# PERFORMANCE AND RISK OF AGRICULTURAL ASSETS: A TIME-VARYING APPROACH

Undergraduate Thesis

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# CHAPTER 1: INTRODUCTION

## Background and Motivation

After the 2008 financial crisis, there has been an increasing investing interest about farmland. Farmland has been considered as a counter cyclical investment choice. Other than investment in farmland, the agriculture industry has entered a booming period since that time. In this booming period, commodity price also went up and there are many examples of new investments and investors drawn into the industry, reflecting a greater overall interest. Some arguments in the media included “And this sector (agriculture) won’t go down if the rest of the market slows. When times get tough, people still have to eat” (Globe Investor Magazine, 2007) and "buy land -- they're not making it anymore” (Wall Street Journal, 2008). The rising farmland price together with these examples showed that farmland is a good investment choice during downturn. However, in May 2013 Wall Street Journal first reported that “the rise in prices for agricultural land slowed” and more recently in November 2013 another article in Wall Street Journal speculated that farmland prices might past peak season already. It is possible that there are also many bubbles in farmland prices, which make it riskier.

Agriculture industry has not gain much attention from mainstream institutional investors historically. First of all, the high degree of fragmentation in the production agriculture is likely drives economic profits near zero. Unlike industries categorized as oligopoly, there are over 2 million farms producing output in the United States, very few with liquid, transferrable farmlands. This illiquidity is a major barrier to easily invest in farmland. Other barriers to invest in farmland include its comparatively low returns, and

a comparatively high need for specific background and knowledge of operating production industry.

Due to the rapid price increase of farmland, there has been substantial institutional and academic literature focus on investing in farmland. Agribusiness, on the other hand, could potentially has the same counter cyclical characteristic as farm land because of its close connection to production agriculture. However, there is not enough studies focusing on the returns and risks of agribusiness equities. Therefore, it is very interesting to see whether exposure to farmland through investing agribusiness stocks has the same little systematic risk as farmland.

As a very diverse industry, agribusiness could vary a lot across different sub-industries. Agribusiness stocks could range from Monsanto, an agricultural chemical and seed company, to John Deere, a farm machinery producer, to Kraft, a packaged food producer. The point that agriculture is so diverse is that different sub-industries may have different returns and risks. For investors to invest in agribusiness stocks, it is necessary to know which group of stocks have relatively high risk adjusted return. Clark (2012) categorized agriculture industry in terms of the connection to production agriculture. The closer connection a sub-industry has to production agriculture, the lower risks it may have to be incorporated into a portfolio. However, in this paper, I still analyze returns and risks across different sub-industries. Generally speaking, sub-industries like crop production is closer and food processing and service has less connection to production agriculture.

## Objectives

There are three objectives in this paper. There are listed as below:

1) Assess the returns of agriculture equities among three different sub-industries.

2) Assess the risks of agriculture equities among three different sub-industries.

3) Compare these returns and risks with market portfolio.

The three sub-industries I am focusing on are packaged foods and meats, fertilizers & agricultural chemicals, and agricultural products according to GICS code.

## Thesis layout

The thesis is organized in four chapters. Following this introductory chapter, Chapter 2 gives a summary of past literature about returns and risks of agribusiness stocks and other agricultural assets. Chapter 3 includes details about data source and methodology of the analysis. Chapter 4 provides a summary of the results and conclusion.

# CHAPTER 2: LITERATURE REVIEW

The first work discussing the performance of agribusiness returns, authored by Collins (1998), complied 10 publicly traded agribusiness stocks to calculate the required rate of return by using Arbitrage Pricing Theory. He finds that there is little reason to argue that agriculture equity returns are more or less risk than other industries.

Another work that exam the agribusiness equity is Chaddad and Heckelei (2003), which compare merger rationale for cooperatives and publicly traded companies, and find that cooperatives merge due to limited means to access outside investment dollars, which is a somewhat less prevalent factor for public companies. They suggest capital is constrained as investment is extremely sensitive for cash flow in cooperatives, but not in publicly traded corporations. Both of these two works relates to the assessment of risk and return agricultural equity.

