2010

The returns and volatility of agribusiness stocks: how do they measure up to non-agribusiness stocks?

Benjamin Michael Clark
Louisiana State University and Agricultural and Mechanical College, bclark1@tigers.lsu.edu

THE RETURNS AND VOLATILITY OF AGRIBUSINESS STOCKS: HOW DO THEY MEASURE UP TO NON-AGRIBUSINESS STOCKS?

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The Department of Agricultural Economics and Agribusiness

by
Benjamin Michael Clark
B.S., Louisiana State University, 2007
May 2010

This thesis is dedicated to my wife, Liz.
Without her support and love,
this work would not have been possible.

ACKNOWLEDGMENTS

Completing this work has been a wonderful yet challenging experience that could not have been accomplished without the assistance and support of many great individuals. First, I would like to express my deepest gratitude to my major professor, Dr. Joshua Detre. Thank you for your encouragement, patient guidance, and late night proofreading. It has been an honor to be your first graduate student. I would also like to thank Dr. Lynn Kennedy for his review of this research and Dr. Hector Zapata for the initial idea of creating an agribusiness stock price index and his review of the final document. Their comments and contributions have added tremendous value to the study. I also would like to recognize Dr. Gail Cramer, Dr. Matt Fannin, and Dr. Richard Kazmierczak for encouraging me to attend graduate school at LSU.

Next, I would like to acknowledge all my fellow graduate students in the Department of Agricultural Economics, particularly my officemates in room 1. Thank you for all the kind words, laughs, and birthday cakes. Specifically, I would like to express gratitude for doctoral students Jeremy D'Antoni and Tyler Mark, and fellow masters student, Juan Tanca. Jeremy has provided valuable and time saving insight on the subject of index calculation and security return measures that have allowed me to expand this research beyond its original scope. Tyler's literature suggestions and all around counsel regarding the research process have been invaluable over the past two years. I thank Juan for his review of this work and his friendship over the past two and a half years that have made the time enjoyable.

I also would like to express sincere thanks to my parents for their infinite love, support, and for being an incredibly positive influence in my life. I am unbelievably lucky to have such a great support system. Finally, I want to convey my deepest adoration to my wife Liz, for her love and encouragement during this process. Without her selfless sacrifice, patience, and understanding, completing this project would not have been possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Little literature exists that analyzes the historical risk and return associated with investing in the US agricultural sector. However, several observable trends have recently made investing in the US agricultural sector an area of interest among investors. Stock price indexes are a commonly used tool for summarizing the historical performance of a specific sector. A market-capitalization weighted stock price index is created to represent the largest US agribusiness firms since 1970, using the US Census Standard Industrial Classification system and the Economic Research Service's definition of agribusiness. Geometric returns, standard deviation, Sharpe Ratio, and beta values are calculated for one, five, and ten-year holding periods. These performance measures are compared to that of the market as a whole using the Standard & Poor's 500 and Dow Jones Industrial Average indexes as proxies.

The results indicate that the historical returns associated with investing in the US agricultural sector were less than what could be expected by investing in a market index, however, the most recent data periods show the sector outperforming the market. *Ex post*, standard deviation measures indicate that the sector is less susceptible to price variability, while Sharpe Ratio measures show that it has enjoyed higher excess returns per unit of risk in recent years. The calculated beta values indicate that price movements in the sector, as summarized by the AG Index, lag behind general market movements.

CHAPTER 1: INTRODUCTION

1.1 Trends in Agribusiness

The market performance of agribusiness firms traded on U.S. exchanges relative to their non-agribusiness counterparts has been the subject of limited research. The recent downturn in the overall market caused by the financial crisis has caused many investors to reassess their investment strategies. A common reaction during uncertain economic periods is to shift money investments to assets that carry less risk. The historically defensive nature of US food companies makes them an appealing investment diversification opportunity during a period of high market volatility (Dirks, 1958). Defensive stocks tend to remain stable under difficult conditions in the economy as a whole (Ang et al., 2006). Volatility in a specific industry's stock prices is related to the level of risk that is associated with investing in the industry. Corporate financial risk can be estimated by calculating the systematic risk estimator "beta", as defined in the Capital Asset Pricing Model (Sharpe, 1964), (Lintner, 1965). According to the New York University Stern School of Business, the beta value for the US Food Processing Industry was 0.63, as of January 2009 (Damodaran, 2009). Thus, the historical evidence suggests that investing in the U.S. Food Industry is less risky than investing in a market index.

Various trends in today's society make investment in food-marketing firms an interesting topic for research. First, human health education is becoming the subject of much global interest and the demand for "healthy foods" on both a domestic and international level has increased significantly. Past research has shown that consumers identify organic food products as having additional nutritional value over food products grown with traditional methods (Hay, 1989). In the United States organic food industry, sales have grown from just over $1 billion in 1990 to approximately $19 billion in 2007 (Dimitri, 2002), (Nutrition Business Journal, 2008). Food

processors, like General Mills, Unilever, and Kellogg have taken notice of this trend and have introduced their own organic product lines. As of 2006, food retail giant, Wal-Mart, offered more than 400 organic food products (Associated Press, 2006). The global food market forces agribusiness firms to constantly search for ways to increase market share (innovation, etc.), if they are to remain profitable. Furthermore, the introduction of genetically modified (GMO) and functional food products has been a worldwide topic of debate among producers and consumers. GMO's have been the subject of legislation reform in Brazil. As GMO's become more accepted worldwide and new markets begin to relax GMO restrictions, agribusiness firms involved in their production stand to make tremendous profit. There is also an unprecedented demand for the inputs used in agricultural production and agribusiness processing by non-agricultural industries. The increase in competition for these inputs may influence the profitability of agribusiness firms, which ultimately affects their share prices and dividend streams. For example, the increasing demands for corn, sugarcane, and soybeans by firms involved in the production of ethanol and biodiesel has decreased the available supply of these inputs for those agribusiness firms who traditionally use these inputs in their production process. Consequently, companies that engage in oil/gas exploration, alternative fuels, and other commodity related companies have been reporting record profits over the past few years. Recent volatility in the crude oil market has only strengthened this trend. Finally, the recent slump in the financial and banking sector has acted to reinforce this movement towards stocks that are more defensive in nature (Kahn, 2008). That is to say, defensive stocks lag behind downturns in the general market, i.e. have a beta value of less than one.

There are, however, certain risk factors that are unique to the agricultural industry that add uncertainty to investing in the sector. These include but are not limited to, weather and natural disasters, biological and environmental factors, and the industry's policy sensitive nature,

as a large portion of farm income are solely dependent on Farm Bill Policy, which is typically renewed every seven years (Beierlein et al., 2003). The aforementioned factors provide a signal for the need in understanding the sector specific risk and performance of agribusiness firms relative to their non-agribusiness peers.

1.2 Goals

Two objectives are accomplished through this work. First, to provide a thorough review of the limited existing literature that compares the financial performance of agribusiness firms relative to non-agribusiness firms. Second, to contribute original research on the returns and risks associated with a large-cap index of publicly traded US agribusiness companies. The second task will be accomplished in two stages. First, a large-cap index of US agribusiness stocks using the Economic Research Service's definition of agribusiness as the framework for selection. Firms eligible for inclusion in the index have US Economic Census Standard Industrial Classification Codes (SIC codes) (US Census Bureau, 2009) that correspond to the ERS classification of firms that are related to agriculture (Economic Research Service, 2005). The sample will be restricted to large-cap domestic agribusinesses, traded on the three major US exchanges, and that have data available from The Center for Research in Security Prices Daily Stock Price Dataset (CRSP) (Center for Research in Security Prices, 2009). A large-cap company is defined as a firm ranking in the top 70^{th} percentile of the industry, by market capitalization. Second, the calculated risk and return associated with the agribusiness index will be compared to that of the market as a whole. Implications and further extensions of this research will also be provided.

CHAPTER 2: LITERATURE REVIEW

The literature review will be organized in three sections. First, literature that examines agricultural businesses as an investment strategy; the attitude towards investment in agricultural related companies in the investment and academic community will be explored. Second, this section will cover the literature concerning stock index creation. In particular, in depth coverage will be given to the mathematical methods for creating indices. The final section will provide a review of the literature regarding proper means of comparing indices. For example, industry accepted risk and return methods are explored.

2.1 Investing in Agribusiness

2.1.1 Unique to Agriculture

Much of the risk agribusinesses face is unique to the industry as it is subject to an unusual set of external factors. Weather, environmental concerns, biological factors, and governmental policy all affect the profitability of firms in the sector. It is also understood that fluctuations in a country's aggregate business cycle are closely related to the share of agricultural output in the economy (Da-Rocha and Restuccia, 2006) and to farmland value (Bjornson, 1995). Countries with a high share of employment in production agriculture are subject to higher fluctuations in aggregate output than countries with little production agriculture employment. In fact, most of the major American industrial business cycles from 1800 to WWI were caused by fluctuations in the size of the cotton harvest that resulted from exogenous factors such as weather (Davis et al., 2009). Therefore, it is important to understand how shocks like weather, international trade restrictions, domestic farm policy, and the level of employment in the sector affect agricultural output and cycles. The length these cycles (on input and output market prices) and their

relationship with US Gross Domestic Product is what is important from an investment perspective.

2.1.2 Organics

Global sales of organic products are estimated to be growing at a rate between 10 and 20 percent a year. Estimated U.S. sales of organic produce in 2001 ranged between $5.5 and $6.5 billion dollars, as compared with $2.1 billion in 1995 and $3.3 billion in 1998 (Dimitri and Richman, 2000). The growing concern of fitness, health, toxin exposure, and a recent series of food safety scares have acted to strengthen the trend towards the consumption of more organically grown food products (Byrne et al., 1991), (Tregear et al., 1994), (Davies et al., 1995), (Dimitri, 2002), (Willer and Yussefi, 2004). The North American market for organic products is experiencing the highest growth worldwide. Organic food and drink sales in the US were estimated to be approximately 14.5 billion in 2005. US consumer demand for organic products is expected to remain strong and account for most global organic food revenues going forward (Willer and Yussefi, 2004). This growth has occurred despite the fact that organic product premiums have been estimated to range from 50 percent to 75 percent (Willer and Yussefi, 2004). Consequently, for a family of four to adopt an organic only diet they would increase their annual food expenditures by almost 50 percent (Brown and Sperow, 2005). Numerous studies have presented organic consumer profiles and determined characteristics that make a person more likely to purchase organic products (Byrne et al., 1991), (Govindasamy et al., 2001), (Thompson and Kidwell, 1998), (Zepeda and Jinghan, 2007). These studies have found that consumers that purchase organic food products are typically young, highly educated, females, high-income earners, and have children living at home. Further research shows that parents of young children are becoming increasingly aware of their children's organophosphorus pesticide exposure (Hood, 2003). A highly publicized 2003 study of Seattle preschool children, showed that those children

who consumed organically grown produce and juices significantly decreased OP exposure as compared to children who consumed conventionally grown produce and juices (Curl et al., 2003). However, recent research indicates that the long-term health benefits of organic food over non-organic products is inconclusive (Dangour et al., 2009). Given the previous research on organic food consumption, it is likely that the organic industry will continually grow on both the domestic and international level. Consequently, agribusinesses that operate in this high margin industry should expect to see increases in their sales, which should ultimately make them more profitable.

2.1.3 Growing Global Demand

Global population is expected to increase from 6.5 billion in 2005 to 9.1 billion by 2050. Most of this growth (97.7 percent) is expected to come from less developed regions in the world (United Nations, 2008). Population growth India and China alone should account for 22.3 percent of the expected increase in world population by 2050. At the same time, incomes, measured by per-capita Gross Domestic Product (GDP), are expected to continue to grow in countries that have recently enjoyed industrialization. For instance, Korea, India, and Thailand experienced average annual growth of 11.76, 10.03, and 8.52 percent, respectively, from 1998 to 2007 (United Nations, 2008b). Indian and Chinese per-capita income is expected to increase by 5.7 and 5.8 percent, respectively, per year between now and 2020 with a similar, but slightly lower, income growth expectation for Asia in general, Eastern Europe, and Sub-Saharan Africa (Rosegrant et al., 2001). Research shows that as incomes in these areas rise and as more people move out of rural areas to more densely populated areas, general food consumption patterns change. A 2001 study showed that, as incomes rise and populations become more urbanized, consumption patterns shift from basic staple items to diets consisting of more processed foods and meat and dairy products (Rosegrant et al., 2001). These changes in consumption patterns will put strains

on these developing nations' agricultural production industry. Countries that are land poor will become increasingly dependent on food imports to meet the growing demand and changing food preferences of its citizens, while those countries that have abundant land endowments but are cash strapped will convert more land in to agricultural use (Rosegrant et al., 2001). Many US agribusiness firms have the necessary infrastructure and supply chain investments in place to capitalize on the growing demands that will be placed on the global food and fiber industry by these developing countries, and therefore they stand to earn large profits.

2.1.4 Biofuels/Ethanol Industry

The rate at which global ethanol production has increased in the last 10 years is remarkable. The creation of such bio-based combustibles requires large masses of starch or sugar rich crops. In fact, demand for corn to be used in the production of ethanol is expected to reach 5 billion bushels by 2015 (United States Department of Agriculture, 2009). A 2007 study projected corn-based ethanol production to increase to over 14 billion gallons by 2010 (Tokgoz et al., 2007). It is clear that the global demand for feedstock based biofuels has been a major factor in the current increase in global grain prices (Trostle, 2008), (Rosegrant, 2008). This increase in prices, has served as a signal for farmers to increase the production of those crops that can be used in bio-fuel conversion. In fact, ERS predicts planted acres of corn to increase every year until 2019 (Economic Research Service, 2009). Similar trends exist for other oil crops such as soybeans and sugar cane. As global demand for these products continue to increase and the governmental mandates on ethanol/gas mix requirements are maintained, companies involved in their production will likely see increased revenues.

2.1.5 Impact on Agricultural Inputs Sector

Grain prices have recently reached all time highs. According to an ERS report, world grain prices increased by 60 percent from 2006 to 2008 (Trostle, 2008). The aforementioned literature

indicates that this trend resulted from growing global demand for food, competition within grain markets for their alternative uses, and changing tastes and preferences. This translates in to an increase in farm profits and expected future earnings. In fact, net cash farm income has established multiple record highs between 2004 and 2008 and reached a peak of more than 89 billion dollars in 2008 (Harris, 2008). Though, net farm income is expected to decline in the near term from the high levels of 2008, it will remain historically strong and rebound to near-record levels by the end of the USDA projections in 2018 (United States Department of Agriculture, 2009). The accompanying increase in demand for agricultural products has multiplier effect, which is felt throughout the agriculture input sector (equipment/machinery, seed, fertilizer, pesticide, herbicides, etc…). Increased commodity prices will create derived demand for farm inputs, which in turn will improve agribusiness input supplier profitability. Many investors expect farmers to re-invest a portion of their income in on-farm capital improvements (Shinkle and Marquardt, 2008). If this is the case, manufacturers of tractors, combines, planters, sprayers, and tillage equipment can expect increased business. A 2008 ERS report estimated the value of farm equipment purchases in 2008 was 4.8 billion (Harris, 2008).

2.1.6 Investor Interest

Within the past few years, analysts have seriously started examining agriculture stocks as a potential source of diversification, long-term investment growth, and short-term protection from downturn in the general market. Jeff Auxier, investor and founder of Auxier Asset Management, spoke about the investment opportunity in agriculture in a recent interview with U.S. News & World Report, "I think agriculture looks really bright over the next 10 years, if we maintain the biodiesel mandates, with the demographics for baby boomers eating healthier, and then the 2-3 billion [new] customers [worldwide]… it looks really good from the investment standpoint" (Wolgemuth, 2008). In another recent interview, David Fondrie, chief investment officer of

Heartland Advisors spoke of US farmers, "The farmer is now in a great position to spend… [f]arm balance sheets are in great shape, the land is worth more, and prices are high for crops. Farmers can now go out and buy more machinery as well as crop inputs like fertilizer and seed". In the same article, the author reported on a recent note to Morgan Stanley clients, where analyst Robert Wertheimer wrote, "[John Deere] is still in the earlier stages of a multi-year boom in farm equipment" (Marquardt, 2008). In a recent article, Senior Editor of U.S. News and World Report, Kirk Shinkle, wrote that "despite some recent selling along with the rest of the market, agriculture remains one of just a few bright spots enjoying solid fundamental growth and some defensive characteristics" (Shinkle and Marquardt, 2008). These statements are supported by former analyst and current Barron's Magazine contributor, Michael Kahn, who noted that despite recent poor performance in the general stock market, agriculture was a pocket of strength (Kahn, 2008). A 2002 study suggested that *farm owners* might be better off investing some equity of the farm in a portfolio of food and agribusiness stocks rather than a well-diversified market based portfolio (Duval and Featherstone, 2002). They found that even given the systematic and non-systematic risk associated with such a portfolio, it is still a viable alternative to other value-added portfolios for all the farms in their sample (Duval and Featherstone, 2002). A similar study found that livestock farmers could diversify risk and capture value-added profits through investing in a portfolio consisting of publicly traded value added firms in the meat processing industry (Detre et al., 2007).

In summary, the US Agriculture sector is believed to carry less risk, enjoy higher risk adjusted return, be defensive in nature as compared to a market portfolio, and be an area of growth in the future. However, little research exists that attempts quantify these beliefs. What is needed from an investment standpoint is an index comprised of agribusiness stocks that summarizes the historical market performance of US Agribusiness firms. Such an index would

allow investors to understand how these stocks compare to non-agribusiness companies and the market as a whole. Index and data service firms have recognized this growth in investor interest in agriculturally related businesses. Two major agriculture-based indices have been published within the past 6 years. In 2003, the Deutsche Boerse Group, a global exchange organization, launched the DaxGlobal Agribusiness Index. The index tracks 46 domestic and international firms in five major sectors; agriculture chemicals, agri-product operations, agriculture equipment, livestock operations, and ethanol/biodiesel.[1] In August 2007 Van Eck Global, a New York based investment firm, launched the Market Vectors Agribusiness Exchange-Traded Fund (ETF) which seeks to track, before fees and expenses, the performance of the DaxGlobal Agribusiness Index. The ETF is publicly traded on the AMEX exchange under the ticker "MOO" with a beta value of 0.89 and had year-to-date returns of 10.2 percent, as of May 2008. In June of 2009, Standard and Poor's released the North American Agribusiness Index (S&P-AG) as the industry's first index. The S&P-AG index consists of 24 of the largest publicly traded agribusiness companies trading on the U.S. and Canadian exchanges.[2] The constituents of the S&P-AG index are equally distributed between two clusters; Producers, Distributors, and Processors; and Equipment and Materials Suppliers (Standard & Poor's, 2009). In an interview on the day on the index's launch, Liz Taxin, Director of Strategy Indices for Standard & Poor's Index Services, noted, "The Index was created based on external market demand from product producers and distributers whose clients have voiced a preference for a regional version of the popular S&P Global Agribusiness Index" (Guarino, 2009).

What is still missing though, is historical back testing of index methodology, as both of these indices only provide a couple of years of historical data. Therefore, the main contribution

[1] Appendix A contains the December 2009 list of constituent firms that make up the DAXGlobal Agribusiness Index
[2] Appendix B contains the December 2009 list of constituent firms that make up the S&P North American Agribusiness Index

of this study is the development of a continuous price series that summarizes the historical performance and risk of the US agriculture sector during the past 39 years.

2.2 Stock Price Indices

Mathematical stock price indexing is popular means of aggregating stock price movements in industries or an entire stock market. They are used as benchmarks to evaluate the performance of professional money managers, create and monitor an index fund, measure market rates of return in economic studies, for predicting future market movements, and as a proxy for a market portfolio of risky assets (Reilly and Brown, 2003). U.S. industry indices have been used since 1884, when the Dow Jones Transportation Average was created to track price movements in the US transportation industry. Today, there are market indices for almost every industrial sector in the economy. The most widely followed major market indices in the US are the Standard and Poor's 500 (S&P 500) and the Dow Jones Industrial Average (DOW). Each index contains a unique formula of stocks and follows one of two general mathematical weighting schemes. The S&P 500 is a market-capitalization-weighted index of 500 stocks intended to be a representative sample of the leading companies in the top US industries. The DOW is a price-weighted index containing 30 "blue-chip" stocks in the top US industrial sectors. Because of their wide use in financial and investment literature, these two indices will be used as proxies for the "market as a whole" in this study.

2.2.1 Types of Indices

Each method consists of three main components: the security price, the security weight, and a divisor. The security price is the value of the stock being indexed. In the case of a stock price index, the price is simply the current value of one share of a firms stock. The security weight depends on the type of index. The weight can be based on the number of outstanding shares for a security, the market value of the security, the price of the security, or the index can be equally

weighted among all of the securities. The weighting scheme is what distinguishes one type of index method from another. An index divisor is the basis for comparisons of the index over time and a starting point to which adjustments must be made as the makeup of the underlying securities change. In addition, since most indices are an aggregate of stock price values, sometimes in the trillions of dollars, a divisor can be used to scale an index so that its number is easier to track. Once the base year of the index is determined, the divisor is used to scale the index to a base value, usually 10, 100, or 1000. Understanding the divisor is critically important to understanding how indices are calculated. Further discussion of the divisor and the base year can be found in the methods section.

The first and simplest method is the price-weighted index. In this method, the price of each component stock is the only consideration when determining the value of the index. Found in equation (1) the calculation of the price-weighted index is:

$$Index\,Level = \frac{\sum_i P_i}{Divisor} \qquad (1)$$

where the *Index Level* is determined by the sum of each security's price, divided by a *Divisor*. The *Divisor* is adjusted to account for changes in share counts and other changes in the sample over time[3]. With this method, each company's weight in the index depends on its price level and therefore a 10 percent price movement in a $100 security, regardless of the size of the firm, will have a larger influence in the value of the index than a similar movement in a $10 security.

[3] Each index has its own list of events that will result in changes in the divisor.

Because of this flaw, price weighted indices are not widely used – although, with much criticism, the DOW continues to utilize this method[4].

The second type of index weighting method is market-capitalization weighting, also known as market-cap. The basic formula for a market-cap index is:

$$Index\,Level = \frac{\sum_i P_i * Q_i}{Divisor} \qquad (2)$$

where the *Index Level* is determined by the sum of each security's price multiplied by its respective weight (Q_i), divided by a *Divisor*. This method takes in to account the size of each firm in the index and weights each security accordingly. The weight is calculated by determining the percentage market value of each security in the index out of the total value of all securities included. Daily market value (DMV) is determined by the following equation:

$$DMV_i = S_i * P_i \qquad (3)$$

where the DMV_i is the product of the number of outstanding shares (S) and the current market price (P) of security "i". The total market value of the index is given by equation (4) below:

$$IMV = \sum_{i=1}^{n} (DMV_i) \qquad (4)$$

where the index market value (*IMV*) is given by the sum of each security's *DMV*. The weight of each stock is given by the ratio of its market value and the total market value of the index:

$$Q_i = \frac{DMV_i}{IMV} \qquad (5)$$

where Q_i is the weight assigned to security *i*, DMV_i is the daily market value of security *i*, and IMV is the total market value of the index. Examples of market-cap indices are the S&P 500

[4] For more information about investor criticism of the DJIA and other price-weighted indices, see "100 Years of the DJIA," section in *The Wall Street Journal*, 28 May 1996, R29-R56, and "What's Behind the Trailing Performance of the Dow Industrials vs. the S & P 500?" *The Wall Street Journal*, 20 August 1998, C1, C17.

(US), the Hang Seng Index (Hong Kong), and the FTSE 100 (Britain). This method is more widely used by index service firms because firm size is accounted for in the index calculation. Because of this characteristic, the market-cap method is the index calculation used in this study. There are however, some limitations to this method. Due to the weighting method, the larger firms in the index can crowd out the smaller ones as they generally carry more weight in the index. In industries that are highly concentrated this can affect the validity of the index. To get around this issue, many index managers set a per-firm cap, usually 8 to 10 percent of the total index value per firm in the index.

