general welfare (at society level).

Such "situations A" could be instances in which individuals consume more goods (unnecessary or damaging goods), then need more money to obtain the "extra" goods, then need to work more time making more money (here it can be assumed that more time worked decreases utility but this assumption is not necessary to make the point), then have less time to do "positive" activities (whatever activities increasing their utility level), which decreases their utility (even assuming that more time worked does not decreases utility). This model may also worked under a number of scenarios or assumptions.

In general, it can be proposed that "situations A" may occur whenever the individual loses inter-strength and/or becomes more dependent on the outside world. This reasoning follows the "Potential explanations 2 and 3 for "Model 2"" noted above, in which utility is increased by means of focussing in self-dependency and in the natural power potentially existing within the individual.

The following example aims to picture a situation in which more percapita income (and more social economic growth) along with lower rate of unemployment may be worse-off than the initial situation.

Let the initial situation be "situation 0" ("s0"), occurring at "time 0" ("t0"). Under "s0" there exist two individuals ("i1" and "i2") and two jobs ("j1" and "j2", which are "washing dishes once a year" and "drying dishes once a year", respectively). Just for formality, an arbitrary initial wealth level may be assumed. Let´s assume that both individuals receive $10 per year from a given (unknown) source and both individuals spend $10 a year in a given set of goods.

Under "s0" each individual washes and dries his/her own dishes whenever he/she wants or feels at his/her maximum efficiency. "i1" does not depend on "i2" to perform "j1" and "j2", which may be seen as enjoyment of freedom and independence.

Let the new situation or "situation 1" ("s1") be a situation in which "i1" "specializes" in washing dishes, "i2" "specializes" in drying dishes, each one pays $10 (from new money) to each other for performing i´s "specialization", and all else remains equal.

Under "s1" and under the standard (neoclassical) macroeconomic rationality, unemployment decreased by a given percentage, percapita income increased by $10 or 100%, and economic growth in the system went up by $20 or 100%.

However, now each individual must perform his/her task depending on the other individual, each one depends on the other, and some freedom and independence was lost. Moreover, because of such "specialization" of labor, "artificial" ignorance (know how) and dependency has been created. Indeed, there must be many situations in which more economic growth and less unemployment rate are the result of dependent, helpless, consumists, and controllable mentalities, popularized in a given culture or country.

Therefore, more percapita income, more economic growth, and less unemployment is not necessarily better than otherwise. It is important to notice that the model proposed here does not include distribution of wealth issues. That is, the propositions of this model apply even without distribution of wealth and social justice problems.

The model could be complicated introducing a third individual or "i3" (an explicit "service" sector) who coordinates the activities of "i1" and "i2", however, the simple case pictured above should be enough in order to visualize the situation.

6.13. Limitations of the study:

This study may have a number of limitations, as follows:

1. The definition and measure of firm performance may be seen (by some researchers) as a controversial issue, which may limit the acceptance of personal "utility" (as conceptualize in economic theory: satisfaction, well being, happiness, etc. (Randall (1987, p.33, 64), Tweeten and Mylay (1986, p.1))) as the "core" (or "the best") performance measure.

2. The growth measures and general risk measures (variability of income as measured by the coefficient of variation) may not be very reliable due to the fact that the period covered in this study was only five years, which may be seen, by some researchers, as a relatively short time.
   However, since the sample size is relatively large (about 400), one could claim (based in the central limit theorem (DeGroot (1987, p.274)) that any "false" variation in the measures used is random. Therefore, the reliability of the growth and general risk measures is likely to be relatively high.

3. A number of variables (such as technological/production efficiency) were not included in the study. Studying such variables could offer important information related with the issue of firm performance definition and measurement.

4. Comparisons among different populations (perhaps defined in terms of cultural and/or technological characteristics) was not done in this study. Making such comparisons may disclose a number of variables (cultural/technological, etc.) influencing utility, which may have important policy making implications.

5. Bodies of literature (such as animal science and agricultural engineering) were not explicitly covered in this study. Such bodies of literature could offer some inside related with specific technological practices used by different populations, including their "advantages", "disadvantages", and "standard" recommendations.

6.14. Further research:

After concluding this study, it seems that several relevant questions arrive. For example,

1. Given that a number of variables (such as technological/production efficiency) were not covered in this study, are there other "important" variables significantly influencing utility?,

2. Are there bodies of literature in other fields (such as animal science and agricultural engineering which were not explicitly covered in this study (for the matter, it may be said that this study covered mainly literature in the fields of economics, agricultural economics, financial accounting, and statistics)) which may have done contributions related with comparisons among populations (defined in terms of cultural and/or technological characteristics)?.

Therefore, following this study, it seems that further research needs to be done, at least in three areas. The nature of these areas is defined in terms of variables not included in this study, in terms of bodies of literature not included in this study, and in terms of populations (defined in cultural and/or technological terms) not included in this study.

In this way, following the above statements, a research project may be proposed in the following (general) terms.

The goals or objectives of the (new) research may be stated as follows:

1. To study other variables not analyzed in this dissertation (such as technological/cultural characteristics).

2. To introduce bodies of literature not explicitly covered in this dissertations such as animal science and agricultural engineering).

3. To make comparisons among different population. Comparisons could be made among:
   a. The USA-Midwest standard farming population,
   b. The USA-Midwest amish/mennonite and related farming populations.

The statistical analysis could be formulated in terms of the model

Utility = f(a. profitability,
b. financial risk,
c. technological/production practices,
d. demographics within populations (education, etc.))

and the statistical tools to be used could be correlation and regression analysis within populations and comparisons of results among different populations.

The hypothesis of the (new) research project could be formulates as:

1. Financial variables such as profitability and financial risk influence utility,

2. Farm enterprise characteristics such as technological/production practices influence utility,

3. Demographic variables such as education influence utility,

4. The set of variables influencing utility does not vary across farming populations.

The type of inferences/conclusions to be formulated may be rationalized, in terms of given results. For example:

Let´s assume that

> it is found that, indeed (as found in this study), marginal utility of farm income is positive, while marginal utility of off-farm income is negative.

If

> off-farm profits reflect "outside" influences such as machineries and lack of contact with nature (animal drafting, home remedies, etc.),

then,

> it could be the case that a population such as the amish is willing to "sacrifice" outside influences such as more income (from off-farm sources).

Therefore,

> it may be interesting to research the farming production practices of different populations (standard vs amish) and their influence on performance (defined in terms of utility).

Then,

> extracting the "good" (utility increasing) technological/cultural practices of each population may be very important for policy making purposes.

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