Schumacher and Boland (2003) compared business performance of cooperative owned and publicly traded agribusinesses, focusing on vertical integration and the persistence of profitability. They split their groups, based on Standard Industry Classification codes, into retail, processing, wholesale, and restaurant groups. Results of this study highlighted industry vs. firm-specific effects and the persistence of profitability across these 4 SIC code groups, noting that food retail businesses have a greater stability and persistence of profits over time. The authors also found that industry effects are more persistent for profitability than corporate, firm-specific effects

Tre-Pech, Weldon and Gunderson (2008) continue in the topic of agribusiness financial ratios by measuring work capital levels and stock returns for 13 different agribusiness, sorted by 3-digit Standard Industry Classification codes. Out of their 13

different value-weighted indices, they found that the food service SIC group returned the highest. At the end of their work, they suggests that future work should include an analysis of risk in the agribusiness equities.

The unpublished thesis written by Griffin Moag, assessed returns and risks of five agricultural assets using ordinary least square and flexible least square method. Five agricultural assets included agribusiness equity (three sub-groups), commodity and farmland price performs compared to the market. It specifically exanimated the returns and risks over financial crisis.

Clark et al. (2012) developed a composite agribusiness stock index called AGB index and then compare the returns and volatility to other broad-based market indices. The paper then evaluates the diversification potential of agribusiness stocks in the context of an investment portfolio under capital asset pricing model. They found that until recent years, the AGB Index has historically exhibited lower returns than the market indices. It has also exhibited lower risk and correlation with treasury securities than broad market indices.

Based on the construction of AGB index by Clark et al (2012), *D'Antoni and Detre (2013)* estimated the dependence between daily returns of the S&P 500 and AGB index from 1970 through 2008 using copulas. Their work supported that "agribusiness stocks have strong lower tail dependence with large U.S. stocks and are actually less correlated in the upper tail of the distribution." Meaning, the agribusiness index moves in near lockstep with U.S. stocks in downturns and more independently in large upswings. The result provides little evidence to support the investment strategy of purchasing agribusiness stocks broadly to gain exposure to farmland.

Katchova and Enlow (2012) examines how publicly-traded agribusinesses perform financially compared to all firms over the period from 1961 to 2011. Their research shows that agribusinesses exhibit strong financial performance and outperform the sample of all firms based on many of the financial criteria. These findings are important for investors considering agribusinesses as part of their investment portfolios.

Chen, Songjiao, et al (2013) analyzes constructed a class-specific porforlio consist of farmland and other agricultural investments including agribusiness stocks and grain futures. They use the Copula-VaR and Copula-VaR with restrictions methods to find, compare, and contrast the optimal portfolio compositions among these assests. The results show that farmland dominates the portfolios, particularly for lower risk tolerances. However, as risk tolerance is increased, a shift to other agricultural assets would potentially bring higher returns.

Perold (2004) lays out the key ideas of the Capital Asset Pricing Model, which is the first coherent framework to analyze how the risk of an investment affect its expected reture. The CAPM brought up the idea that certain risk associated with particular investment could be diversified away while investors held other investments at the same time. Construction of a portfolio could gain benefits of diversification. The paper also places CAMP and its development in a historical context, and discusses its applications and enduring importance to the field of finance.

# CHAPTER 3: DATA AND METHODOLOGY

## Global Industry Classification System

Many studies compare and measure trends and indicators by industry, such as profitability, market value, growth rate and returns. Government and academic researchers can then use these measurements to track effects of policy changes, providing valuable research data to evaluate certain policy. Investors and business analysts could also benefits from studies across different industries to compare financial performances in different industries.