2.3 Index Performance and Comparison

A vast body of academic literature exists concerning security price return, risk, and comparison methods. Additionally, rating agencies, financial analysis firms, and index service providers publish thousands of documents each year that explain new measures of security performance and risk. The purpose of this section is to determine the proper measures of risk and return to be used to analyze and compare stock indices.

2.3.1 Index Performance

Before a discussion of performance measures, it is important to note that the index in this study, like most stock price indices, ignores dividend payments. Therefore, a true investment return *cannot be calculated*, only a measure of price appreciation is calculable. It is possible to make an adjustment for dividends in some cases by splicing an index with a dividend yield index (Wilson and Jones, 2002). Recently, many index service and database firms have begun to publish versions of popular indices that have been corrected for dividends payments[5]. However, it can be argued that because dividend payments are somewhat constant and predictable, their value is

[5] An example of such an index is the Center for Research in Security Prices indices on the S&P 500 that have been corrected for dividends CenterforResearchinSecurityPrices. (2009). "CRSP Daily Stock Price Database." from http://www.crsp.com/products/index.html..

already represented in the company's stock price, which by definition is the current value of expected future earnings. In the following discussion, any reference to "return" refers only to change in the index's price, not actually total investment return.

Most financial literature primarily involves return data, or change in price, instead of prices of securities. There are many statistical advantages to using security returns. (Campbell et al., 1997) argued that for average investors, returns are a complete and scale-free summation of the investment opportunity and that return series are easier to handle that price series because of their attractive statistical properties. Return calculation is an active area of academic research and is an important issue for investors who need to make informed decision for their clients. The next few sections will discuss simple return measures, holding period return measures, and risk adjusted performance measures.

2.3.1.1 Simple Return Measures

A simple return measure, or rate of change, can be calculated for one or multiple periods of investment. From (Tsay, 2005), assuming no dividend payments, a one-period simple gross return is given by:

$$1+R_t = \frac{P_t}{P_{t-1}} \qquad (6)$$

moreover, the equivalent simple return is given by:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \qquad (7)$$

where R_t is the return on trading day *t*, P_t is the security's price on trading day *t*, and P_{t-1} is the security's price on day *t-1*. From (Tsay, 2005), the multi-period gross return calculation is given by:

$$1+R_t[k]=\frac{P_t}{P_{t-1}}*\frac{P_{t-1}}{P_{t-2}}*\ldots*\frac{P_{t-k+1}}{P_{t-k}}$$
$$=(1+R_t)(1+R_{t-1})\ldots(1+R_{t-k+1}) \quad (8)$$
$$=\prod_{j=0}^{k-1}(1+R_{t-j})$$

where the security is held for *k* periods between the trading day *t-k* and *t,* and the k-period simple gross return is the product of the one-period simple gross returns of all periods within the *k* period. Therefore, the *k*-period simple return is:

$$R_t[k]=\frac{(P_t-P_{t-k})}{P_{t-k}} \quad (9)$$

where $R_t[k]$ is the simple multi-period return for the period *k,* P_t is the security's price on date *t*, and P_{t-k} is the security's price on date *t-k.*

2.3.1.2 Geometric Return

A geometric return is considered the industry standard for return reporting when a security is held for a year or more. The following calculation, from (Campbell et al., 1997), is used to find the geometric return (GR) of security *i* in time *t*:

$$GR_t^i=\left[\prod_{j=0}^{k-1}(1+R_{t-j})\right]^{1/k}-1 \quad (10)$$

where the geometric return is equal to the multi-period simple gross return to the *1/k* power and *k* is the number of years in the holding period. The reported returns using this method will always be smaller than returns calculated with the simple arithmetic method.

2.3.1.3 Risk Adjusted Returns

Investors are not always interested in a security's return in itself. Rather, they are often concerned with the security's relative performance as compared to some risk-less security, usually U.S. Treasury Bills. The resulting measure is often referred to as the "risk-adjusted

return". Examples of these types of measures are excess return and the Sharpe Ratio. A security's excess return is the difference between the security's return and the risk free security's return and is calculated as:

$$Z_t^i = R_t^i - R_t^{rf} \qquad (11)$$

where Z_t^i is the excess return for security *i* on day *t*, R_t^i is the return on security *i* on day *t*, and R_t^{rf} is the return on the risk free security on day *t*. Building on the excess return model, (Sharpe, 1966) developed a method that measures a security's excess return per unit of risk, known as the reward to variability ratio (R/V), or, the Sharpe Ratio. It is now considered to be one of the most commonly used measure of risk-adjusted performance (Simons, 1998 and Lo,2002). The Sharpe ratio at time *t* for security *i* can be expressed as:

$$Sharpe\,Ratio_t^i = \frac{R_t^i - R_t^{rf}}{\sigma_t^i} \qquad (12)$$

where $R_t^i - R_t^{rf}$ is the difference of security *i*'s return in time *t* and the risk-free return in time *t*, and σ_t^i is the standard deviation of security *i* in time *t*. The Sharpe Ratio essentially represents the tradeoff between risk and return. Therefore, unlike simple return measures, the Sharpe Ratio can be used as a standard of performance and risk ranking to compare different investment options.

2.3.2 Index Risk

2.3.2.1Standard Deviation

When making investment decisions, investors are not only concerned with security performance, but also with the risk associated with said security. By taking on additional price risk, an investor will expect higher returns and it is understood that traditionally less risky assets will have lower returns. Understanding how to measure this risk and the ability to compare assets of differing

configurations is necessary for informed investment decision making. Within the scope of this study, security risk can be thought of as the uncertainty in price movement. Some of the most widely used measures of price risk are; standard deviation, beta value, and value at risk. The most basic measure of stock price variability is the standard deviation. In general, standard deviation is defined as, a measure of dispersion calculated as the positive square root of variance (Weiers, 2002). Variance is defined as a measure of dispersion based on the squared differences between observed values and their mean (Weiers, 2002). In general, variance is given by equation (13),

$$\sigma^2 = \frac{\sum (x_i - \mu)^2}{N} \qquad (13)$$

where σ^2 is the variance, x_i is the i^{th} data value, μ is the population mean, and N is the number of data values in the population. The square root of the variance is the standard deviation (σ) or,

$$\sigma = \sqrt{\sigma^2} \qquad (14)$$

When applied to security price analysis, the standard deviation gives investors a measure of daily, monthly, or annual variability of price movements.

2.3.2.2 Beta Value

In the introductory section of this study, the CAPM, or capital security pricing model was briefly discussed. Specifically, the "beta" parameter within the CAPM framework was considered. A security's beta value gives investors an idea of the security's returns relative to that of the financial market as a whole. The beta value of the market portfolio is always one. A security with a beta value of 1 or -1 means that its price is perfectly correlated with the market, while a beta value of zero means that the security's price is not correlated at all with the market. If the beta value is less than one but positive, it means that the market and the security's prices move in

similar directions but with dissimilar magnitudes (positive correlation), while a negative beta that's greater than -1 means that they move in opposite directions but with dissimilar magnitudes (negatively correlated). This powerful characteristic makes the beta value is a popular measure of an assets statistical variance. A beta value can be estimated for individual companies through simple regression analysis against a market proxy, such as the S&P 500. As previously mentioned, the beta for the U.S. Food Processing Industry was estimated to be 0.65, indicating that the sector lags behind market movements but still moves in similar directions. The broader agricultural sector is believed to have the same characteristics though little research has been published to test this hypothesis.

2.3.2.3 Value at Risk

Another popular measure of price risk is Value at Risk (VaR). The VaR measure was first used to evaluate price risk associated with derivatives trading at major banks (Simons, 1998). The measure was further popularized by the 1993 special report by the Group of Thirty, *Derivatives: Practices and Principles*, which further recommended VaR for derivative risk analysis (Global Derivatives Study Group, 1993). The VaR measure tells an investor how much the value of a portfolio could decline over a given amount of time based on a given probability. To calculate VaR, stock prices must be assumed to be distributed normally and, therefore, it is assumed that 95 percent of all deviation around the mean occurs within 1.96 standard deviations. Thus, the 5% VaR calculation is given by:

$$VaR_t^i = R_t^i - 1.96 * \sigma_t^i \qquad (15)$$

where VaR_t^i is firm *i*'s value at risk for time period *t*, R_t^i is firm *i*'s return for time period *t*¸ and σ_t^i is firm *i*'s standard deviation for time period *t*. This measure of risk is particularly useful for investments that have significantly different compositions over time, such as an index or mutual

fund (Simons, 1998). Since this research is primarily concerned with the historical risk of agriculturally related firms and not future or present risk, a VAR measure will not be calculated.

The measures mentioned above are universal and can be compared across investment options. When comparing different investment possibilities, it is important to choose options for comparison that are similar in composition. For instance, if an investor wanted to compare the risk and return of a collection of small-cap stocks to the performance of small-cap stocks as a whole, it would not be wise to choose the S&P 500 or Dow Jones Industrial Average, as they are large-cap indices. A more suitable comparison index would the Standard and Poor's small-cap index. For the purposes of this study, the S&P 500 and the Dow Jones Industrial Average are proper comparison indices, given that the AG Index is comprised of large-cap stocks.

CHAPTER 3: METHODS

3.1 Data

3.1.1 Overview

Daily closing stock prices, returns, and outstanding shares are collected from The Center for Research in Security Prices Database (CRSP) though the Wharton Research Data Services (WRDS) database. The CRSP US Stock Database contains end-of-day and month-end prices on all New York Stock Exchange (NYSE) (December 31, 1925-Present), American Stock Exchange (AMEX) (July 2, 1962-Present), and the National Association of Securities Dealers Automated Quotations (NASDAQ) (December 14, 1972-Present) common stocks along with basic market indices, distribution information, and total return calculations.

3.1.2 Firm Selection

The USDA's Economic Research Service (ERS) provides a listing of industries closely tied to production agriculture by the U.S. Economic Census Standard Industrial Classification Code (SIC codes). SIC codes aggregate industries into related groups. For example; farm production, agricultural services, forestry, and fishing; agricultural input industries; agricultural processing and marketing industries; wholesale and retail trade of agricultural products; and indirect agribusinesses. ERS defines farm and farm-related industries as those industries generally having 50 percent or more of their national work force employed in providing goods and services necessary to satisfy the final demand for agricultural products and indirect agribusiness are those industries having between 32 and 50 percent. Appendix C contains ERS's listing of these sectors.

A list of publicly traded firms with SIC codes that correspond to the ERS classification of agribusiness firms was generated using the CRSP database. The CRSP database is the leading provider of the most comprehensive US historical stock market databases and is the most widely

used database in finance literature. The CRSP database contains daily price quotations for common stocks, excluding preferred stock and including American Depositary Receipts, traded on the New York and American stock exchanges and NASDAQ. Daily returns provide a more accurate measure of market efficiency than monthly returns (Henderson, 1990), (Armitage, 1995), (MacKinlay, 1997). Daily data begin in July 1962. While NYSE data are available throughout the entire period, AMEX data starts in 1962, and NASDAQ data begins in 1972.

For a stock to be eligible for inclusion in this study, the stock must have daily return data in the CRSP database and have data available for a full year of trading. Any agribusiness firm that did not have daily return data for the aforementioned dates was excluded from the choice set. Appendix D provides a list of the firms, by years, which were dropped from the sample due to missing data. Once a sample of eligible stocks was compiled, the sample was broken up in to three sub-industry groups based upon the ERS classification grouped according to SIC codes: farming stocks, closely related to farming, and peripherally related to farming. A full list of the component industries in each group is provided in Appendix C. Within each industry group, only the firms that make up the top 70^{th} percentile based on market share were selected for the final index selection.[6] This selection process is repeated on the first trading day of each year in the index calculation. A list of all firms included in each year's index is provided, by permanent number (PERMNO), in Appendices E and F. Finally, the daily closing prices (*prc*) and number of outstanding shares (*shrout*) were obtained for each firm from the CRSP database. "*Prc*" is defined by CRSP as the closing price or the negative bid/ask average for a trading day. If the closing price is not available on any given trading day, the number in the price field has a negative sign to indicate that it is a bid/ask average and not an actual closing price. If neither

[6] The 70^{th} percentile selection process is discussed in length in a later chapter.

closing price nor bid/ask average is available on a date, the value in the price field is set to zero. Corrections were made to the data to eliminate any negative values, by using the absolute value function in Microsoft Excel (abs()). When a daily price value was not available, the value for the previous trading day was used. In the cases where data for consecutive days was not available, the last available trading day value was used for up to 10 consecutive days of missing data. If more than 10 consecutive days of data were missing from the dataset, the firm was removed from the sample. "*Shrout*" is defined by CRSP as the number of publicly held shares, recorded in thousands. This is sometimes referred to as the "float" or the number of outstanding shares that are available to investors. Floated share counts exclude shares closely held by control groups, other publicly traded companies, or government agencies. Using a floated share count reflects the value available in the public markets.

The data collection, management, and risk and return calculations were completed in Microsoft Excel 2007 and Access 2007. In addition to the included statistical functions of these programs, the *DigDB*, *Excel Analysis Tool Pack*, and *Macros Add-in* tools were used.

3.2 Index Membership

The universe from which firms are selected is all publicly listed companies in the CRSP database with a SIC code classification that corresponds to the ERS definition of agriculturally related industries. The list generated via the CRSP database included 374 firms classified as "farming", "closely related to farming" or "peripherally related to farming" that were publicly traded at sometime between January 1970 and December 2008. The universe was then narrowed down to a set of stocks based on several criteria. First, for a stock to be considered for inclusion in the index for a given year, say 1970, price and outstanding share count must be available for the full year of 1970. The sample was then split based on the ERS subcategories of "farm and farm-related industries". These include farming, closely related to farming, and peripherally related to

farming. Next, the sample size was reduced to include only the top 70th percentile of firms among each of the three sub-categories. Please refer to Table 1 for a visual representation of this step. Each year's basket of potential firms was filtered to display only the first trading day's

Table 1: Top 70th Percentile Selection

TRD Day	Firm	PRC	SHROUT	DMV	% MKT Share	CMPD Sum
1	A	94	220292000	20707448000	23.4%	23.4%
1	B	33.5	358815000	12020302500	13.6%	37.0%
1	C	28.63	360136000	10308893000	11.7%	48.7%
1	D	28	201187000	5633236000	6.4%	55.0%
1	E	41.38	133862000	5538540250	6.3%	61.3%
1	F	61.5	70860000	4357890000	4.9%	66.2%
1	G	31.38	129590000	4065886250	4.6%	70.8%
1	H	42.5	92244000	3920370000	4.4%	75.3%
1	I	41.25	81734000	3371527500	3.8%	79.1%
1	J	39	79366000	3095274000	3.5%	82.6%
1	K	17.63	162520000	2864415000	3.2%	85.8%
1	L	17.88	159715000	2854905625	3.2%	89.1%
1	M	54	48283000	2607282000	2.9%	92.0%
1	N	28.13	75190000	2114718750	2.4%	94.4%
1	O	29.75	60168000	1789998000	2.0%	96.4%
1	P	43.88	38203000	1676156625	1.9%	98.3%
1	Q	43	34657000	1490251000	1.7%	100.0%
			Total MKT Value	**88417094500**		

price and share count. The daily market value (*DMV*) was calculated for each firm by applying equation (3) and then sorted from largest to smallest. Next, the total index market value is determined by using equation (4). Then, the percent market share is calculated for each firm by equation (16):

$$\%\,Market\,Share_i = \frac{DMV_i}{Total\,MKT\,Value} \qquad (16)$$

where the *% Market Share* for firm *i* is given by the daily market value of firm *i* divided by the total market value of the index on the first trading day of the year. For example, from Table 1,

firm "A" has a *DMV* of $20,707,448,000 which represents 23.4 percent of the total market value of all the firms in the index for this year within the same sub-group. Next, a compounding sum is calculated as:

$$CMPD\,Sum_B = \%MKT\,Share_B + \%MKT\,Share_A \qquad (17)$$

where the compounding sum equals the sum of the percent market share of firm "B" and the percent market share of firm "A", which is the firm immediately above firm "B" when sorted from largest to smallest by *DMV*. This step is repeated until the *CMPD* Sum reaches 100 percent. Finally, only those firms making up the top 70th percentile, or as close to it as possible, are selected for inclusion in the index for the given year. This is illustrated in Table 1 above, by those firms shaded in gray. In this example, only firms A, B, C, D, E, F, and G are selected for inclusion; all other firms are dropped from the sample for year *t* because they are too small. This procedure is performed separately for each sub-group; farming, closely related to farming, and peripherally related to farming, so that the index represents the top 70th percentile of firms within each of the three sub-groups. Once the final firm selections were made, the firms within each sub-group were combined in to one worksheet. The final dataset was then split in to 39 separate worksheets, organized by year from 1970 to 2008.

3.3 Index Methodology

The index calculation method utilized in this study is defined as the market-capitalization method. As mentioned in an earlier chapter, it is the most widely used form of index calculation. The index calculation is a very straightforward process, the first step of which involves calculating the daily market value (*DMV*) for each firm in the index using the following equation:

$$DMV_i^t = (P_i^t * Shares_i^t) \qquad (18)$$

where the daily market value for security *i* in time *t* is the product of the price and the number of outstanding shares of security *i.* The total index market value for a given day is calculated by:

$$IMV_t = \sum_{i=1}^{n} DMV_i^t \qquad (19)$$

where IMV_t is the index market value at time *t* and DMV_i^t is the daily market value for firm *i,* at time *t.* The symbol "*t"* represents the number of trading days in a given year, usually 253 day. A table containing the number of trading days in each year is available in Appendix G. These steps were repeated for each year in the study.

3.5 Index Scaling and Rebalancing

3.5.1 Scaling the Index Using a Divisor

On any given day, the total market value of an index of stocks can be in the billions or even trillions of dollars. For example, on 5/8/1991 the total index value in this study was $333,644,493,625.00. Tracking a number this large on a day-to-day basis can be a challenge in itself; therefore, the index value is scaled so that it is easier to track. Many index service companies utilize what is called a "divisor" to scale the index. To scale an index using a divisor an index manager must first choose a base date and a base value. The actual base value is irrelevant because it tells us nothing about the performance of the firms in the index. Investors are more concerned with the incremental changes in that value. However, the initial value of the *divisor* is dependent on the base value and is determined at the base date of the index. For example, if the base date for an index is January 2, 2003 and the index manager defines the base value at 100, the initial divisor is calculated by:

$$Divisor_{initial} = \frac{Index\,Market\,Value_{Jan\,2,2003}}{100} \qquad (20)$$

where $Index\,Market\,Value_{Jan\,2,2003}$ is the total market value of the index on the base date.

Therefore, if the total market value of the index on the base date were $25,000,000, the divisor would be 250,000. To get the scaled index value, simply divide the index market value by the divisor using:

$$Scaled\ Index\,Value_t = \frac{Index\,Market\,Value_t}{Divisor_t} \qquad (21)$$

where the scaled index value at time *t* is determined by dividing the index market value at time *t* by the divisor at time *t*. Again, if the index market value is $25,000,000 and the divisor is 250,000 then the scaled index value will be 100. The scaled index value will always be the same as the base value on the base date. Therefore, if the index market value increases to $26,500,000 on the next trading day the scaled index value will be 26,500,000/250,000, or 106, which represents a 6 percent increase in value from the previous day. Note that the divisor in equation (21) does have a time notation. This is because the index manager for maintenance purposes can manipulate the value of the divisor.

3.5.2 Scaling the Index Using the Ratio Method

There are several ways to build and scale a market-value-weighted index. The most straightforward is to use the method outlined in (Chartered Financial Analyst Institute, 2005), which will be referred to as the "Ratio Method". Like the divisor method, the first step is to choose a base date and base value. In addition, the scaled index value is the base value on the base date. However, in this case the scaled index value is given by:

$$SIV_t = \frac{IMV_t}{IMV_{t-1}} * SIV_{t-1} \qquad (22)$$

where SIV_t the scaled index value at time *t* is, IMV_{t-1} is the index market value at time *t-1*, IMV_t is the index market value at time *t*, and SIV_{t-1} is the scaled index value at time *t-1*. By taking the ratio of today's index market value and the previous day's index market value then multiplying it by the previous day's SIV we can achieve the same goal of scaling the index market value to a more manageable number. With this method, there is no need for a divisor.

3.5.3 Bi-Annual Corrections

3.5.3.1 Mid-Year Update

The number of shares available to the public for a given firm can change from day to day for several reasons. If a company issues new shares to the public this number will rise, if they buy back shares the number will reduce. Changes in share count can also occur due to acquisitions, mergers and spin-offs, and several other corporate actions. All indices must have a clearly defined method for accounting for these changes as they can drastically affect the accuracy of the index. For example, the S&P 500 uses what they call the "5 percent rule", where immediate corrections to the index are made only when corporate action or any other force causes a firm's share count to change by more than 5 percent, (Standard & Poor's, 2009b). All other changes that result in less than a 5 percent change are accumulated and made on a quarterly basis. For this study, all changes in share counts, despite size, are accumulated and updated bi-annually. All changes during trading days 1 through 126 and are updated on day 127 and changes during days 127 to the last trading day of the year and are updated on the first trading day of the next year.[7]. This correction is calculated as:

[7] Given the time constraints of this study it was not possible to track share count changes as closely as those published indices like the S&P 500 or Dow Jones Industrial Average.

$$DMV_i^{td} = \begin{cases} P_i^{td} * Shares_i^{t1}, if\ d < ^{127} \\ P_i^{td} * Shares_i^{t127}, if\ d \geq ^{127} \end{cases} \quad (23)$$

where DMV_i^{td} is the daily market value of firm *i* on day *d* in year *t*, P_i^{td} is the security price of firm *i* on day *d* in year *t*, $Shares_i^{t1}$ is the share count for firm *i* on day *1* in year *t*, and $Shares_i^{t127}$ is the share count for firm *i* on day 127 in year *t*. For all trading days preceding day 127, the recorded share count on the first trading day of the year is used. For all trading days on or after day 127, the recorded share count on the 127th day of trading is used.

3.5.3.2 Beginning of the Year Update

On the first trading day of each year, the index is rebalanced to account for two changes to its makeup. First, all changes in share counts and second, all additions and deletions are made to the constituents of the index. In a given year, the firms that make up the top 70th percentile of the agricultural industry can change. Additions and deletions occur because each year some companies are shutdown because of bankruptcy, new companies are started, some companies grow, mergers occur, and others fall in market share. Making annual firm additions and deletions ensures that the AG Index remains an up-to-date representation of the US agriculture sector. These changes are only made at the beginning of each year; consequently, if a company is added to the index in January, it cannot leave the index until the January of the next year.

3.5.4 Rebalancing the Index Using a Divisor

When changes are made to the index's constituents or if share counts change, the index level should not move up or down, as this change does not represent market price movement. To ensure that an index's level does not change when stocks are added or deleted, an adjustment must be made to offset the change in market value. In the case of the S&P 500 and many other indices, the divisor is used to accomplish this (Standard & Poor's, 2009b). The divisor, in this

case, plays a crucial role in the ability to compare index levels over time as changes in the constituents can affect the reliability of the index measure. For instance, if an index closes on December 31, 1972 at 450 and after the close a new firm is added to the index, the index should still open on January 2, 1973 at 450. This offset is accomplished by:

$$Divisor_t = (Divisor_{t-1}) * \frac{IMV_t}{IMV_{t-1}} \quad (24)$$

where $Divisor_t$ is the new divisor at time t, is $Divisor_{t-1}$ is the old divisor at time *t-1*, IMV_t is the index market value at time *t*, and IMV_{t-1} is the index market value at time *t-1*. This new divisor is used to scale the index until another rebalancing is required.

3.5.5 Rebalancing the Index Using the Ratio Method

A more general method used to rebalance the index to offset changes in the constituency and share counts in the index over time is the ratio method (Chartered Financial Analyst Institute, 2005). With indices that are managed daily, this rebalancing is done after the market closes for the day. Because the price data in this study is daily closing price, the intraday prices are not available. Therefore, to properly rebalance the index after a constituent or share count change, the index market value at time *t* (after the change) must be calculated using the prices from time *t-1* (before the change). This new index market value using the adjusted share counts and updated basket of firms will be referred to from this point forward as the Adjustment Index Market Value (*AIMV*). This adjustment figure must be calculated in the beginning of each year to offset the change in constituents and the change in share counts, and at trading day 127 when only the share counts are updated. The *AIMV* calculated at the beginning of each year is given by:

$$AIMV_1 = \left[\sum_{i=1}^{n}(P_i^{y-1d-1} * Shares_i^{yd})\right] + \left[\sum_{j=1}^{n}(P_j^{y-1d-1} * Shares_j^{yd})\right] - \left[\sum_{k=1}^{n}(P_k^{y-1d-1} * Shares_k^{yd})\right] \quad (25)$$

where $AIMV_1$ is the adjusted index market value at trading day 1, P_i^{y-1d-1} is the price for security *i* on trading day *d-1* in year *y-1*, $Shares_i^{yd}$ is the share count for security *i* on trading day *d* in year *y*, and so forth. The second bracketed section in the equation is the total market value of all the firms that are being added to the index using the new share counts and the previous trading day's prices. The third bracketed section is the total market value of all the firms that are leaving the index using the new share counts and the previous trading day's prices. The AIMV at trading day 127 is given by:

$$AIMV_{127} = P_i^{126} * Shares_i^{127} \qquad (26)$$

where $AIMV_{127}$ is the adjustment index market value at trading day 127, P_i^{126} is the price of security *i* at trading day 126, and $Shares_i^{127}$ is the updated share count for firm *i* at trading day 127. The rebalanced and scaled index value for the first trading day of each year is given by:

$$SIV_{y1} = \frac{IMV_{y1}}{AIMV_{y1}} * SIV_{y-1,253} \qquad (27)$$

where SIV_{y1} is the scaled index value at the rebalancing trading day *1* in year *y*, IMV_{y1} is the index market value on trading day *1* in year *y*, $AIMV_{y1}$ is the adjustment index market value on trading day *1* in year *y*, and $SIV_{y-1,253}$ is the scaled index value from the last trading day of the previous year. The rebalanced and scaled index value for the 127-trading day is given by:

$$SIV_{127} = \frac{IMV_{127}}{AIMV_{127}} * SIV_{126} \qquad (28)$$

where SIV_{127} is the scaled index value on trading day *127*, IMV_{127} is the index market value on trading day *127*, $AIMV_{127}$ is the adjustment index market value on trading day *127*, and SIV_{126} is the scaled index value on trading day *126*.

3.6 Index Return

Within the contexts of this study, the term "return", refers only to change in price from one specified point in time to another, not investment return. That being said, the index's return is reported as a geometric return. The first step of this return calculation is to find the holding period ratio (*HPR*) for each year of the index by:

$$HPR_{y}^{Ag\ Index} = \frac{P_{yn}^{Ag\ Index}}{P_{y1}^{Ag\ Index}} \qquad (29)$$

where, the *HPR* for year *y* is given by the ratio of the price of the Ag Index in year *y* on day n (the last trading day of year *y*) and the price of the Ag Index in year *y* on trading day *1* (the first trading day of year *y*). For example, the holding period ratio in 1970 would be calculated as follows:

$$HPR_{1970}^{Ag\ Index} = \frac{101.589}{100} \qquad (30)$$

Therefore, the holding period ratio for 1970 would be *1.01589*. To calculate the geometric return (*GR*) for one period (year) you simple subtract 1 from the period's *HPR* as:

$$GR_{y}^{Ag\ Index} = (HPR_{y}^{Ag\ Index}) - 1 \qquad (31)$$

In the case of 1970, the geometric return was *1.01589 - 1 = 0.01589* or *1.589* percent return. The geometric return for more than one period is calculated by:

$$GR_{x,z}^{Ag\ Index} = \left[(HPR_{x} * HPR_{y} * ... * HPR_{z})^{\frac{1}{n}} \right] - 1 \qquad (32)$$

where $GR_{x,z}^{Ag\ Index}$ is the geometric return for period *x* through *z*, HPR_{x} is the holding period ratio for period *x*, HPR_{y} is the holding period ratio for period y, HPR_{z} is the holding period ratio for period *z*, and *n* is the total number of periods within the return calculation. For the period of 1970 to 1974, the geometric return calculation is given as follows:

$$GR_{1970,1974}^{Ag\ Index} = \left[(1.015894 * 1.07623 * 1.01857 * 0.76175 * 0.68982)^{\frac{1}{5}} \right] - 1 \qquad (33)$$

Therefore, the geometric return for the five-year period of 1970 to 1974 was *-0.101625* or *-10.1625* percent. To ensure comparability across indices, the returns for all comparison indices are calculated using the same methodology.

3.7 Index Risk and Risk Adjusted Performance

The reported measures of risk in this study are standard deviation and beta; and the Sharpe Ratio, a measure of risk-adjusted returns. The resulting values are compared with those of the two comparison indices (S&P 500 and Dow Jones Industrial Average).

The standard deviation (*STDEV*) of the AG Index as well as the comparison indices will be calculated as:

$$STDEV_p^i = \sqrt{\frac{\sum_{t=1}^{n} (SIV_t^i - \mu^i)^2}{N}} \qquad (34)$$

where $STDEV_p^i$ is the standard deviation of index *i* during period *p*, SIV_t^i is the scaled index value for index *i* for the t^{th} trading day and μ^i is the mean value of index *i* for period *p*, and *N*, is the number of data values in period *p*.

Investors are not only concerned about the price risk of the security itself; rather, they are also interested in its risk relative to some other securities. A popular measure that summarizes the correlation between one security and a benchmark is its beta value. As previously mentioned the beta measure is a component of the capital asset pricing model (CAPM). From (Perold, 2004), the CAPM is calculated by:

$$E_s = r_f + \beta(E_M - r_f) \qquad (35)$$

where E_s and E_M are the expected return from the security and the market portfolio, respectively, r_f is the risk free return, and β is the sensitivity of the security's price to the market, i.e., the security's beta value. The security's beta value is calculated by simply regressing the security's return against the market portfolio:

$$R_S = \beta(R_M) + \alpha \qquad (36)$$

where R_S and R_M are the return series from the security and the market portfolio, respectively, β is the slope the regression line and the assets beta value, and α is the error term. For the purposes of this study, the S&P 500 was used as a proxy from the market portfolio. Short and long-term measures are useful to investors making investment decisions on different time horizons. Therefore, to test the belief that the U.S. agricultural sector is defensive in nature, the beta value was calculated for the AG Index for each year in the study, each five-year, and each 10-year holding period.

In the beta calculation, the benchmark security is the market portfolio, which still contains risk. However, investors are also concerned with a security's performance and risk relative to a riskless asset. Excess return measures, like the Sharpe Ratio, provide such information to investors. Because this study is mainly concerned with the past performance of US Agribusiness firms relative to the market as a whole, the ex post Sharpe Ratio is provided. The *ex post*, Sharpe Ratio is given by:

$$Sharpe\,Ratio_i = \frac{R_i - R_{rf}}{\sigma_i} \qquad (37)$$

where R_i is the simple return of security *i*, R_{rf} is the simple return of the risk free security, and σ_i is the standard deviation of security *i*. It is important to note that the Sharpe Ratio measure is

not independent of the time period over which it is measured (Sharpe, 1994). The commonly cited way to annualize the Sharpe Ratio measure (S) is given by:

$$Sharpe\,Ratio_T = \sqrt{T} * Sharpe\,Ratio_1 \qquad (38)$$

where $Sharpe\,Ratio_T$ is the annualized measure over *T* periods, and $Sharpe\,Ratio_1$ is the one period measure. However, this method has been shown to be correct in only a few rare statistical circumstances (Lo, 2002). Therefore, from (Sharpe, 1994), the proper way to calculate multi-period (*p*) Sharpe Ratio measures is given by,

$$Sharpe\,Ratio_i^p = \frac{GR_i^p - GR_{rf}^p}{\sigma_i^p} \qquad (39)$$

where, GR_i^p is the geometric return for security *i* during period *p*, GR_{rf}^p is the geometric return for the risk free security, during period *p*, and σ_i^p is the standard deviation of security *i* for period *p*. When calculating risk adjusted return measures, special attention should be given to selecting a proper proxy for the risk free security in the equation. Typically, short term (90 day) US Treasury Bills are used, however, government securities are not entirely riskless, especially when their maturity period is not matched to the investor's time horizon (Roll, 1969). Therefore, daily yield values for one, five, and ten year US Treasury Bills are used based on the corresponding holding period return.

CHAPTER 4: RESULTS

The results will be organized in to five sections. The first section will discuss the AG Index continuous price series, general characteristics of returns, and other descriptive statistics. The second section will discuss the returns of the AG Index relative to the comparison indices. Annual, 5-year, and 10-year holding period geometric returns will be provided. The third section will compare the standard deviation of the AG Index and the comparison indices. The fourth section will provide the results from the Sharpe Ratio calculation and the fifth and final section will be a discussion of the estimated beta parameters.

4.1 Descriptive Statistics

Figure 1 below, shows the continuous price series of the agribusiness stock index from January 2, 1970 to December 31, 2008. The initial index value is 100, the lowest recorded value

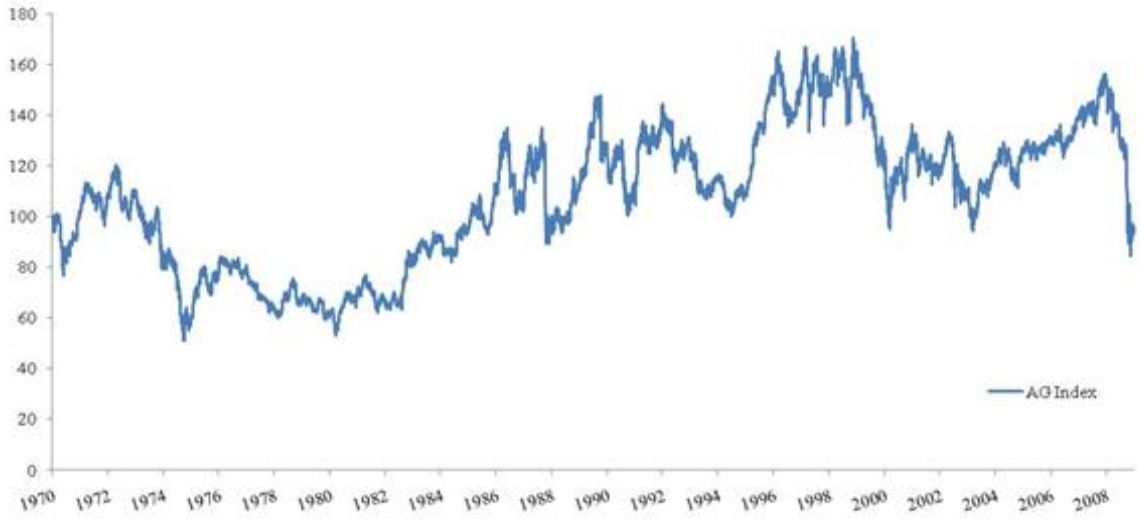


Figure 1: AG Index Value (1970-2008)

was 50.82 on October 3, 1974, and the highest recorded value was 170.55 on November 23, 1998. The average index value was 108.17, median value was 110.54, and had standard

deviation of 27.87. From an investment standpoint, the index price is not as important as the change in said price over time, or, the returns of the index in question. A larger version of this figure is provided in Appendix H. Table 2 displays the daily simple return descriptive statistics

Table 2: Daily and Annual Descriptive Statistics

	AG Index Descriptive Statistics		S&P 500 Descriptive Statistics		DOW Descriptive Statistics	
	Daily	***Annual***	***Daily***	***Annual***	***Daily***	***Annual***
Mean	0.00005	0.01273	0.00029	0.06495	0.00030	0.07476
Standard Error	0.00010	0.02605	0.00011	0.02768	0.00011	0.02655
Median	0.00027	0.02894	0.00039	0.07136	0.00033	0.07179
Mode	0	0	0	0	0	0
Standard Deviation	0.01040	0.16265	0.01056	0.17284	0.01066	0.16581
Sample Variance	0.00011	0.02646	0.00011	0.02987	0.00011	0.02749
Kurtosis	16.86589	0.22506	22.84198	-0.04035	27.87884	-0.23721
Skewness	-0.87764	-0.12207	-0.73049	-0.54564	-0.86131	-0.49628
Range	0.26245	0.74971	0.32047	0.71742	0.33691	0.67583
Minimum	-0.15904	-0.36769	-0.20467	-0.37585	-0.22610	-0.32717
Maximum	0.10340	0.38202	0.11580	0.34157	0.11080	0.34866
Sum	0.49295	0.49643	2.82639	2.53315	2.94795	2.91576
Count	9845	39	9845	39	9845	39

and the geometric annual return descriptive statistics for the AG Index and the two comparison indices. As expected, daily and annual return calculations for the AG Index were less than that of the comparison "market" indices while the AG Index daily and annual price variability, measured by standard deviation, was lower than that of the comparison indices.

4.2 Annual, Five and Ten-Year Geometric Returns

The index of agribusiness stocks shows similar long-term returns to those of the two comparison indices. Appendix I contains the annual geometric returns for the AG Index and the two comparison indices for the period of 1970 to 2008. These results show that the values of these three indices on average from year to year move together. The signs on the return values of the three indices are identical for 26 of the 39 years of the study. Of the 13 years when the signs differ, six differ only between the AG Index and one of the comparison indices. The relationship between the AG Index and the comparison indices is better illustrated in graphical form. Figure 2 shows the annual geometric returns of AG Index and the S&P 500 for the period of 1970 to

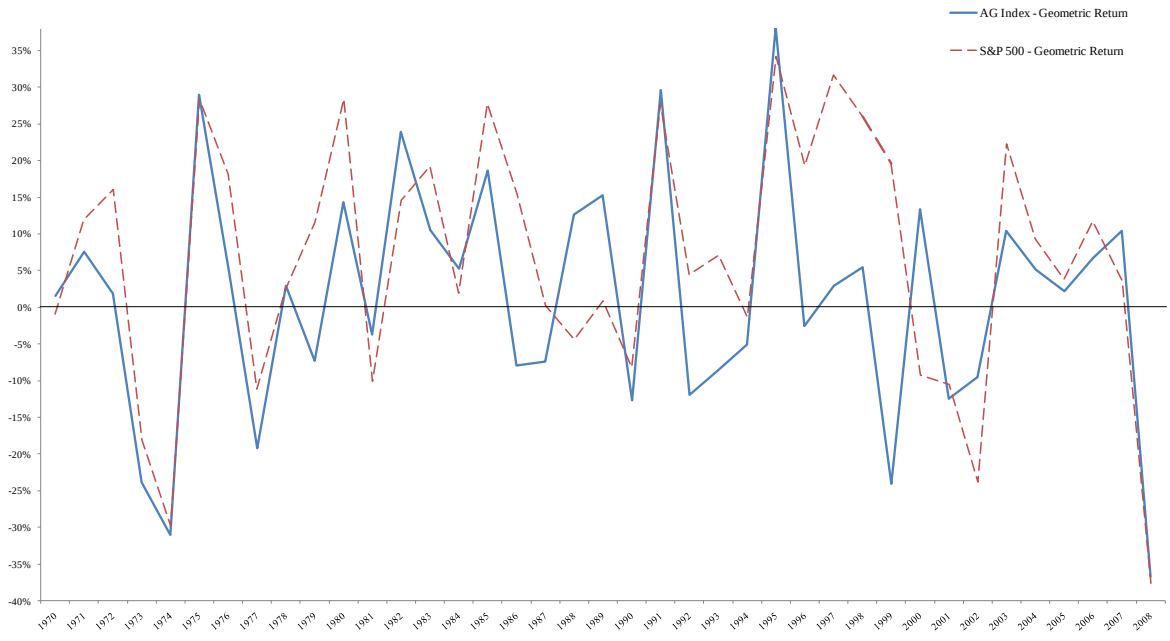


Figure 2: Annual Geometric Return, AG Index and the S&P 500 (1970-2008)

2008. The solid series is the annual geometric returns of the AG Index and the long dashed series is the annual geometric returns of the S&P 500. It is clear that the two indices follow each other closely, with a few exceptions. The periods of 1987 to 1990, 1992 to 1995, and 1997 to 2000 are periods where the two series diverge. It is unclear what the cause of the divergence is, but it is hypothesized that macroeconomic effects or agricultural sector specific effects are to blame. Further extensions of this research should attempt to determine the effects of agriculture specific indicators and macroeconomic factors (gross domestic product, inflation, and the value of the US dollar) on the value of the AG Index. Figure 3 shows the annual geometric returns of AG Index and the Dow Jones Industrial Average (DOW) for the period of 1970 to 2008. The short dashed series is the annual geometric return for the DOW index and the solid series is the annual geometric return of the AG Index. It is clear from the graph that the AG Index and the DOW geometric return series follow each other closely with only two exceptions. During the periods of

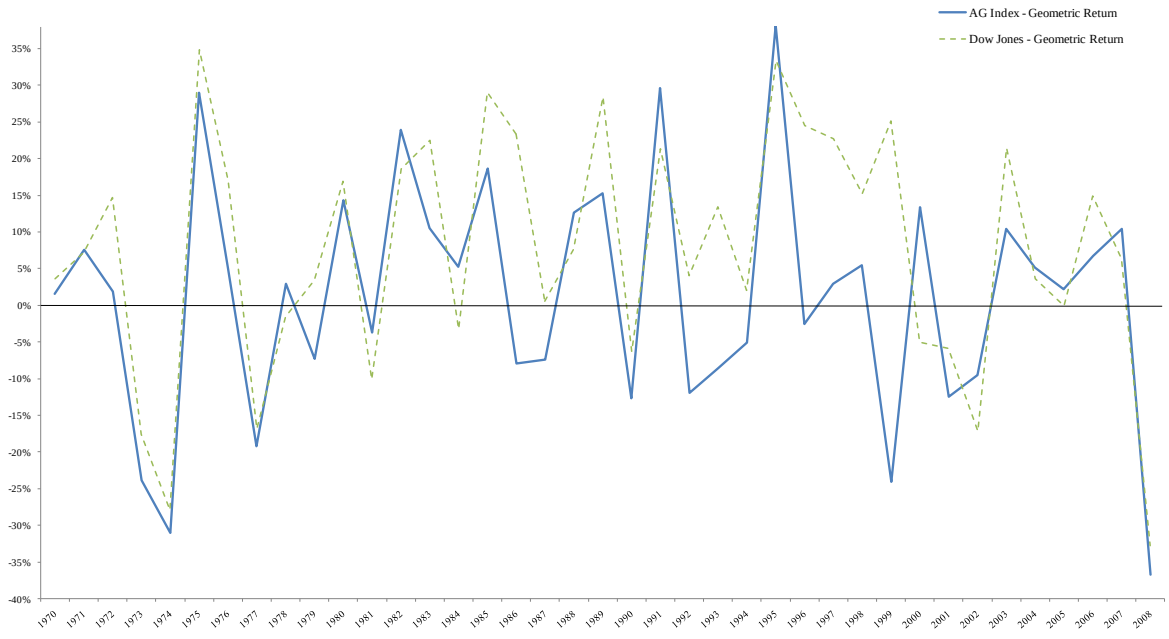


Figure 3: Annual Geometric Return, AG Index and the Dow Jones Industrial Average (1970-2008)

1992 to 1994 and 1999 to 2002, the two return series diverge. Again, it is hypothesized that macroeconomic effects or agricultural sector specific effects are the cause of the divergence.

Figure 4 shows the annual geometric returns for the period 1970 to 2008 for the AG Index and both of the comparison indices. It is clear from the graph that the three indices follow each other with the exception of two periods. The periods of 1992 to 1994 and 1996 to 2000 show a clear divergence between the three series. Specifically, the AG Index annual geometric returns are lower than that of the two comparison indices during these periods. For a better look at the long-term performance of the AG Index, the return series was split in to five and ten-year holding return periods. Table 3 contains the numerical value of the five-year holding period return for AG Index and the comparison indices. Bolded values indicate five-year periods where the AG Index outperformed both of the market indices and asterisked values indicate five-year periods where the AG Index outperformed only one of the market indices. With the exception of two 5-

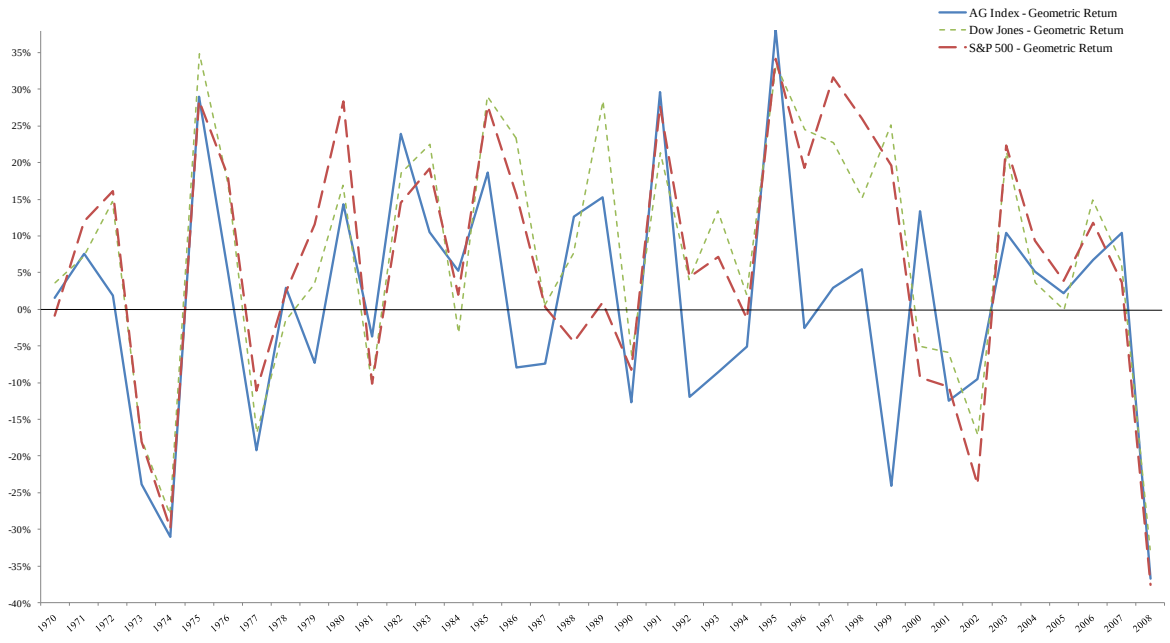


Figure 4: Annual Geometric Return, AG Index, S&P 500, and the Dow Jones Industrial Average (1970-2008)

year periods (1990 to 1994 and 2000 to 2004), the three indices have identical signs. During the 2000-2004 period of divergence the AG Index, showed positive returns while the two

Table 3: Five-Year Geometric Returns, 1970-2008

Return Periods	AG Index	S&P 500	Dow Jones
1970-1974	-10.16246%	-5.82437%	-5.40806%
1975-1979	0.91591%	9.05409%	5.94676%
1980-1984	9.67176%*	9.95148%	8.12703%
1985-1989	5.64102%	7.37845%	17.19192%
1990-1994	-2.84233%	5.30378%	6.50936%
1995-1999	2.12043%	26.02835%	24.07875%
2000-2004	**0.86133%**	-3.72495%	-1.40965%
2005-2008	-6.59831%*	-6.90884%	-4.80796%

comparison indices showed negative returns. The AG Index outperformed at least one of the market indices three of the eight 5-year holding periods (1980-1984, 2000-2004, and 2005-2008). Only in the 2000-2004 5-year holding period did the AG Index showed higher returns than both of the comparison indices. For the period of 2005 to 2008, the AG Index showed less

negative returns than that of the S&P 500 index at -6.59 to -6.91 percent respectively. The largest divergence observed was during the period of 1995 to 1999 where the spread between the AG Index and the S&P 500 and the DOW was 23.91 percent and 21.96 percent respectively. The period of 1995 to 1999 saw tremendous growth in the general market, yet the AG Index did not experience the same growth. Recent results suggest that investor interest in the US Agriculture sector is justifiable as the most recent 5-year periods show the AG Index outperforming the market. The ten-year holding period returns for the AG Index and the two comparison indices show similar characteristics and are given in Table 4. The AG Index failed to outperform the comparison indices in all but one of the four ten-year periods. The most recent decade of data showed the AG Index in negative growth (-2.53 percent) though, the market indices were down further (S&P 500 at -5.15 percent and the DOW at -2.93 percent). Three of the four periods showed negative returns for the AG Index while the comparison indices showed negative returns in only one of the four periods. The only ten-year period of positive AG Index returns was 1980 to 1989 at 7.64 percent, though this trailed behind the returns of the S&P 500 and the DOW at 8.66 and 12.57 percent respectively. Graphs of the five and ten-year geometric returns are provided in Appendix J, K, L, and M.

Table 4: Ten-Year Geometric Returns, 1970-2008

Return Periods	AG Index	S&P 500	Dow Jones
1970-1979	-4.784259%	1.34218%	0.108491%
1980-1989	7.637525%	8.65735%	12.568268%
1990-1999	-0.391852%	15.20096%	14.958898%
2000-2008	**-2.524920%**	-5.15324%	-2.934733%

4.3 Risk Comparisons

Appendix N contains the annual standard deviation results for the AG Index and the comparison indices for the period of 1970 to 2008. Peak annual AG Index price variability was recorded in

2008 at 2.167 percent, though this was lower than the S&P 500 and the DOW indices, which were 2.58 and 2.39 percent, respectively. The lowest annual AG Index price variability was recorded in 2006 at 0.57 percent, while the standard deviation for the S&P 500 and DOW were 0.63 and 0.62 respectively. Both the peak and lowest price variability numbers show that the AG Index carried less price variability than that of the comparison indices. However, Figure 5 shows that this trend was not true for the entire 1970 to 2008 period. The solid series represents the annual standard deviation for the AG Index while the large dashed and small dashed lines represent the S&P 500 and the DOW, respectively. The graph shows that the price variability of the AG Index closely follows that of the comparison indices during the 1970's but deviated from

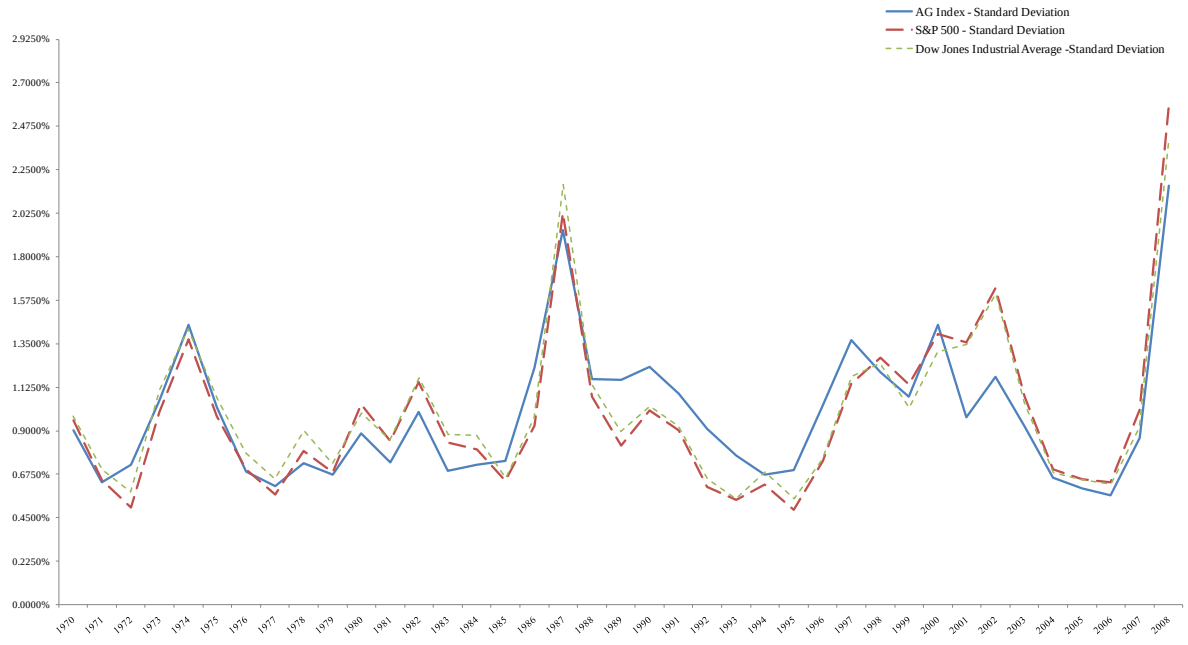


Figure 5: Annual Standard Deviation, AG Index, S&P 500, and the Dow Jones Industrial Average (1970-2008)

them during the early 1980's. From 1978 to 1985, the AG Index showed less price risk than both of the comparison indices did. The sharp increase in price variability during the late 1980's was felt equally across all three indices though the persistence of the risk was longer for the AG

Index. This trend of higher AG Index variability continued in to the late 1990's. From 2001 to the end of the data period in 2008, the AG Index has shown to carry less price variability indicating that the AG Index may be a safer investment than a general market based index. To get a closer look at the story of price risk among the three indices in question, standard deviation measures were calculated for five and ten-year holding periods. Table 5 contains the standard deviation calculations for the AG Index and the two comparison indices. Bolded values indicate a five-year period in which the AG Index showed less price variability than both of the comparison indices did and an asterisked value indicated a five-year period when the AG Index showed less price variability than one of the comparison indices. The AG Index showed less

Table 5: Five-Year Standard Deviation 1970-2008

Periods	**AG Index**	**S&P 500**	**Dow Jones**
1970-1974	1.00025%*	0.95185%	1.01169%
1975-1979	0.75790%*	0.75410%	0.83770%
1980-1984	**0.81340%**	0.94395%	0.96045%
1985-1989	1.30862%	1.20152%	1.28085%
1990-1994	0.95213%	0.75036%	0.78071%
1995-1999	1.10918%	1.01207%	0.99278%
2000-2004	**1.05832%**	1.26754%	1.23033%
2005-2008	**1.24574%**	1.46630%	1.36315%

price variability than at least one of the comparison indices in five of the eight five-year periods and less than both comparison indices in three of five of those periods. Table 6 contains the ten-year period standard deviation measures for the three indices. Again, bolded values indicate a ten-year period in which the AG Index showed less price variability than both of the comparison indices and an asterisked value indicated a ten-year period when the AG Index showed less price variability than one of the comparison indices. The AG Index showed to have less price variability than at least one of the comparison indices in three of the four ten-year periods. During the most recent period, 2000 through 2008, the AG Index showed less price variability

Table 6: Ten-Year Standard Deviation, 1970-2008

Periods	AG Index	S&P 500	Dow Jones
1970-1979	0.88742%*	0.85890%	0.928756%
1980-1989	1.08912%*	1.08005%	1.131851%
1990-1999	1.033415%	0.89122%	0.893263%
2000-2008	**1.144823%**	1.35873%	1.290481%

than both comparison indices. Five and ten-year standard deviation graphs are provided in Appendices O, P, Q, and R.

Based on these preliminary results, it can be argued that the AG Index carried less price variability risk during much of the 39 years of data than the market indices. However, further analysis is needed to determine conclusively the price risk associated with investing in the US Agricultural sector. Investors, in the hopes of getting large returns, are not always opposed to price variability, (large standard deviation value). Rather, they are mainly concerned about downside variability. Since the standard deviation, only reports variability in general with no consideration of upward or downward variability, it only tells part of the story of the risk of a security. "Risk adjusted return" measures, like the Sharpe Ratio, have gained popularity among investors and analysts in recent years and are better measures of security performance.

4.4 Sharpe Ratio

A security's Sharpe Ratio tells an investor how much excess return he/she is receiving per unit of risk. Excess return is defined as the difference between the security's return and the risk free rate. The risk free rate proxy is dependent on the investment horizon. Annual Sharpe Ratio measures are calculated using geometric returns on 1-year US Treasury Bills, five and ten-year Sharpe Ratio measures are calculated using geometric returns on five and ten-year US Treasury Bills. The risk measure used is standard deviation. Appendix S contains the annual Sharpe Ratio calculations for the AG Index, S&P 500, and DOW for the period 1970 to 2008. Appendix T

contains a line graph of the Sharpe Ratio series for all three indices from 1970 to 2008. For 14 out of the 39 years in the study, the AG Index showed higher excess returns per unit of risk (larger Sharpe Ratio value) than at least one of the comparison indices. To explain the long-term risk adjusted risk associated with the AG Index better, measure was calculated for five and ten-year hold periods. Table 7 contains the five-year Sharpe Ratio calculations for the AG Index, S&P 500, and the DOW for the period 1970 through 2008. Bolded values indicate a five-year period in which the AG Index had a higher Sharpe Ratio value than both of the comparison indices and an asterisked value indicates a five-year period when the AG Index had a higher Sharpe Ratio value than one of the two comparison indices. These results indicate that the AG Index showed higher excess returns per unit of risk than a market index in only three of the eight

Table 7: Five-Year Sharpe Ratio, 1970-2008

Period	**AG Index**	**S&P 500**	**DOW**
1970-1974	-7.73	-3.55	-2.92
1975-1979	-7.76	2.95	-1.04
1980-1984	**10.34**	9.23	7.15
1985-1989	9.70	12.01	18.94
1990-1994	-3.10	6.83	8.10
1995-1999	5.82	30.28	28.82
2000-2004	**12.92**	7.23	9.32
2005-2008	9.02*	7.45	9.56

five-year periods. Both comparison indices showed positive returns per unit of risk for the period of 1990 to 1994, while the AG Index a showed negative Sharpe Ratio value. During the period of 1995 to 1999, the market indices experienced tremendous growth, while the AG Index did not exhibit similar risk reward tradeoff. Table 8 contains the ten-year Sharpe Ratio calculations for the three indices. Again, bolded values indicate a ten-year period in which the AG Index showed a higher Sharpe Ratio value than both of the comparison indices did. These results indicate that

the AG Index enjoyed more excess returns per unit of risk than the comparison indices in only the most recent of the four ten-year periods, 2000 through 2008. The most obvious divergence

Table 8: Ten-Year Sharpe Ratio, 1970-2008

Periods	AG Index	S&P 500	Dow Jones
1970-1979	-8.19	-1.32	-2.55
1980-1989	9.77	10.79	13.75
1990-1999	1.85	19.71	19.36
2000-2008	**7.75**	4.61	6.57

among the three indices was during the 1990's. The S&P 500 and DOW during this period enjoyed high-risk adjusted returns at 19.71 and 19.36, respectively, while the AG Index showed only 1.85% return per unit of risk. The five and ten-year Sharpe Ratio calculations, relative to the annual calculations, provide less evidence that an investment in the AG Index would carry less risk than an investment in a market index. However, these results mirror those of the returns and Standard Deviation calculations, as the most recent periods show the AG Index outperforming the two comparison indices. These most recent results legitimize current investor interest in the sector. Graphs illustrating the five and ten-year Sharpe Ratio measures are provided in Appendices U and V.

4.5 Beta Values

A security's beta tells an investor how its return co-varies with a market portfolio. Therefore, it is especially valuable for investors looking to diversify the risk associated with investing in certain assets. To determine how the US agricultural sector co-varies with the market, beta parameters were estimated for all 39 years, each of the 8 five-year holding periods, each of the 4 ten-year holding periods, and over the entire holding period from 1970 to 2008. Table 9 summarizes the results. During the 39 years in study, the AG Index beta value was greater than one only 8 years. Therefore, during 31 out of the 39 in the sample, a 1 percent move

Table 9: Beta Value Estimation Summary, AG Index (1970-2008)

Holding Period	Beta of < 1	Beta of > 1	Total Periods
1 year	31	8	39
Five-Year	7	1	8
Ten-Year	4	0	4

in the value of the market portfolio was followed by a less than 1 percent move in the AG Index. Securities that share this characteristic are considered defensive in nature and are seen as good investments when the general market sours. Appendix W contains the annual beta estimation for the AG Index from 1970 to 2008. Refer to Figure 6 for an illustration of the annual beta value estimation for the AG Index over the 39 years of study. This graph shows that the correlation of the AG Index and the market portfolio (S&P 500) was not constant over time. Two large drops in correlation were observed with the first in the late 70's and second in the late 90's. However, this figure clearly shows that over most of the observed period, the AG Index had a beta value of less

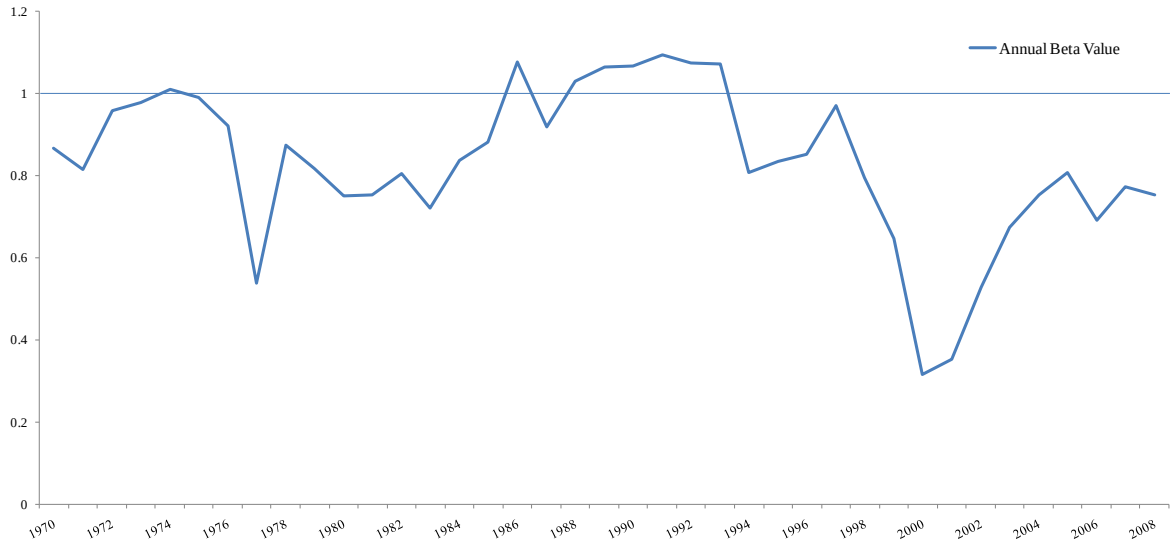


Figure 6: Annual Beta Value Estimation, AG Index (1970-2008)

than one. Five-year and ten-year beta estimations show identical results. They are provided in Table 10 and Table 11. The AG Index had a beta value of greater than one in only one of the 8 five-year periods examined in this study. For the ten-year holding period beta estimations, all 4

Table 10: Five-year Average Beta Estimation

Year	AG Index Beta Estimation
1970-1974	0.952277005
1975-1979	0.874722411
1980-1984	0.774966197
1985-1989	0.96696327
1990-1994	1.042287329
1995-1999	0.811818249
2000-2004	0.471286473
2005-2008	0.757134992

periods showed the AG Index to be defensive towards market movements. These results are consistent with the a priori expectations of this study, the beta estimation of the US Food Sector by NYU, and with the aforementioned investor sentiment regarding the US agricultural sector. This information would be very valuable to investors seeking ways to diversify portfolio risk.

Table 11: Ten-year Average Beta Estimation

Year	AG Index Beta Estimation
1970-1979	0.921846822
1980-1989	0.89318051
1990-1999	0.894844709
2000-2008	0.617782228

Five and ten-year estimated beta values are provided in graphical form in Appendix X and Y. The beta value for the AG Index over the entire observed period was .793, indicating that the long term reaction of the AG Index returns to the market was defensive.

CHAPTER 5: CONCLUSION

5.1 Discussion and Future Research

As expected, the AG Index has historically exhibited lower returns than the market indices; however, data that is more recent has shown a shift in this paradigm. Preliminary evidence also indicates that the sector carries less risk than the market as a whole. Over the past 39 years, the US agriculture sector, as summarized by the AG Index, has shown to have a lower standard deviation, higher excess return per unit of risk, and beta value of less than one. All of these results indicate that the industry would be a wise investment during periods of high market volatility. Additionally, in recent years the sector has outperformed the market indices.

Overall, the agricultural industry has undergone tremendous growth during the past 39 years. Refer to Table 12 for firm and market size statistics in 2009 dollars. The total market value of the index, which represents only the top 70th percentile of firms in the sector, grew from $24.675 billion in 1970 to $91.8 billion in 2008 in real terms, an increase of more than 270 percent. This increase in market value has occurred while the number of firms that make up the top 70th percentile of the sector has decreased from an average of 53 firms throughout the 1970's to 36.22 in the 2000's. Refer to Appendix Z for a list of the number of firms included in the index by year. In other words, an average of 36.22 firms in the 2000's were, worth almost four times what an average of 53 firms were worth in the 1970's in real dollars (2009 dollars). Moreover, the average real market value per firm increased over this period by more than 440

Table 12: Average Firm Size and Average Real Market Value (1970-2008)

Decade	Average # of Firms	Average Real MKT Value	Average Real MKT Value/Firm
1970's	53	24,675,675,000.00	465,578,773.58
1980's	54.7	30,180,185,000.00	551,740,127.97
1990's	43.6	71,827,484,000.00	1,647,419,357.80
2000's	36.22	91,620,218,000.00	2,529,547,708.45

percent. To summarize these results; the top 70th percentile of the US agriculture sector has grown tremendously over the past 39 years, though the average market value per firm has grown at almost twice the rate. It is quite clear that this trend is linked to the increasing concentration of firms within the Agricultural sector. Consolidation and vertical integration can affect firm profitability, therefore investors are likely to be interested in how these trends and how they affect stock price value.

As noted in an earlier section, a limitation of many stock price indices is that dividend payments are usually ignored. However, from an investor's point of view, income from dividend streams is often just as important as price growth. Furthermore, it can be argued that dividend payments reduce retained earnings, which in turn imply lower future cash flows and consequently, lower stock price return. Therefore, the lower stock price returns observed in the AG Index over the past 39 year may be explained by higher dividend payments. This limitation will be addressed in future research, however, some preliminary results suggest that the observed lower returns of the AG Index, as compared to the market, may indeed be offset by the comparably larger dividend yield associated with the agribusiness firms in the index. Current dollar dividend payments per share were attained for all the firms included in the index in 2008. Percent dividend, or "yield", was calculated for each firm by dividing the share price of each index by their respective dollar dividend payment. The average yield was calculated for the entire index, by subsector, and by the top five and top ten firms in the AG Index. The same calculations were completed for funds that follow the comparison indices and a fund that represents the total market. Table 13 contains these preliminary dividend results. The top 5 and 10 firms included in the AG Index, as of 2008, had higher dividend yield than those top firms in all three of the comparison indices. When all of firms included in the AG Index are considered, the yield was somewhat lower than that of the market indices though a further segmentation of

Table 13: Average Dividend Yield, AG Index, S&P 500, Dow Jones Industrial Average, and the Vanguard Total Market ETF (2009 Prices and Dividend Data)

Average Yield	AG Index	S&P 500 (Vanguard 500 "VFINX")	DOW (DIAMONDS Trust "DIA")	Vanguard Total Market (VTI)
Top 5 Firms	**4.47%**	2.13%	2.80%	2.13%
Top 10 Firms	**3.30%**	2.53%	2.84%	2.53%
All	2.16%	2.68%	3.06%	2.53%

the AG Index tells a more interesting story. When the average yield is calculated for each of the three SIC code subcategories, it is clear that the "closely related to farming" category carries the highest dividend yield among the three. These values are provided in Table 14. When compared to the three market indices, the closely related to farming subsector shows higher or similar yield potential. These results indicate that even though these three categories are involved to some extent in satisfying the final demand for agricultural products, each one may have differing characteristics. The results from the table below indicate that, from an investment standpoint, it might be beneficial to drop the pure farming stocks and specify the index to represent the "first

Table 14: Average Dividend Yield by Subcategory, AG Index (2009 Prices and Dividend Data)

	Average Yield
Farming	0.55%
Closely Related to Farming	3.05%
Peripherally Related to Farming	2.43%

handlers" of raw agricultural products in the closely related to farming category. This includes processors, marketers, and agricultural input firms. It is likely that each category has unique performance and risk characteristics that can be exploited through different investment strategies. Therefore, segmenting the larger US agriculture sector by specific characteristics such as firm size or input versus output orientation could be very valuable to investors. Moreover, recent literature suggests that farm owners looking to hedge some of their financial risk may be better off investing in the larger Ag sector rather than just a market portfolio. Detre et al. (2007)

showed that an investment in both the AG sector and a market index could reduce downside risk exposure as compared to an investment in only a market index. A possible application of this research is the development of an investible Equity Traded Fund (ETF) or an agriculturally related family of mutual funds. ETF's are investible vehicles that are traded on a stock exchange much like a normal stock. Investors purchase shares of an ETF, which replicates the performance of an index of a basket of stocks, minus fees and expenses. Like stocks, commodities, or any other tradable security, ETF's can be shorted and their capital gains can be controlled. Therefore, farm owners expecting poor farm returns can short a larger AG sector ETF to hedge on-farm risk. Likewise, institutional investors looking to diversify portfolio risk could hold a portion of investment capital in one of these tradable securities. Moreover, future projections of the AG Index would be very useful to investors, as would projections of price risk. These estimations are attainable through modern econometric methods such as autoregressive conditional heteroskedasticity (ARCH) and generalized autoregressive conditional heteroskedasticity (GARCH) volatility models. Future extension of this research will consider these issues.

As previously discussed, the role of seasonality and agricultural planting and harvest cycles can affect performance and risk conditions in the sector. The effect of seasonality can be felt on the demand and supply side of any market. This effect is particular important when studying commodities and agribusiness companies. This is because one of the biggest determinants of supply is weather and climate. Business cycles, by definition, are fluctuations in economic activity along the long-term growth trend. Having the ability to determine where businesses are in their cycle is of great benefit to the potential investor. Further research is needed to determine the impact of these factors, as they are likely to affect the accuracy of price projections.

Another valuable extension of this research would be to determine the impact of

changing macroeconomic factors on agribusiness profitability and stock prices. Examples of these factors could include, US Gross Domestic Product, the value of the US dollar, the price of gold, the price of oil and other commodities, and inflation. The links between these factors can examined through simple correlation calculations.

In any statistical or financial study, it is important to discuss the limitations of the methods and therefore the accuracy of results. As with most indices, dividends were ignored in this study. Over long holding periods, dividend income can influence investment returns greatly. Because dividends are ignored, the return calculations are only measures of price change from one period to another, not investment return with dividends reinvested. Future extensions of the AG Index will examine the possibility of correcting for dividends to determine a true investment holding period return. Another limitation is the frequency by which share counts were updated. A more accurate tracking of the US agricultural sector would require immediate corrective action for large changes in share counts and quarterly correction of all small changes in share counts. Lastly, the fees and transactional costs of investing in the AG Index are not included in this study. Potential investors should closely evaluate these costs before making investment decisions.

5.2 Summary

The growing global demand for food, popularity of organic products, and increasing competition among the alternative uses of feed crops, are a few observable trends that have made investing US agricultural sector an area of interest among investors. The rising prices of commodity crops and subsequent increase in firm profitability have signaled famers to increase production. The accompanying increase in demand for agricultural inputs such as feed, seed, and equipment, has affected the profitability of US agribusiness firms involved in their production. Despite these trends, little literature exists that analyzes the historical risk and return associated with investing

in publicly traded US agricultural securities. This study has provided original research on the returns and risks associated with an investment in publicly traded agribusiness companies. This was accomplished through the development of a large-cap agribusiness stock price index. The resulting index is a continuous series that represents the largest US agribusiness firms over a 39-year period. The calculated risk and return measures associated with the agribusiness index were compared to that of the market as a whole. The results indicate that although the returns associated with investing in the US agricultural sector were less than what could be expected by investing in a market index, preliminary evidence indicates that the sector is less susceptible to price variability and is defensive in nature.

REFERENCES

Ang, Andrew, J. Chen and Y. Xing (2006). "Downside Risk." The Review of Financial Studies 19(4): 1191-1239.

Armitage, S. (1995). "Event Study Methods and Evidence on Their Performance." Journal of Economic Surveys 9(1): 25-52.

Associated Press. (2006). "Wal-Mart Goes Organic." MSNBC Online Retrieved March 19, 2009, from http:www.msnbc.msn.com/id/11977666/.

Beierlein, J. G., K. C. Schneeberger and D. D. Osburn (2003). Principles of Agribusiness Management. Long Grove, IL, Waveland Press, Inc.

Bjornson, B. (1995). "The Impacts of Business Cycles on Returns to Farmland Investments." American Journal of Agricultural Economics 77(3): 566-577.

Brown, C. and M. Sperow (2005). "Examining the Cost of an All-Organic Diet." Journal of Food Distribution Research 36(01): 20-27.

Byrne, P. J., U. C. Toensmeyer, C. L. German and H. R. Muller (1991). "Analysis of Consumer Attitude Toward Organic Produce and Purchase Likelihood." Journal of Food Distribution Research 22: 49-62.

Campbell, J. Y., A. W. Lo and A. C. MacKinlay (1997). The Econometrics of Financial Markets. Princeton, New Jersey, Princeton University Press.

Center for Research in Security Prices. (2009). "CRSP Daily Stock Price Database." from http://www.crsp.com/products/index.html.

Chartered Financial Analyst Institute (2005). CFA Program Curriculum: Corporate Finance and Equity, Pearson Custom Publishing.

Curl, C. L., R. A. Fenske and K. Elgethun (2003). "Organophosphorus Pesticide Exposure of Urban and Suburban Preschool Children with Organic and Conventional Diets." Environmental Health Perspectives 111(3): 377-382.

Da-Rocha, J. and D. Restuccia (2006). "The Role of Agriculture in Aggregate Business Cycles." Review of Economic Dynamics 9: 455-482.

Damodaran, A. (2009). "Betas by Sector." Retrieved December 10, 2009, from http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html.

Dangour, A. D., S. K. Dodhia, A. Hayter, E. Allen, K. Lock and R. Uauy (2009). "Nutritional quality of organic foods: a systematic review." American Journal of Clinical Nutrition 90: 680-685.

Davies, A., A. J. Tifferington and C. Cochrane (1995). "Who Buys Organic Food? A Profile of the Purchasers of Organic Food in Northern Ireland." Brittish Food Journal 97: 17-24.

Davis, J. H., C. Hanes and P. Rhode. (2009). "Harvests and Business Cycles in Nineteenth-Century America." Retrieved May 12, 2009, from http://ssrn.com/paper=1335711.

Detre, J. D., C. A. Wilson and A. W. Gray (2007). "Buying Stock in Value-Added Companies: An Alternative Choice for Vertical Diversification?" Agricultural Finance Review 67(1): 175-196.

Dimitri, C and C. Green (2002). Recent Growth Patterns in the U.S. Organic Foods Market. Economic Research Service. Washington D.C., U.S. Department of Agriculture.

Dimitri, C. and N. Richman (2000). Organic Food Markets in Transition. U.S. Department of Agriculture and Henry A. Wallace Center for Agricultural and Environmental Policy. Greenbelt, MD, Henry A. Wallace Center for Agricultural and Environmental Policy. Policy Studies Report No.14.

Dirks, F. C. (1958). "Recent Investment Return on Industrial Stocks." The Journal of Finance 13(3): 370-385.

Duval, Y. and A. M. Featherstone (2002). "Interactivity and Soft Computing in Portfolio Management: Should Farmers Own Food and Agribusiness Stocks?" American Journal of Agricultural Economics 84(1): 120-133.

Economic Research Service. (2005). "Farm and Farm-Related Employment: SIC Industry Groups and Components." Retrieved June, 02, 2008, from http://www.ers.usda.gov/Data/FarmandRelatedEmployment/SIC-Industries2.htm.

Economic Research Service. (2009). "Agriculture Baseline Database: Baseline Data Delivery System." Retrieved October 6, 2009, from http://ers.usda.gov/data/baseline/default.asp?ERSTab=3.

Global Derivatives Study Group (1993). Derivatives: Practices and Principles, Group of Thirty.

Govindasamy, R., M. DeCongelio, J. Italia, B. Barbour and K. Anderson (2001). Empirically Evaluating Consumer Characteristics and Satisfaction with Organic Products. New Brunswick, New Jersey, The State University of New Jerset Rutgers.

Guarino, D. R. (2009). "S&P Launches Agribusiness Index for North America." Retrieved June 23, 2009, from http://www2.standardandpoors.com/spf/pdf/index/20090623_AgribusinessNA-Launch.pdf.

Harris, J. Michael (2008). Agricultural Income and Finance Outlook. Economic Research Service. Washington D.C., U.S. Department of Agriculture. AIS-86.

Hay, J. (1989). "The Consumer's Perspective on Organic Food." Canadian Institute of Food Science Technology Journal 22(2): 95-99.

Henderson, G. V., Jr. (1990). "Problems and Solutions in Conducting Event Studies." The Journal of Risk and Insurance 57(2): 282-306.

Hood, E. (2003). "Organic Food for Thought: Lessening Children's Pesticide Exposure." Environmental Health Perspectives 111(3): A166-A166.

Kahn, M. (2008). "Agriculture Sector Still Sprouting Winners." Retrieved March 19, 2009, from http://online.barrons.com/article/SB120027699343486619.html?mod=b_hpp_9_0%09002_b_online_exclusives_weekday_r1.

Lintner, J. V. (1965). "The Valuation of Risk Assets and the Selection of Risk Investments in Stock Portfolios and Capital Budgets." Review of Economics and Statistics 47: 13-37.

Lo, A. W. (2002). "The Statistics of Sharpe Ratios." Financial Analysts Journal 58: 52.

MacKinlay, A. C. (1997). "Event Studies in Economics and Finance." Journal of Economic Literature 35(1): 26-39.

Marquardt, K. (2008). "3 Farm-Equipment Stocks to Watch." Retrieved March 26, 2009, from http://www.usnews.com/articles/business/economy/2008/01/24/3-farm-equipment-stocks-to-watch.html?s_cid=related-links:TOP2.

Nutrition Business Journal (2008). "Organic Markets Overview." Nutrition Business Journal.

Perold, A. F. (2004). "The Capital Asset Pricing Model." The Journal of Economic Perspectives 18(3): 3-24.

Reilly, F. and K. Brown (2003). Investment Analysis Portfolio Management. Mason, Ohio, Thomson Learning.

Roll, R. (1969). "Bias in Fitting the Sharpe Model to Time Series Data." The Journal of Financial and Quantitative Analysis 4(3): 271-289.

Rosegrant, M. W. (2008). Biofuels and Grain Prices: Impacts and Policy Responses. U.S. Senate Committee on Homeland Security and Government Affairs. Washington, D.C., International Food Policy Research Institute**:** 4.

Rosegrant, M. W., M. S. Paisner, S. Meijer and J. Witcover (2001). Global Food Projections to 2020: Energind Trend and Alternative Futures, International Food Policy Research Institute.

Sharpe, W. F. (1964). "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk." Journal of Finance 19: 425 - 442.

Sharpe, W. F. (1966). "Mutual Fund Performance." The Journal of Business 39(1): 119-138.

Sharpe, W. F. (1994). "The Sharpe Ratio." The Journal of Portfolio Management 21(1): 49-58.

Shinkle, K. and K. Marquardt. (2008). "Investing in Commodities Funds." U.S. News and World Report Retrieved March 18, 2009, from http://www.usnews.com/articles/business/economy/2008/01/24/investing-in-commodities-funds.html?loomia_ow=t0:a41:g29:r6:c0.001378:b20319067&s_cid=loomia:a-long-term-bull-on-agriculture.

Simons, K. (1998). "Risk-Adjusted Performance of Mutual Funds." New England Economic Review September/October: 33-47.

Standard & Poor's (2009) "S&P Agribusiness North America Index." Index Fact Sheet, 2.

Standard & Poor's (2009b). Index Mathematics: Methodology. New York, The McGraw-Hill Companies, Inc.

Thompson, G. and J. Kidwell (1998). "Explaining the Choice of Organic Produce: Cosmetic Defects, Prices, and Consumer Preferences." American Journal of Agricultural Economics 80: 277-288.

Tokgoz, S., A. Elobeid, J. Fabiosa, D. J. Hayes, B. A. Babcock, T. Yu, F. Dong, C. E. Hart and J. C. Beghin (2007). Long-Term and Global Tradeoffs between Bio-Energy, Feed, and Food. American Agricultural Economics Association Annual Meetings. Portland, OR.

Tregear, A., J.B. Dent and M.I. McGregor (1994). "The Demand for Organically-Growth Produce." Brittish Food Journal 96: 21-26.

Trostle, R. (2008). Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Commodity Prices. Economic Research Service. Washington D.C., United State Department of Agriculture. WRS-0801.

Tsay, Ruey S. (2005). Analysis of Financial Time Series. Hoboken, New Jersey, John Wiley & Sons, Inc.

United Nations. (2008). "World Population Prospects: The 2008 Revision." UN Population Database Retrieved October 5th, 2009, from http://esa.un.org/unpp/index.asp.

United Nations. (2008b). "Estimates of Per Capita GDP in US Dollars." United Nations Statistics Division Retrieved October 5, 2009, from http://unstats.un.org/unsd/snaama/selectionbasicFast.asp.

United States Department of Agriculture (2009). USDA Agricultural Projections to 2018. Interagency Agricultural Projections Committee. Washington D.C., USDA Office of the Chief Economist.

US Census Bureau. (2009). "Standard Industrial Classification (SIC) system." Retrieved June 12, 2009, 2009, from http://www.osha.gov/pls/imis/sic_manual.html.

Weiers, R. M. (2002). Introduction To Business Statistics. Belmont, CA, Wadsworth Group/Thomson Learning.

Willer, H. and M. Yussefi (2004). "The World of Organic Agriculture: Statistics and Emerging Trends." International Federation of Organic Agriculture Movements.

Wilson, J.W. and C. P. Jones (2002). "An Analysis of the S&P 500 Index and Cowles's Extensions: Price Indexes and Stock Returns, 1870-1999." The Journal of Business 75(3): 505-533.

Wolgemuth, L. (2008). "A Long-Term Bull on Agriculture." U.S. News & World Report Retrieved March 28, 2009, from http://www.usnews.com/articles/business/economy/2008/01/24/a-long-term-bull-on-agriculture.html.

Zepeda, L. and L. Jinghan (2007). "Characteristics of Organic Food Shoppers." Journal of Agricultural and Applied Economics 39(1): 17-29.

APPENDIX A: DAX GLOBAL AGRIBUSINESS INDEX CONSTITUENTS (AS OF DECEMBER 2009)

Company Name	Country	Trading Symbol	Exchange
AGCO Corp	United States	AGCO	NYSE
Agrium Inc	Canada	AGU	NYSE
The Andersons Inc	United States	ANDE	NasdaqGS
Astra Agro Lestari	Indonesia	AALI.JK	JKT
AWB Ltd	Australia	AWB.AX	ASX
BRF - Brasil Foods SA ADR	Brazil	BRFS	NYSE
Bunge Ltd (Bermuda)	United States	BG	NYSE
CF Industries Holdings	United States	CF	NYSE
China Agri Inds Hld	Hong Kong	CIDHF.PK	Other OTC
Chiquita Brands Intl Inc	United States	CQB	NYSE
CNH Global NV	Netherlands	CNH	NYSE
Corn Products Intl	United States	CNP	NYSE
Cosan Ltd	Brazil	CZZ	NYSE
Cresud SA Com Ind	Argentina	CRESY	NasdaqGS
Darling Ing Intl Inc	United States	DAR	NYSE
Del Monte Foods Co	United States	DLM	NYSE
Glanbia Plc	Ireland	GL9.IR	ISE
Golden Agri-Res	Singapore	4G3A	SES
Graincorp Ltd	Australia	GNC.AX	ASX
Indofood Agri Res	Singapore	ZVF	SES
Intrepid Potash	United States	IPI	NYSE
IOI Corporation Ber	Malaysia	IOI MK	KLS
Kuala L Kepong B	Malaysia	KLKB MK	KLS
Lindsay Corp	United States	LNN	NYSE
London Sumatr Ind	Indonesia	LSIP.JK	JKT
Maple Leaf Foods	Canada	MFI.TO	TOR
Nufarm Ltd	Australia	NUF.AX	ASX
Nutreco Hldg Nv	Netherlands	NUO.AS	AMS/AEX
Olam Intl Ltd	Singapore	O5I	SES
Potash Corp. (US)	Canada	POT	NYSE
Smithfield Foods Inc	United States	SFD	NYSE
Soc Quimica Min ADR B	Chile	QYM	NYSE
Tate & Lyle	Britain	36IS.L	LSE
Terra Industries Inc	United States	TRA	NYSE
Tyson Foods Inc A	United States	TSN	NYSE
Viterra Inc	Canada	VT.TO	TOR
Wilmar Intl Ltd	Singapore	RTHA	SES
Yara International	Norway	YAR.OL	OSL

APPENDIX B: STANDARD AND POORS AGRIBUSINESS NORTH AMERICA INDEX CONSTITUENTS (AS OF DECEMBER 2009)

Company Name	**Country**	**Trading Symbol**	**Exchange**
AGCO Corp	United States	AGCO	NYSE
Agrium Inc	Canada	AGU	NYSE
Archer-Daniels-Midland Co	United States	ADM	NYSE
BRF - Brasil Foods SA ADR	Brazil	BRFS	NYSE
Bunge Ltd (Bermuda)	United States	BG	NYSE
CF Industries Holdings	United States	CF	NYSE
CNH Global NV	Netherlands	CNH	NYSE
Cal Maine Foods Inc	United States	CALM	NasdaqGS
Chiquita Brands Intl Inc	United States	CQB	NYSE
Corn Products Intl	United States	CPO	NYSE
Deere & Co	United States	DE	NYSE
Fresh Del Monte Produce(Caymans)	United States	FDP	NYSE
Hormel Foods Corp	United States	HRL	NYSE
Kubota Corp ADR	Japan	KUB	NYSE
Monsanto Co.	United States	MON	NYSE
Mosaic Co	United States	MOS	NYSE
Potash Corp. (US)	Canada	POT	NYSE
Sanderson Farms	United States	SAFM	NasdaqGS
Smithfield Foods Inc	United States	SFD	NYSE
Sociedad Quimica y Minera de Chile -B (ADR)	Chile	SQM	NYSE
Syngenta AG ADR	Switzerland	SYT	NYSE
Terra Industries Inc	United States	TRA	NYSE
Tyson Foods Inc A	United States	TSN	NYSE
Viterra Inc	Canada	VT.TO	Toronto

APPENDIX C: ECONOMIC RESEARCH SERVICE AGRIBUSINESS INDUSTRY GROUPS BY STANDARD INDUSTRIAL CLASSIFICATION CODES

Industry groups and components			1987 Standard Industrial Classification (SIC)
Farming:			
	Farm production (farm proprietors, and wage and salary		01-02 [1]
Closely related industries:			
		Agricultural services, forestry, and fishing	**071** Soil preparation services **072** Crop services **074** Veterinary services **075** Animal services, except veterinary **076** Farm labor and management services **08** Forestry **09** Fishing, hunting, and trapping
	Agricultural input industries--		
		Agricultural chemicals	**287**
		Farm machinery and equipment	**3523**
		Farm supply and machinery (wholesale trade)	**5083** Farm and garden machinery and equipment **5191** Farm supplies
		Commodity contract brokers and dealers	**622**
	Agricultural processing and marketing--		
		Meat products	**201**
		Dairy products	**202**
		Canned, frozen, and preserved fruits and vegetables	**203**
		Grain mill products	**204**
		Bakery products	**205**
		Sugar and confectionery products	**206**
		Fats and oils products	**207**
		Beverages	**208**
		Miscellaneous food preparations and kindred products	**209**
		Tobacco products	**21**
		Apparel and textiles	**221** Broadwoven fabric mills, cotton **222** Broadwoven fabric mills, manmade fiber and silk **223** Broadwoven fabric mills, wool (including dyeing and finishing) **224** Narrow fabric and other smallwares mills: cotton, wool, silk, and manmade fiber **2251** Women's full-length and knee-length hosiery, except socks **2252** Hosiery, NEC **2253** Knit outerwear mills **2254** Knit underwear and nightwear mills **2257** Weft knit fabric mills **2258** Lace and warp knit fabric mills **226** Dyeing and finishing textiles, except wool fabrics and knit goods **228** Yarn and thread mills **231** Men's and boys' suits, coats, and overcoats **232** Men's and boys' furnishing, work clothing, and allied garments **233** Women's, misses', and juniors' outerwear **234** Women's, misses', children's, and infants' undergarments **235** Hats, caps, and millinery **236** Girls', children's, and infants' outerwear **237** Fur goods **238** Miscellaneous apparel and accessories **2397** Schiffli machine embroideries **3965** Fasterner, buttons, needles, and pins
		Leather products and footwear	**302** Rubber and plastics footwear **31** Leather and leather products
		Packaging	**2441** Nailed and lock corner wood boxes and shook **2449** Wood containers, NEC **3221** Glass containers **3411** Metal cans **3466** Crowns and closures
		Farm-related raw materials (wholesale trade)	**515**
		Warehousing	**4221** Farm product warehousing and storage **4222** Refrigerated warehousing and storage

(APPENDIX C CONTINUED)

Peripherally related industries:		
	Agricultural wholesale and retail trade --	
	Wholesale trade	**513** Apparel, piece goods, and notions **514** Groceries and related products **518** Beer, wine, and distilled alcoholic beverages **5194** Tobacco and tobacco products
	Retail trade	**54** Food stores **56** Apparel and accessory stores **58** Eating and drinking places **592** Liquor stores **5948** Luggage and leather goods stores **5949** Sewing, needlework, and piece goods stores **5993** Tobacco stores and stands
	Indirect agribusiness --	
	Chemical and fertilizer mining	**147**
	Miscellaneous textile products	**2259** Knitting mills, NEC **2298** Cordage and twine **2299** Textile goods, NEC **2393** Textile bags **2395** Pleating, decorative and novelty stitching, and tucking for the trade
	Containers, paper products, and pulpwood products	**263** Paperboard mills **265** Paperboard containers and boxes **2671** Packaging paper and plastics film, coated and laminated **2672** Coated and laminated paper, NEC **2673** Plastics, foil, and coated paper bags **2674** Uncoated paper and multiwall bags **2679** Converted paper and paperboard products, NEC
	Food products machinery	**3556**
	Miscellaneous manufacturing	**2448** Wood containers, NEC **3497** Metal foil and leaf

APPENDIX D: FIRMS DROPPED FROM THE INDEX BY CRSP PERMANENT NUMBER (1970-2008)*

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
16926	16926	16926	19828	10525	10525	10525	18359	18359	20968	19802	19802	22074	22074	20598	12395	12395	20598	10535	10061	10661	10661	10384	10384	10346	10384	10384	11677	51925
19828	19828	19828	34198	18359	18359	18359	20968	18702	22074	22074	22074	36214	42121	22074	20598	18949	51562	11419	20598	20598	11082	11082	11082	10384	11952	20598	21039	55589
22883	22883	22883	37640	18702	18702	19828	22920	20968	27108	32708	32708	36688	42729	42121	22074	20598	51757	20598	51925	33232	20598	20598	11971	11971	20598	51925	51925	70113
37890	44556	14349	37962	19828	19828	22920	27108	22074	32708	35916	35916	37962	49780	50630	24265	22074	51925	51562	57315	51925	51925	51925	20598	20598	51925	70113	70113	75310
10225		23384	42948	21507	20714	23683	33961	22162	36214	36214	36214	42729	50630	54093	49323	24185	53137	51925	79410	91708	91708	75729	31414	31414	62594	76390	76390	76390
10241		37890	48995	21793	21507	27108	36214	22883	37962	37373	37373	49780	55888	55888	50630	49884	54903	57315	81331	92436	92436	76390	51925	51925	70113	91708	80138	79375
		44556	51298	22883	23683	32273	36688	27108	38827	37962	37962	50630	64996	72710	53137	50630	57315	79410	91708			91708	75729	75729	76390		91708	80138
		34198	51773	27108	27108	32571	37962	28302	40951	40951	42729	53217	72710	78418	54093	51562	57753	81331	92436				76390	76390	80715			80785
		37962	54093	27765	27765	33961	38827	32708	42729	41161	44231	55888	73163	79410	62958	51757	79410	91708					91708	91708	91708			91708
			59460	28330	28493	36214	41515	33961	42842	42729	46085	62958	78418	81331	63909	51925	92436	92436										
			60330	28493	29874	37962	42729	36214	50657	42842	48020	64996	81331		72710	53137												
			61874	29874	30112	38827	50657	36688	51773	44231	50630	72710			78418	54093												
			62594	30112	31958	42842	51298	37962	54093	48020	50657	73163			79410	57315												
			66844	31958	32273	42948	51458	38827	53217	50657	53137					79410												
			70798	32273	32571	43530	51773	41515	55888	53137	53217																	
			72710	32571	33961	46835	53460	42729	64709	53217	53540																	
			73163	33080	36214	50657	54093	42842	64996	54093	54093																	
			78079	33961	36645	51298	54157	46085	72710	55888	55888																	
			82094	34198	37640	51773	54413	48040	73163	59504	59504																	
			82580	34454	37962	53460	55888	50657	73665	64709	64996																	
			84014	36214	38827	54093	58836	51458	80283	64996	72710																	
			18702	36645	40951	55888	62594	51773	81438	72710	73163																	
			21793	37640	41515	58836	64709	53217		73163	73665																	
			22884	37962	42842	59460	64996	53460		73665																		
			29866	38608	42948	62594	72710	54093																				
			32273	38827	43530	64709	73163	55888																				
			36688	39597	46835	64996	80283	64709																				
			37824	41515	47240	72710		64996																				
			38608	42842	48040	73163		72710																				
			38827	42948	48995	75083		73163																				
			41515	43530	49780	78079		73665																				
			42323	46253	50657			80283																				
			46200	46835	51190			81438																				
			46835	48995	51298																							
			57963	49780	51773																							
				50412	53460																							
				51095	54093																							
				51298	58836																							
				51773	59256																							
				54093	59460																							
				55301	62594																							
				58836	64709																							
				59301	64996																							
				59460	65753																							
				61058	70798																							
				61874	70923																							
				62594	71483																							
				64709	72710																							
				64996	73163																							
				70413	78079																							
				70798	82094																							
				72710																								
				73163																								
				77105																								
				78079																								
				82094																								
				82580																								
				84014																								

* No firms were cut from the sample because of missing data for the following years: 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, or 2008.

APPENDIX E: AG INDEX CONSTITUENTS BY CRSP PERMANENT NUMBER (1970-1989)

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
41208	41208	41208	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	10535	11790	11790
49648	49648	49648	22729	20598	22729	22729	22729	22729	22729	22729	22729	22729	22729	26650	26650	26650	10661	26650	12006
10989	51190	51190	37904	22729	26650	41208	41208	26650	41208	26650	26650	41208	41208	51190	51190	51318	11790	51190	26650
11308	51318	51318	41208	41208	49648	49648	49648	41208	51318	41208	41208	49648	51318	51318	51318	52741	26650	51318	51190
11447	10225	10225	49648	49648	51318	51318	51318	51318	54950	51190	49648	51190	54950	54950	54950	54950	51318	57007	51318
11658	10241	10989	51318	51318	54950	54950	54950	54950	57007	51318	51190	51318	57007	57007	57007	57007	57007	58077	57007
12503	10989	11308	54950	54950	57007	57007	57007	57007	58077	54950	51318	57007	63096	63096	63096	63096	63096	63096	58077
12730	11308	11447	57007	57007	58077	58077	58077	58077	63096	57007	57007	63096	64274	64274	64274	64274	64274	64274	63096
13311	11447	12503	58077	63096	63096	63096	60126	60126	77730	63096	63096	64274	67619	67619	67619	67619	67619	66341	67619
13354	12503	12730	60126	66975	66975	77730	63096	63096	10225	77730	77730	77730	77730	77730	77730	77730	77730	77730	77730
13661	12730	13311	10225	10225	10225	10225	10225	10225	10241	10225	10225	10225	10225	10225	10225	10225	10225	10225	10225
13856	13311	13661	10989	10989	10241	10516	10241	10241	10989	10516	10516	10516	10516	10516	10516	10516	10516	10516	10516
13901	13661	13856	11308	11308	10989	10989	10989	10989	11308	10989	10989	10989	10989	10989	10989	10989	10989	10989	10989
14218	13856	13901	11447	11447	11308	11308	11308	11308	11447	11308	11308	11308	11308	11308	11308	11308	11308	11308	11308
14533	13901	14218	12503	12503	11447	11447	11447	11447	12503	11447	11447	11447	11447	13856	13856	13856	13856	13856	13856
15034	14218	14533	12730	12730	12503	12503	12503	12503	12511	12503	12503	12511	13856	13901	13901	13901	13901	13901	13901
15659	14533	15034	13311	13311	12511	12730	12511	12511	12730	12511	12511	13661	13901	14218	14218	14218	14218	14218	16571
16109	15659	15659	13661	13856	12730	13661	12730	12730	13311	13311	13354	13856	14218	15659	15659	15659	15659	16571	17005
16571	16109	16109	13856	13901	13661	13856	13311	13311	13856	13354	13856	13901	15659	16109	16360	16360	16360	17144	17144
17144	16571	16571	13901	14218	13856	13901	13661	13661	13901	13856	13901	14218	16109	16360	16571	16571	16571	19916	19350
17953	17144	17005	14218	14533	13901	14218	13856	13856	14218	13901	14218	15659	16360	16571	17005	17005	17005	22840	19916
19166	17953	17144	14533	15659	14218	14533	13901	13901	14533	14218	15659	16109	16571	17005	17144	17144	17144	23077	22840
19350	19166	17953	15659	16109	14533	15659	14218	14218	15659	14533	16109	16360	17005	17144	17953	19166	19916	24539	23077
19916	19350	19166	16109	16571	15659	16109	14533	14533	16109	15659	16571	17005	17144	17953	19166	19350	22840	25320	24539
19940	19916	19350	16571	17144	16109	16571	15659	15659	16360	16109	17005	17144	17953	19166	19350	19916	23077	26710	25320
20677	19940	19916	17005	17364	16571	17144	16109	16109	16571	16360	17144	17953	19166	19350	19916	22840	24539	26825	26710
22840	20677	19940	17144	17953	17144	17364	16571	16360	17005	16571	17364	19166	19350	19916	22840	23077	25320	28310	26825
23077	22840	20677	17364	19166	17953	17953	17144	16571	17144	17144	17953	19350	19916	22840	23077	24539	26710	28353	28310
24539	23077	22840	17953	19350	19350	19166	17364	17005	17364	17364	19166	19916	22840	23077	24539	25320	26825	38973	28353
25320	24539	23077	19166	19916	19916	19350	17953	17144	17953	17953	19350	22840	23077	24539	25320	26710	28353	59184	38973
26710	25320	24539	19350	19940	19940	19916	19166	17364	19166	19166	19916	23077	25320	25320	26710	26825	38973	15456	59184
26825	26710	25320	19916	23077	20677	20677	19350	17953	19350	19350	23077	25320	26710	26710	26825	28353	59184	16678	15456
28353	26825	26710	19940	24539	23077	23077	19916	19166	19916	19916	25320	26710	26825	26825	28353	38973	61970	19895	19895
30365	28353	26825	20677	25320	25320	25320	20677	19350	22840	22840	26710	26825	28353	28353	33080	59184	15456	22592	22592
38324	30365	28353	22840	26825	26825	26825	22840	19916	23077	23077	26825	28353	30365	30365	59184	61970	16678	24803	24803
45081	38324	30365	24539	28353	28353	28353	23077	22840	25320	25320	28353	30365	33080	33080	61970	15456	19721	36978	26657
46447	45081	38324	25320	30365	30365	30365	25320	23077	26825	26710	30365	59184	47897	47897	15456	16678	19895	37189	36978
15456	46447	45081	26710	38324	46447	38324	26825	25320	28353	26825	38295	61970	59184	59184	16678	19721	22592	37197	37189
16678	15456	46447	26825	45081	47897	46447	28353	26825	30365	28353	47897	63255	61970	61970	17291	19895	24803	39917	37197
17291	16678	12626	28353	47897	59184	47897	30365	28353	46447	30365	59184	12626	63255	63255	19721	22592	39917	42059	39917
19721	17291	15456	30365	59184	15456	59184	38324	30365	47897	46447	61970	15456	15456	15456	19895	24803	40053	43449	43449
22592	19721	17291	38324	15456	17291	59248	46447	46447	59184	47897	15456	16678	16678	16678	22592	39917	43449	46703	44951
23325	22592	19721	45081	17291	19721	15456	47897	47897	15456	59184	16678	17291	17291	17291	24803	40053	44951	50032	46703
26657	23325	22592	46447	19721	22592	17291	59184	59184	16678	15456	17291	19721	19721	19721	39917	42059	46703	57817	50032

(APPENDIX E CONTINUED)

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
39917	26657	23325	59184	22592	23325	19721	59248	15456	17291	16678	19721	19895	22592	19895	40053	43449	50032	64064	52038
40053	39917	26657	59416	23325	24803	22592	15456	16678	19721	17291	19895	22592	23325	22592	42059	44951	52038	64282	57817
43449	40053	39917	15456	24803	39917	23325	17291	17291	19895	19721	22592	23325	24803	24803	43449	46085	57817		64064
46703	43449	40053	17291	39917	40053	24803	19721	19721	22592	19895	23325	24803	36249	39917	44951	46703	59010		64282
		43449	19721	40053	43449	39917	19895	19895	23325	22592	24803	39917	37189	40053	46085	50032	64064		71176
		46703	22592	43449	55351	40053	22592	21039	24803	23325	39917	40053	39917	42059	46703	55351	64282		
			23325	46703		43449	23325	22592	39917	24803	40053	43449	40053	43449	50032	63060	66114		
			24803			46703	24803	23325	40053	39917	43449	44951	43449	44951	55351	64064			
			38455			55351	39917	24803	43449	40053	44951	46085	44951	46085	63060	64282			
			39917				40053	39917	46085	43449	46703	46703	46085	46703	64064	66114			
			40053				43449	40053	46703	44951	55351	47431	46703	50032	64282				
			43449				46703	43449	55351	46085		50032	50032	52038	66114				
			46703				55351	46703		46703		55351	52038	55351					
			55351					47431		55351			55351	57817					
								55351					63060	63060					
													64282	64064					
														64282					

APPENDIX F: AG INDEX CCONSTITUENTS BY CRSP PERMANENT NUMBER (1990-2008)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
11790	11790	11790	11614	11614	11790	10661	11614	11614	11614	11614	11790	11790	11790	11790	11790	11790	10661	11790
12006	12006	12006	11790	11790	12006	11614	11790	11790	11790	11790	20598	20598	26650	20598	20598	20598	11790	20598
26650	26650	26650	12006	12006	26650	11790	12006	26650	26650	26650	26650	26650	51318	26650	26650	26650	20598	26650
51190	51190	51190	26650	26650	51318	12006	26650	51318	51318	51318	51318	51318	57007	57007	57007	57007	26650	57007
51318	51318	51318	51190	51318	57007	51318	51318	57007	57007	57007	57007	57007	76264	71862	71862	71862	57007	77730
57007	57007	57007	51318	57007	58077	57007	57007	58077	58077	58077	58077	76264	77730	77730	77730	77730	71862	89329
58077	58077	58077	57007	58077	63096	58077	58077	63096	76264	71862	77730	77730	79255	79255	79255	79255	77730	91837
63096	63096	63096	63096	63096	76264	63096	63096	76264	77730	77730	79255	79255	85982	85982	85982	85982	85982	92216
67619	76264	76264	76264	77730	77730	77730	77730	77730	79255	79255	85982	85982	86171	86171	86171	86171	89329	92259
77730	77730	77730	77730	79255	79255	79255	79255	79255	86171	86171	86171	86171	89329	89329	89329	89329	91837	92384
10225	10225	10225	10225	10225	10225	10516	10516	10516	10989	11308	11308	11308	11308	11308	10516	10516	10516	10516
10516	10516	10516	10516	10516	10516	10989	10989	10989	11308	13856	13856	13856	13856	13856	11308	11308	11308	11308
10989	10989	11308	10989	10989	10989	11308	11308	11308	13856	13901	13901	13901	13901	13901	13856	13856	11552	13856
11308	11308	13856	11308	11308	11308	13856	13856	13856	13901	15659	17005	17005	15472	17005	13901	13901	13856	13901
13856	13856	13901	13856	13856	13856	13901	13901	13901	17005	17005	17144	17144	17144	17144	15472	15472	13901	17005
13901	13901	15077	13901	13901	13901	17144	17144	19350	19916	17144	22840	22840	19350	19350	17005	17005	17005	19350
16571	17144	17144	17144	15077	17144	19350	19350	22840	22840	19350	23077	23077	22840	22840	17144	17144	17144	26710
17005	19916	19916	19916	17144	19350	19916	19916	23077	23077	22840	25320	25320	23077	23077	19350	19350	19350	26825
17144	22840	22840	22840	19350	19916	22840	22840	25320	25320	23077	28310	26825	26825	25320	22840	22840	25320	28310
19350	23077	23077	23077	19916	22840	23077	23077	26710	26825	25320	56274	28310	28310	26825	23077	26710	26710	57665
19916	25320	25320	25320	22840	23077	25320	25320	26825	28310	26825	59184	56274	56274	28310	26710	26825	26825	75844
22840	26710	26710	26710	23077	25320	26710	26710	28310	56274	28310	16678	59184	59184	56274	26825	28310	28310	86946
23077	26825	26825	26825	25320	26825	26825	26825	56274	59184	56274	21371	89006	70500	57665	28310	57665	57665	88668
25320	28310	28310	28310	26710	28310	28310	28310	59184	70500	57665	22592	16678	89006	59184	56274	59184	59184	89006
26710	28353	56274	56274	26825	56274	56274	56274	70500	16678	59184	39917	21371	16678	89006	57665	86946	75844	90386
26825	59184	59184	59184	28310	59184	59184	57665	76597	21371	16678	43449	22592	21371	16678	59184	88661	86946	16678
28310	15456	76597	76597	56274	76597	16678	59184	16678	22592	21371	50032	39917	22592	21371	88668	88668	88661	21371
28353	22592	15456	15456	59184	15456	19721	16678	21371	24803	22592	52038	43449	39917	22592	89006	89006	88668	22592
59184	24803	19895	19721	76597	16678	19895	19895	22592	39917	39917	59010	50032	43449	39917	16678	16678	89006	39917
15456	26657	22592	19895	15456	19721	21371	21371	24803	43449	43449	76149	52038	50032	43449	21371	21371	16678	43449
19895	32205	24803	22592	16678	19895	22592	22592	39917	50032	50032	87055	59010	52038	50032	22592	22592	21371	46703
22592	37189	37189	24803	19895	21371	24803	24803	43449	52038	52038		76149	59010	52038	39917	39917	22592	52038
24803	37197	37197	37189	22592	22592	39917	39917	44601	59010	59010		87055	64282	59010	43449	43449	39917	59010
26657	39917	39917	37197	23297	24803	43449	43449	50032	76149	76149			76149	64282	44601	52038	43449	76149
37189	43449	43449	39917	24803	39917	44601	44601	52038	87055	87055			87055	76149	50032	57817	46703	87055
39917	44951	44951	43449	39917	43449	50032	46703	57817						87055	52038	59010	52038	
43449	50032	50032	44951	43449	44601	52038	50032	59010							59010	64282	57817	
44951	52038	52038	46703	44951	50032	57817	52038	64282							64282	76149	59010	
45225	57817	57817	50032	50032	52038	59010	57817	76149							76149	78963	64282	
46703	59010	59010	52038	52038	57817	64282	59010	77157							87055	87055	76149	
50032	64064	64064	57817	57817	59010	76149	64282	87055									87055	

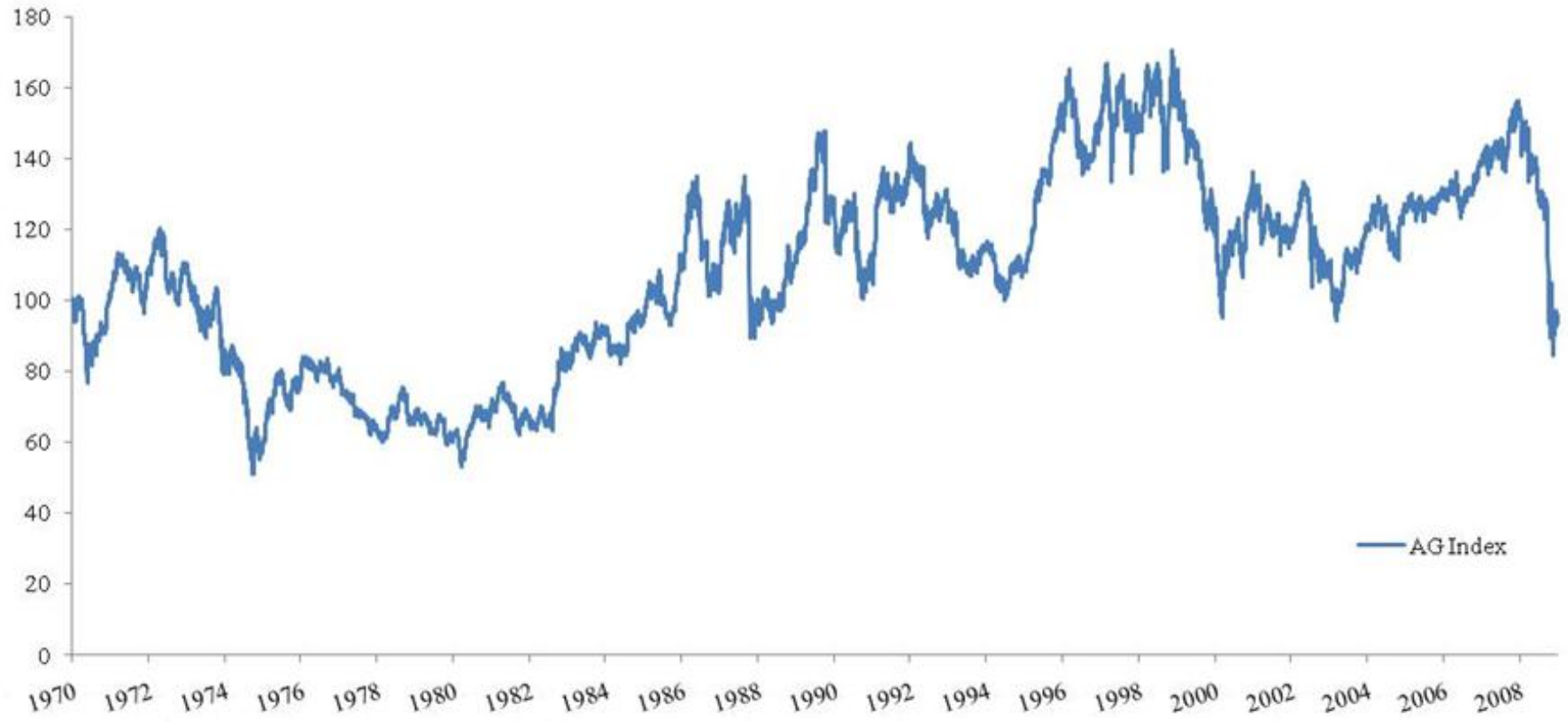
(APPENDIX F CONTINUED)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
52038	64282	64282	59010	59010	64282	87055	66114											
57817	87055	66114	64282	64282	66114		76149											
59010		87055	66114	66114	76149		87055											
64064			71176	71176	77015													
64282			87055	76149	87055													
66114				77015														
				87055														

APPENDIX G: NUMBER OF TRADING DAYS BY YEAR (1970-2008)

Year	# of Trading Days
1970	254
1971	253
1972	251
1973	252
1974	253
1975	253
1976	253
1977	252
1978	252
1979	253
1980	253
1981	253
1982	253
1983	253
1984	253
1985	252
1986	253
1987	253
1988	253
1989	252
1990	253
1991	253
1992	254
1993	253
1994	252
1995	252
1996	254
1997	253
1998	252
1999	252
2000	252
2001	248
2002	252
2003	252
2004	252
2005	252
2006	251
2007	251
2008	253

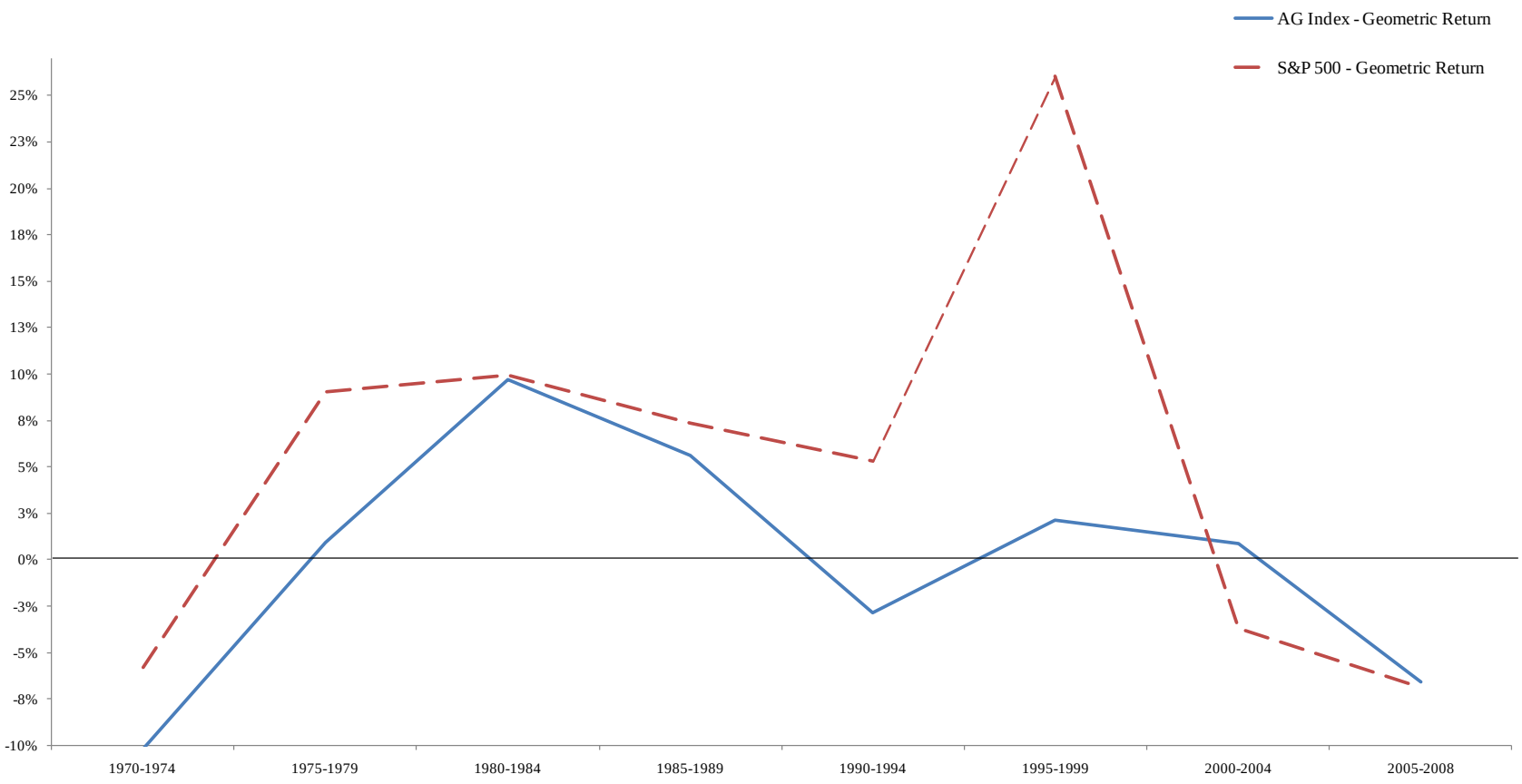
APPENDIX H: GRAPH - AG INDEX VALUE (1970-2008)



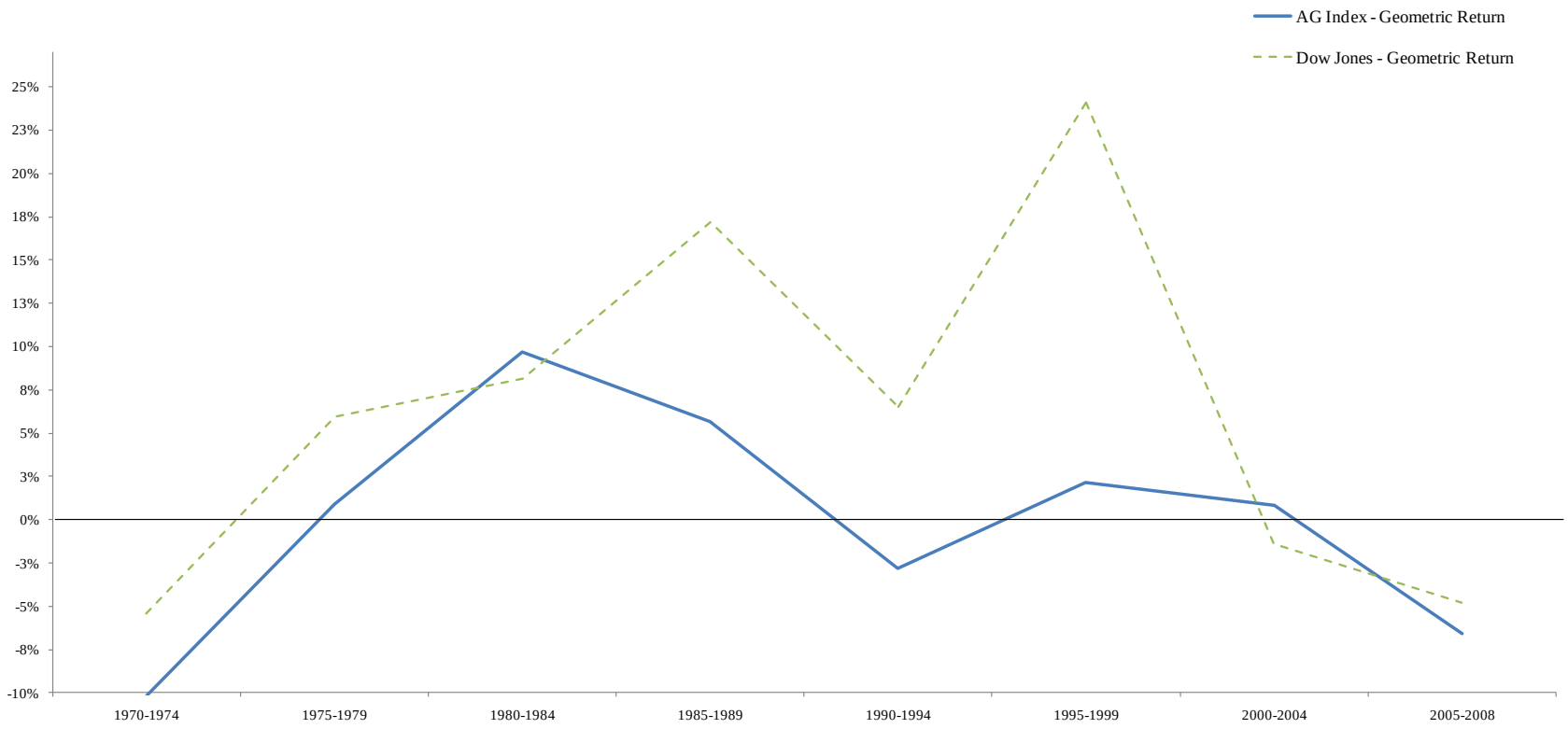
APPENDIX I: ANNUAL GEOMETRIC RETURN, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)

Period	AG Index	S&P 500	Dow Jones
1970	1.58935%*	-0.91398%	3.67276%
1971	7.62254%*	12.00219%	7.17941%
1972	1.85683%	16.11095%	14.69920%
1973	-23.82525%	-18.09404%	-17.52675%
1974	-31.01787%	-29.81163%	-27.95211%
1975	29.02264%*	28.42090%	34.86646%
1976	5.30076%	18.21782%	16.99526%
1977	-19.23706%	-11.12150%	-16.86222%
1978	**2.89380%**	2.44084%	-1.55673%
1979	-7.29580%	11.58896%	3.36694%
1980	14.28594%	28.36611%	16.90821%
1981	**-3.72838%**	-10.11442%	-10.05160%
1982	**23.92878%**	14.58367%	18.58541%
1983	10.52141%	19.22076%	22.55024%
1984	**5.28449%**	1.95074%	-3.28640%
1985	18.68194%	27.76199%	29.01065%
1986	-7.87475%	15.54463%	23.29538%
1987	-7.36100%	0.25563%	0.59772%
1988	**12.64345%**	-4.43463%	7.60799%
1989	15.31872%*	0.93106%	28.37586%
1990	-12.63256%	-8.19317%	-6.28045%
1991	**29.62800%**	27.76535%	21.38135%
1992	-11.97989%	4.42170%	4.05685%
1993	-8.54084%	7.13629%	13.44335%
1994	-5.04279%	-1.32563%	2.07209%
1995	**38.20239%**	34.15739%	33.31110%
1996	-2.59837%	19.33369%	24.54529%
1997	2.90604%	31.67121%	22.75145%
1998	5.51871%	26.06970%	15.27161%
1999	-24.01794%	19.63602%	25.18273%
2000	**13.38657%**	-9.27282%	-5.01448%
2001	-12.48483%	-10.53481%	-5.86672%
2002	**-9.45797%**	-23.80334%	-17.19151%
2003	10.43562%	22.31940%	21.45101%
2004	5.20083%*	9.33170%	3.58468%
2005	2.17573%*	3.84417%	-0.11119%
2006	6.68611%	11.78279%	14.89517%
2007	**10.41616%**	3.65382%	6.33531%
2008	-36.76891%*	-37.58465%	-32.71683%

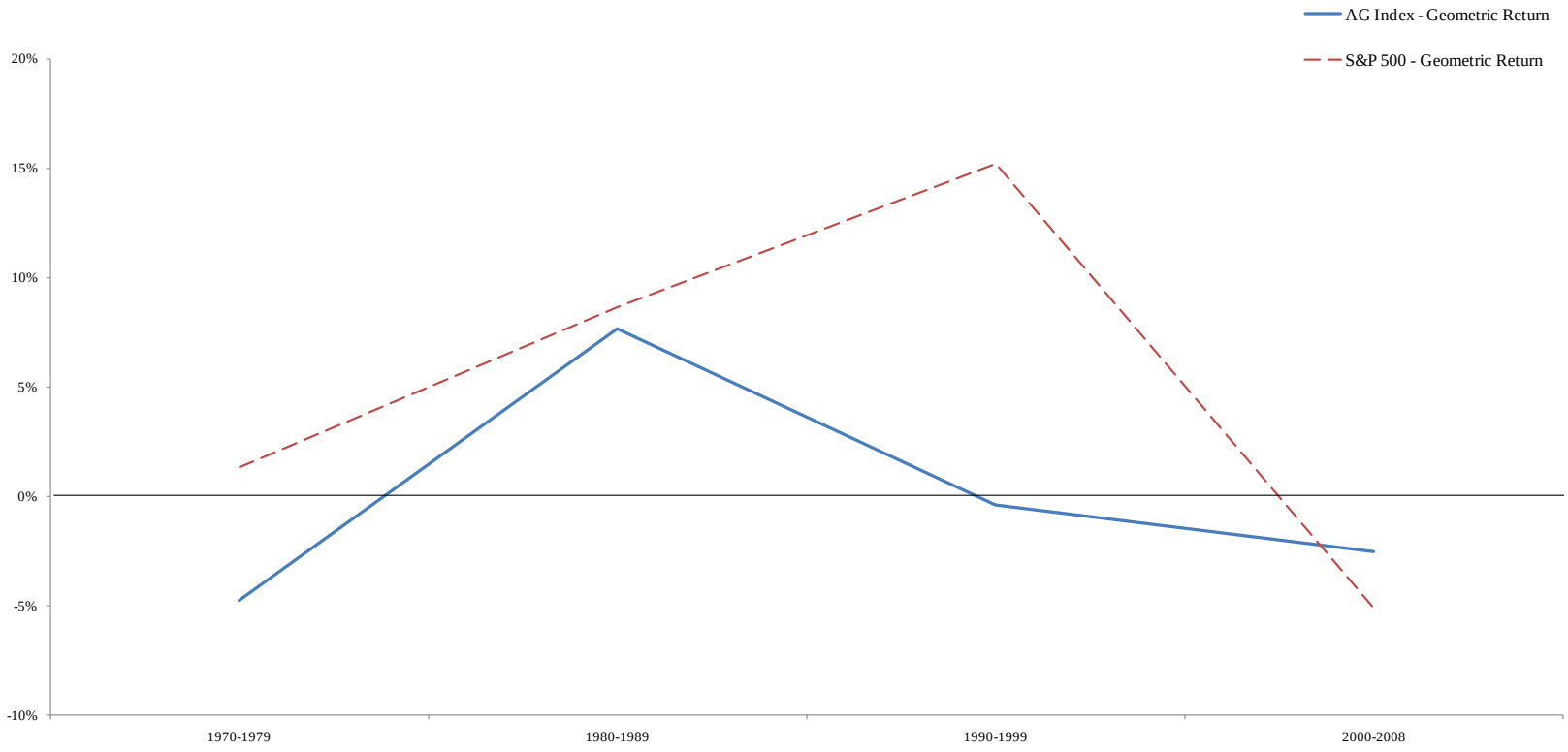
APPENDIX J: GRAPH - FIVE-YEAR GEOMETRIC RETURN, AG INDEX AND THE S&P 500 (1970-2008)



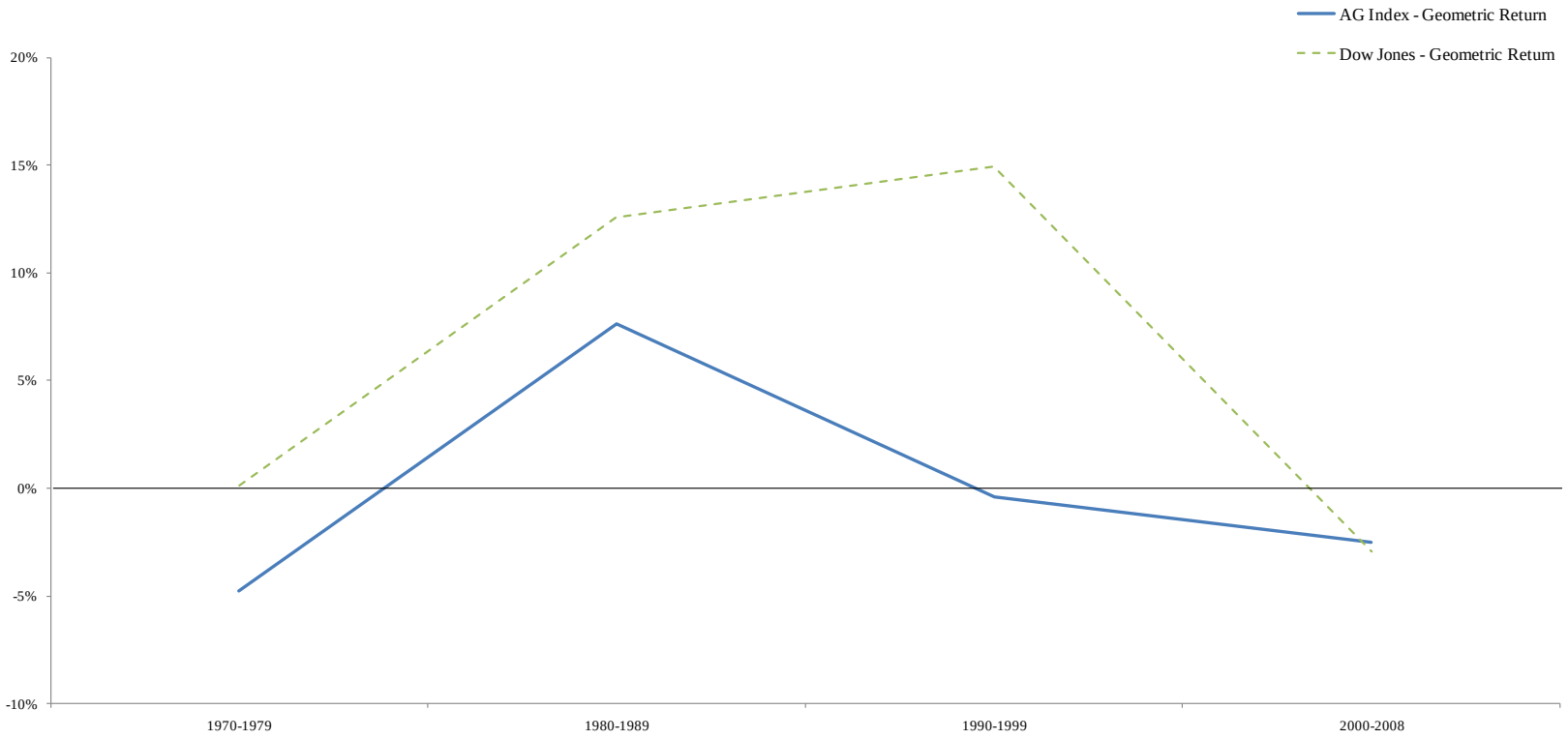
APPENDIX K: GRAPH - FIVE-YEAR GEOMETRIC RETURNS, AG INDEX AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



APPENDIX L: GRAPH - TEN-YEAR GEOMETRIC RETURN, AG INDEX AND THE S&P 500 (1970-2008)



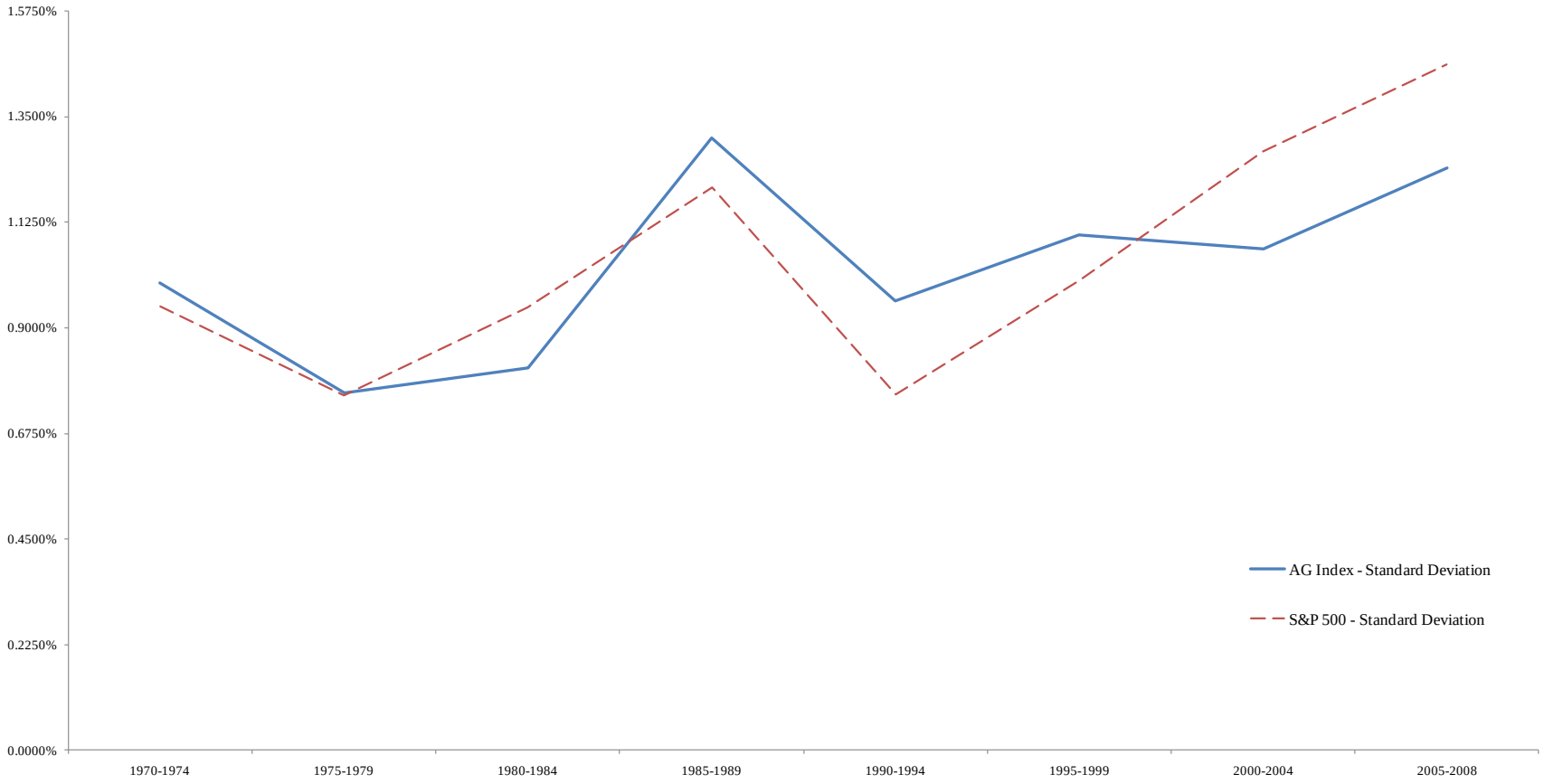
APPENDIX M: GRAPH - TEN-YEAR GEOMETRIC RETURN, AG INDEX AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



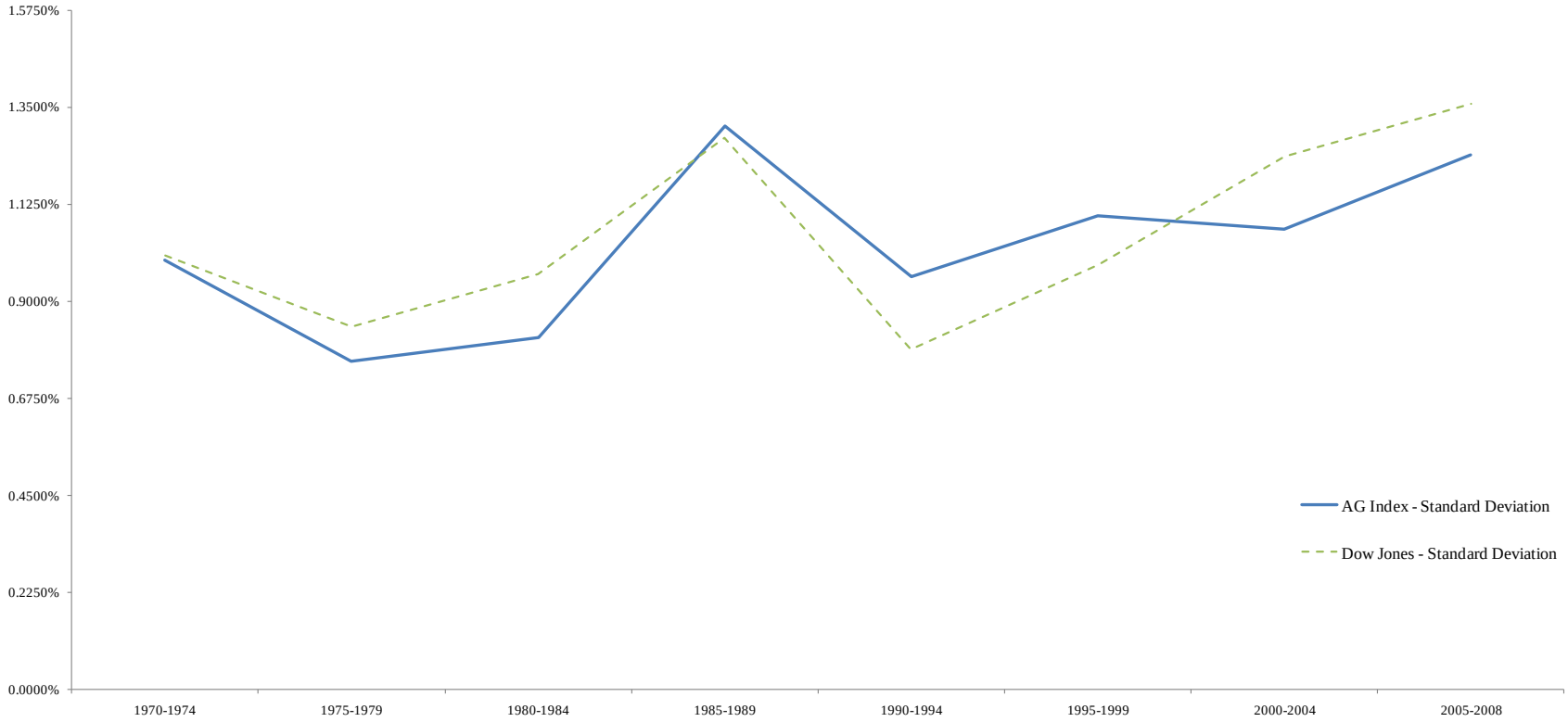
APPENDIX N: ANNUAL STANDARD DEVIATION, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)

Period	AG Index	S&P 500	DOW
1970	**0.90105%**	0.95275%	0.97498%
1971	**0.63183%**	0.64337%	0.69817%
1972	0.72247%	0.50143%	0.58341%
1973	1.054462%*	0.99686%	1.11397%
1974	1.44840%	1.37459%	1.42532%
1975	1.01992%*	0.97201%	1.06453%
1976	**0.68944%**	0.69961%	0.78396%
1977	0.6137%*	0.57171%	0.65196%
1978	**0.73187%**	0.79343%	0.89920%
1979	**0.67311%**	0.68321%	0.72922%
1980	**0.88779%**	1.03718%	0.98958%
1981	**0.73533%**	0.84738%	0.85165%
1982	**0.99720%**	1.15004%	1.17494%
1983	**0.69442%**	0.83913%	0.88138%
1984	**0.72238%**	0.80309%	0.87687%
1985	0.74251%	0.64026%	0.65332%
1986	1.22587%	0.92561%	0.96619%
1987	**1.94011%**	2.02469%	2.17207%
1988	1.16705%	1.07639%	1.14317%
1989	1.16294%	0.82257%	0.89521%
1990	1.23033%	1.00471%	1.02820%
1991	1.09214%	0.90074%	0.92297%
1992	0.90946%	0.60995%	0.65074%
1993	0.77174%	0.54182%	0.54651%
1994	0.67284%*	0.62012%	0.68747%
1995	0.69772%	0.49177%	0.54666%
1996	1.03093%	0.74210%	0.75439%
1997	1.36848%	1.14215%	1.17947%
1998	**1.20128%**	1.27802%	1.24968%
1999	1.07703%*	1.13838%	1.01829%
2000	1.44898%	1.39990%	1.30642%
2001	**0.97118%**	1.35793%	1.34533%
2002	**1.17792%**	1.63971%	1.60907%
2003	**0.92359%**	1.07516%	1.04479%
2004	**0.65577%**	0.69883%	0.68313%
2005	**0.60236%**	0.64780%	0.64881%
2006	**0.56621%**	0.63153%	0.62167%
2007	**0.86385%**	1.00700%	0.91558%
2008	**2.16655%**	2.58107%	2.38646%

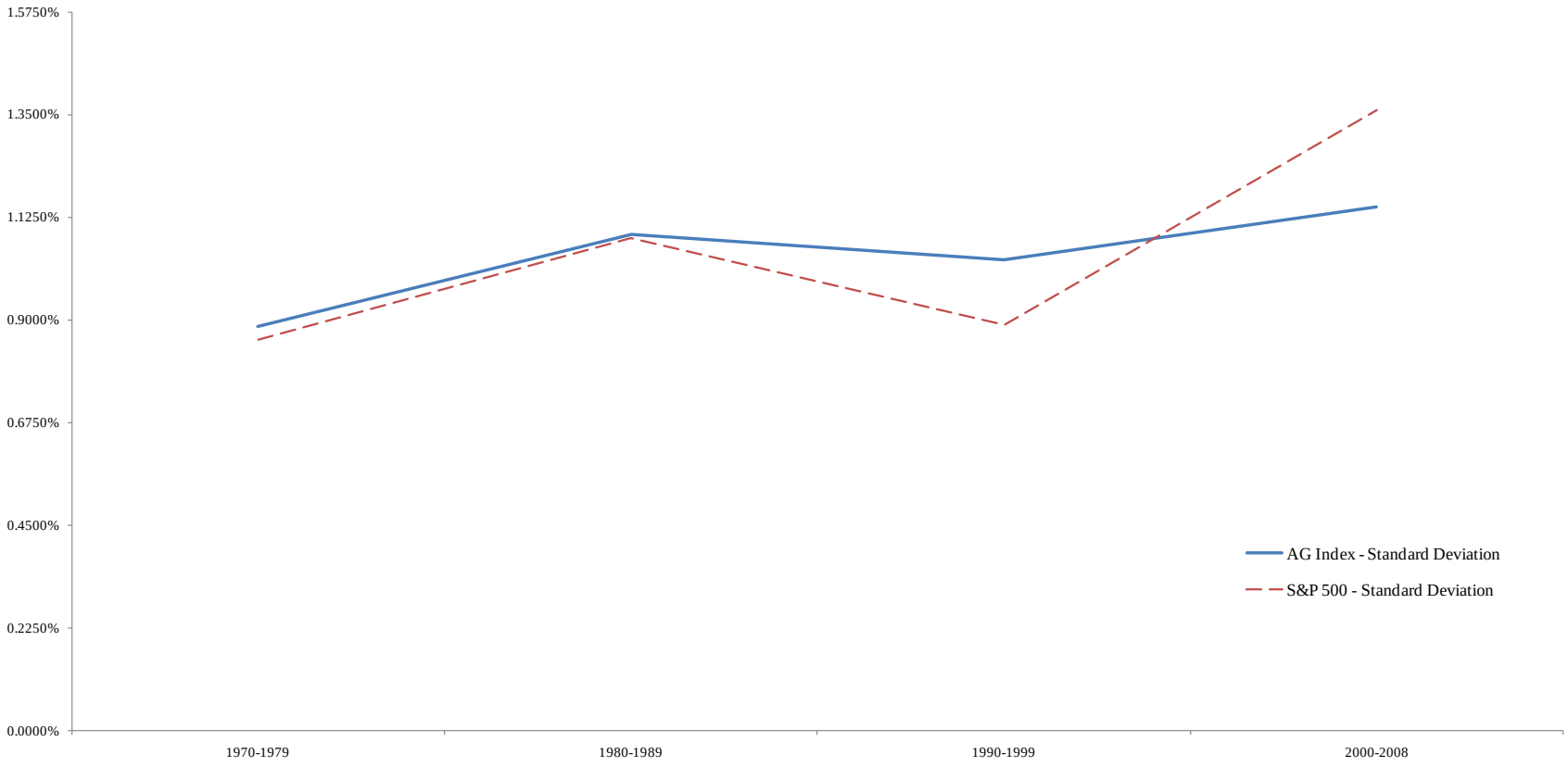
APPENDIX O: GRAPH - FIVE-YEAR STANDARD DEVIATION, AG INDEX AND THE S&P 500 (1970-2008)



APPENDIX P: GRAPH - FIVE-YEAR STANDARD DEVIATION, AG INDEX AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



APPENDIX Q: GRAPH - TEN-YEAR STANDARD DEVIATION, AG INDEX AND THE S&P 500 (1970-2008)

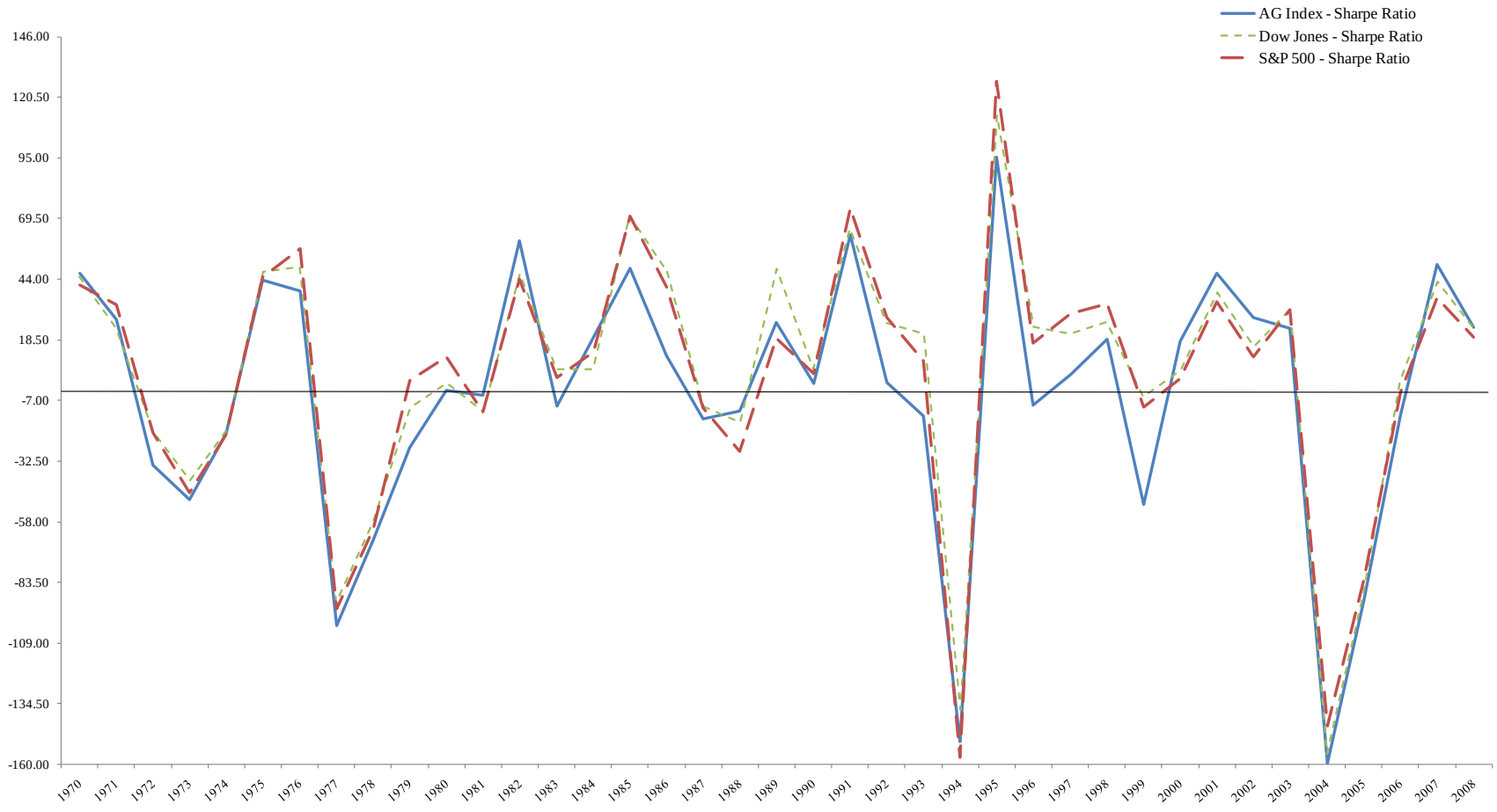


APPENDIX R: GRAPH - TEN-YEAR STANDARD DEVIATION, AG INDEX AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)

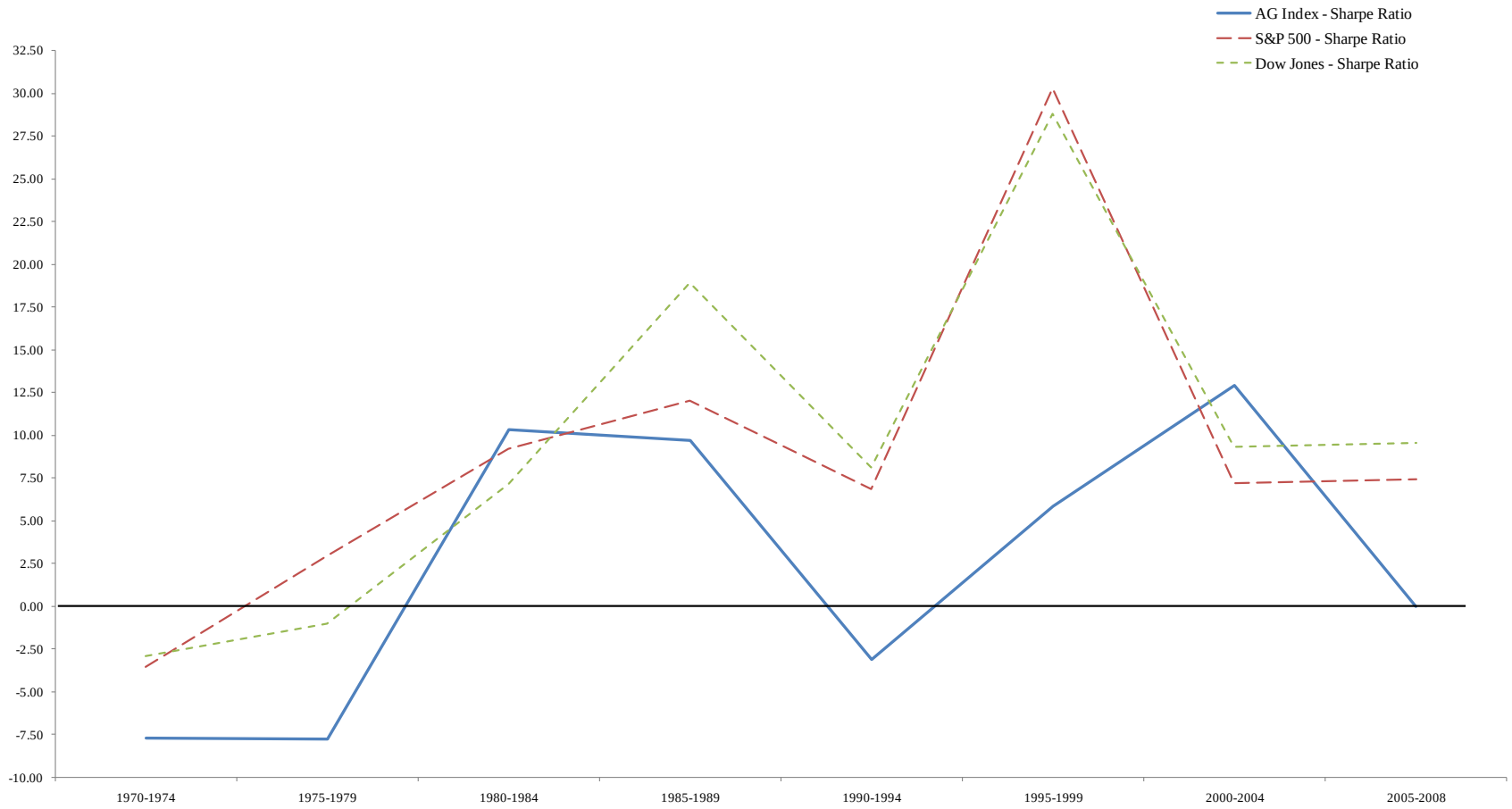
APPENDIX S: ANNUAL SHARPE RATIO, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)

Period	AG Index	S&P 500	DOW
1970	**46.53**	41.38	45.14
1971	26.86*	33.19	23.67
1972	-34.11	-20.73	-20.23
1973	-48.79	-45.86	-40.53
1974	-21.13*	-21.39	-19.33
1975	43.43	44.95	47.10
1976	39.04	56.93	49.25
1977	-101.46	-94.72	-91.87
1978	-65.73	-61.20	-58.45
1979	-26.57	1.47	-9.90
1980	-2.57	11.37	0.34
1981	**-4.88**	-11.77	-11.64
1982	**60.09**	43.97	46.45
1983	-9.24	2.72	6.37
1984	**19.50**	13.39	6.29
1985	48.46	70.38	70.89
1986	11.62	40.69	47.01
1987	-14.70	-10.32	-9.47
1988	**-11.58**	-28.42	-16.22
1989	25.92*	19.15	48.25
1990	0.04	4.46	6.22
1991	62.72	73.98	65.28
1992	0.67	27.89	25.58
1993	-13.61	9.54	21.00
1994	-150.45*	-157.25	-136.90
1995	95.39	127.12	112.80
1996	-8.90	17.19	23.82
1997	3.68	29.60	16.83
1998	18.77	33.73	25.85
1999	-50.68	-9.60	-5.29
2000	**17.96**	2.41	5.84
2001	**46.39**	34.61	38.40
2002	**27.72**	11.16	15.48
2003	23.50	31.24	31.32
2004	-159.69	-143.94	-155.66
2005	-91.00	-82.04	-88.01
2006	-13.19	-3.76	1.19
2007	**50.18**	36.33	42.89
2008	**23.80**	19.66	23.30

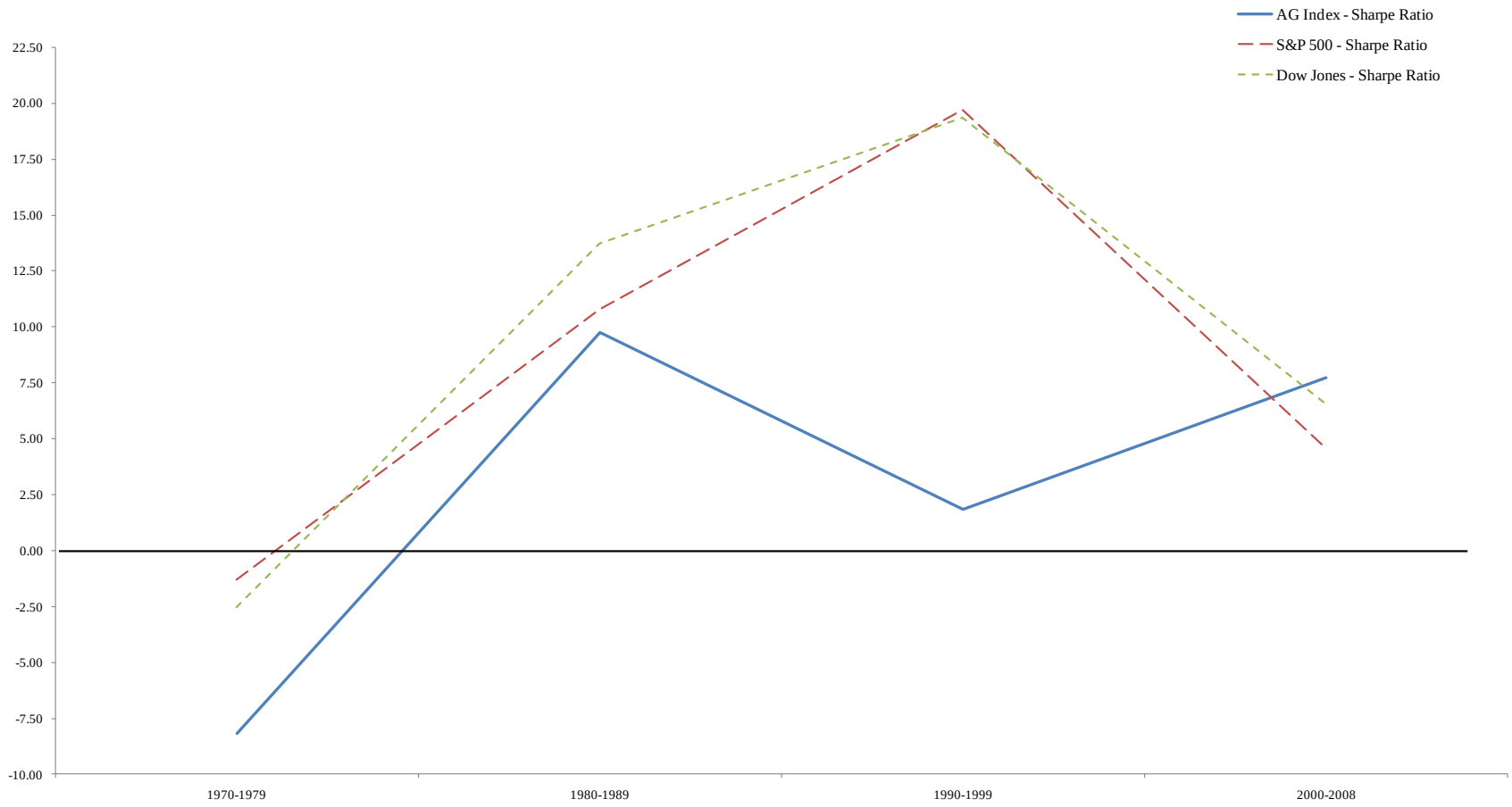
APPENDIX T: GRAPH - ANNUAL SHARPE RATIO, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



APPENDIX U: GRAPH – FIVE-YEAR SHARPE RATIO, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



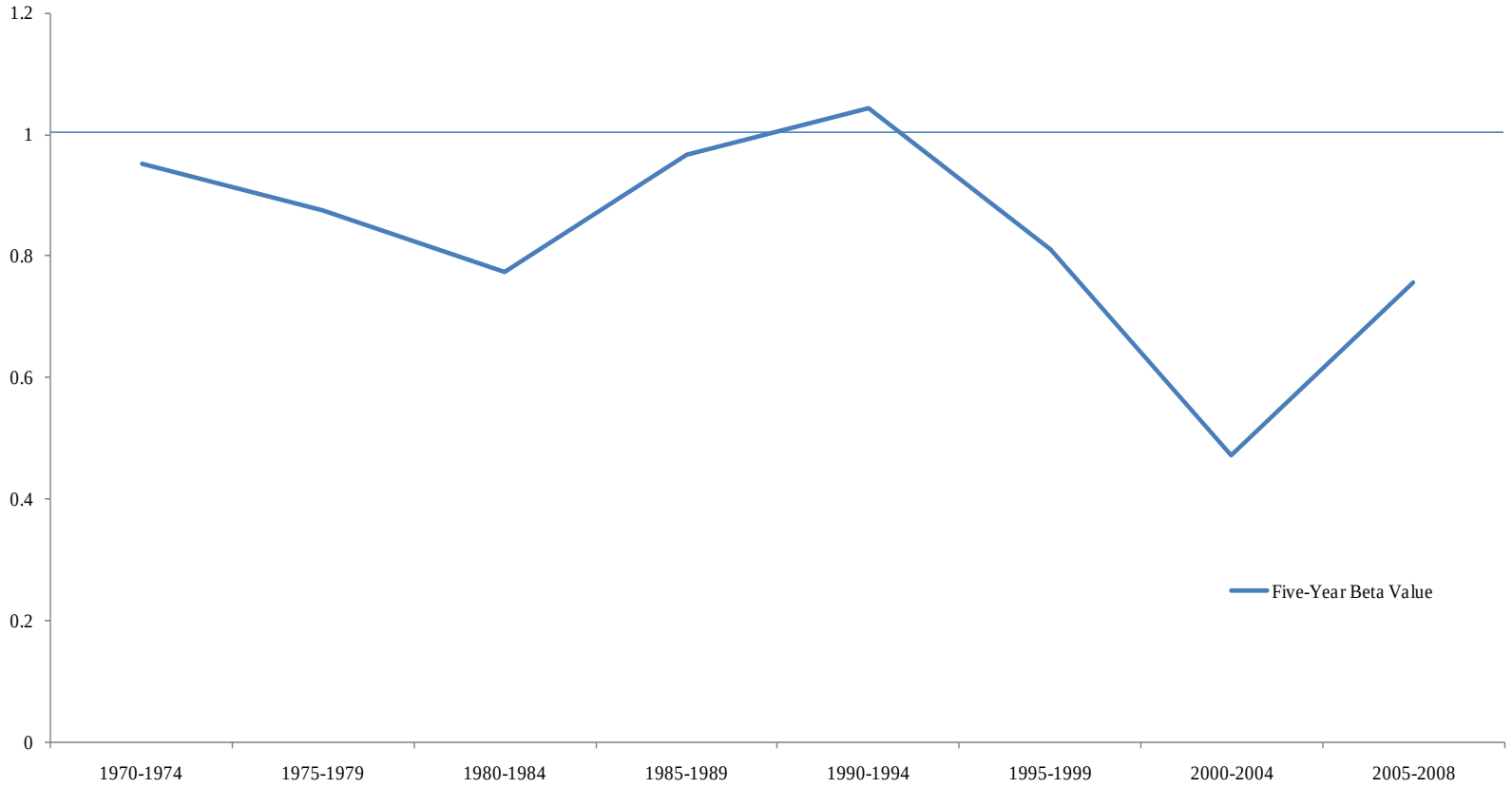
APPENDIX V: GRAPH – TEN-YEAR SHARPE RATIO, AG INDEX, S&P 500, AND THE DOW JONES INDUSTRIAL AVERAGE (1970-2008)



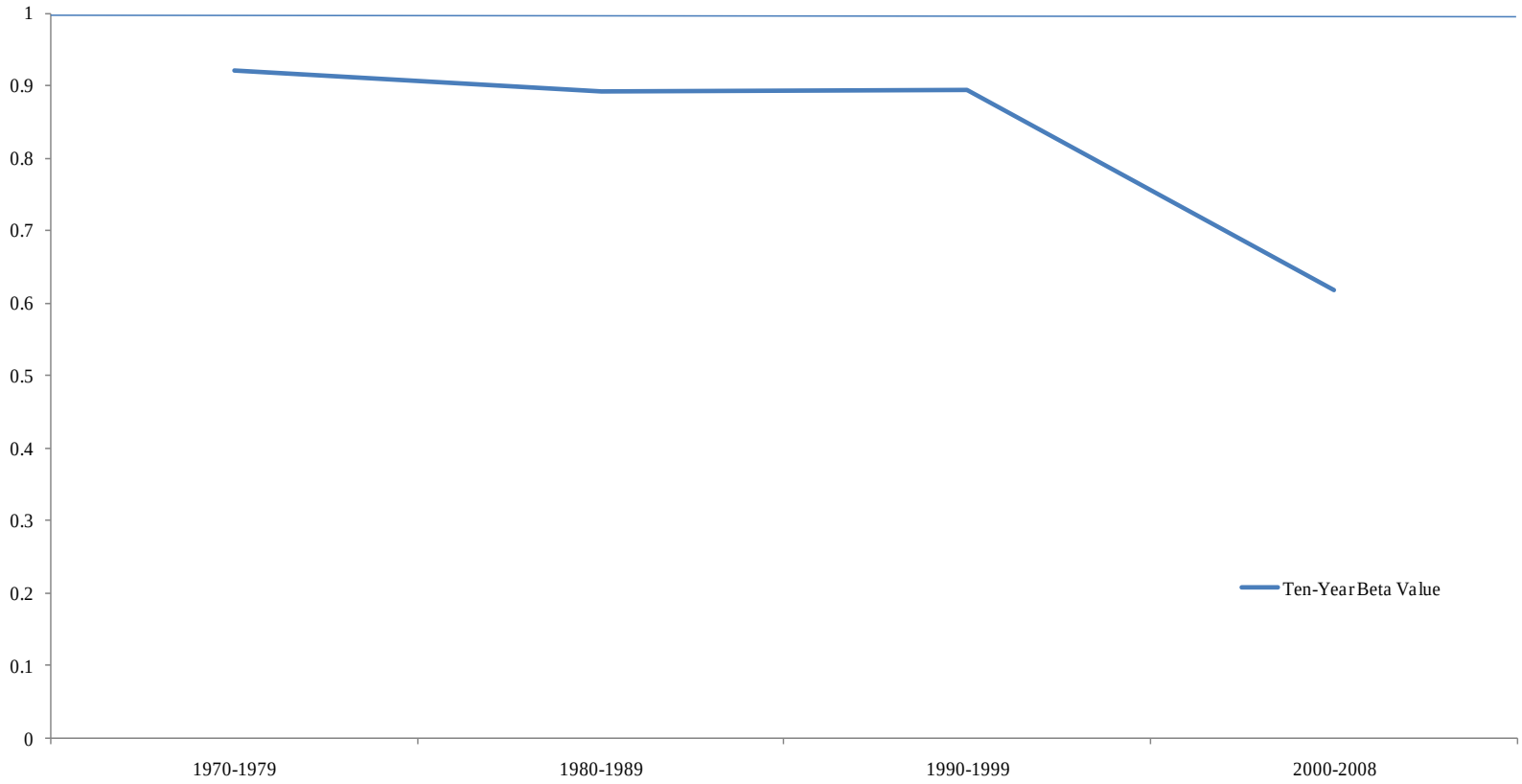
APPENDIX W: ANNUAL BETA VALUE ESTIMATION, AG INDEX (1970-2008)

Year	AG Index
1970	0.8673522
1971	0.814655374
1972	0.957848146
1973	0.97733653
1974	1.010285371
1975	0.990376806
1976	0.92249389
1977	0.539339786
1978	0.875118904
1979	0.818083808
1980	0.751708057
1981	0.753252878
1982	0.806229279
1983	0.721237264
1984	0.836670553
1985	0.882333666
1986	1.076474714
1987	0.918651449
1988	1.030492438
1989	1.064008532
1990	1.068307286
1991	1.093708485
1992	1.07502552
1993	1.071220489
1994	0.807102592
1995	0.835797474
1996	0.852878645
1997	0.970509587
1998	0.794700964
1999	0.64788324
2000	0.314776233
2001	0.351949199
2002	0.527148295
2003	0.675452115
2004	0.754172555
2005	0.807023211
2006	0.692120307
2007	0.773707482
2008	0.754433291

APPENDIX X: GRAPH - FIVE-YEAR BETA VALUE ESTIMATION, AG INDEX (1970-2008)



APPENDIX Y: GRAPH - TEN-YEAR BETA VALUE ESTIMATION, AG INDEX (1970-2008)



APPENDIX Z: NUMBER OF FIRMS INCLUDED IN THE AG INDEX BY YEAR (1970-2008)

Year	# of Firms
1970	48
1971	48
1972	50
1973	58
1974	51
1975	50
1976	53
1977	57
1978	59
1979	56
1980	58
1981	55
1982	57
1983	60
1984	61
1985	56
1986	54
1987	51
1988	46
1989	49
1990	47
1991	43
1992	44
1993	46
1994	48
1995	46
1996	42
1997	44
1998	41
1999	35
2000	35
2001	31
2002	33
2003	35
2004	36
2005	40
2006	40
2007	41
2008	35

VITA

Benjamin Michael Clark was born in October 1985, in Baton Rouge, Louisiana. He graduated from Louisiana State University and Agricultural and Mechanical College, Baton Rouge, Louisiana, in December 2007, with a bachelor's degree in agricultural economics. From May 2006 to May 2007, he worked as a marketing intern for the Baton Rouge non-profit organization, Big River Economic and Agricultural Development Alliance. In 2007, he was the recipient of a Policy Fellowship with the Rural Coalition in Washington, D.C. In January 2008, he entered the master's program in the Department of Agricultural Economics and Agribusiness at Louisiana State University and Agricultural and Mechanical College. During his graduate studies, he held the positions of Treasurer and Vice-President of the Graduate School College Council. He is currently a candidate for the degree of Master of Science in agricultural economics.