Standard Industry Codes (SIC), which have 4 digits, were originally designed to assist the US government collect, analyze, and research business data by industry in the 1930's. Companies were assigned to different industries according to their primary type of production activity, like printing or mining. Companies sharing the same 4 digits were considered very close in terms of economic relatedness, whereas sharing the first digit showed were considered to be less related. However, there are some limitations of SIC code to do financial research. First of all, SIC codes system did not have consistency over time because the industry code of some companies can change over time. For financial research this gives a low degree of consistency over time. Secondly, the SIC coding system lack a global perspective for companies engage in international business. SIC code are not available for companies that enlisted in stock exchanges in other countries. Finally, SIC code is relatively an old system. In In 1997, the Office and Management and Budget replaced SIC codes with North American Industry Classification System (NAICS) codes to better adapt to the globalizing, changing economy. The NAICS codes removed some definitional issues inherent to the SIC

system. The latest literature after 1997 rarely used SIC to compare industry effects. However, for my analysis, the NAICS code still has the first two limitations same as SIC code. Therefore alternative approach is used in my analysis.

Standard & Poor's developed a new system, focusing a common global for finance researchers and analysts. Global Industry Classification System (GICS) is a global system which considered the needs of the financial community to research and compare securities across countries. GICS assigned each firm to an 8 digit code, containing four levels: sector, industry group, industry, and sub-industry. This system assigned firms by primary business activity, which is defined by revenues. Other than this criteria, market perception of investors also helps to classify companies within a specific, 8-digit industry code. GICS has several advantages. First it is designed for financial community and investors. There are already some industry ETF fund tracing index developed by GICS. For example, MSCI Agriculture & Food China Indices consisted many big agribusiness and food companies in the world. Secondly, it has the good consistency over time. Although S&P modifies classification over the time, they all keep the consistency. For example, a company could be classified in agricultural products industry initially. S&P may change it to food and packaged meat industry. But it will assign that company to the new industry from the beginning period that the company was enlisted. Therefore, research that estimate industry effects would have more accurate results.

Today, the GICS system covers 38,000 firms globally, divided into 10 sectors, 24 industry groups, 68 industries, and 154 sub-industries. Of these sub-industries, 3 are specific to agriculture. In this research, I examine the returns from three agribusiness

sub-industries as the table below shows. 'Agricultural Products' includes companies involved in the production and processing of crops, but not the packaging of agribusiness products. 'Packaged Foods & Meats' include dairy, meat, and food companies involved in some way in the packaging of food products. 'Fertilizers & Ag Chemicals' include producers of potash, phosphorus, and other chemicals used in agriculture. These are the three groups used in this work because of their close relation to agriculture and the classification are mutually exclusive. One thing to be noted is that although these three industries included most of important agribusiness companies, there are few companies that is not included in my analysis. For example, John Deere is not included due the relatively small size of agriculture equipment. Cargill is also not included because it is still a private company.

Table 1 Sub-industries and their GICS codes

| Sub-industry | GICS Code |
|---|---|
| Packaged Foods and Meats | 30202030 |
| Fertilizers & Agricultural Chemicals | 15101030 |
| Agricultural Products | 30202010 |

## Packaged Foods and Meats Description

The sub-industry is most broadly included in the Consumer Staples sector and the Food, Beverage & Tobacco Industry Group. In more detail, PF&M is classified in the Food Products Industry, and finally the Packaged Foods & Meats sub-industry.

The GICS Description for Packaged Foods and Meats reads, "Producers of packaged foods including dairy products, fruit juices, meats, poultry, fish, and pet foods." Notable constituents of the Packaged Foods & Meats group include Nestle, Unilever, Kraft Foods, Groupe Danone, Cadbury, Wrigley, General Mills, Kellogg, Heinz,

Campbell Soup, ConAgra, Sara Lee, Hershey, Tyson, Hormel, Tate & Lyle, Smithfield Foods, and Dean Foods.

## Agricultural Products Description

The sub-industry is most broadly included in the Consumer Staples sector and the Food, Beverage & Tobacco Industry Group. In more detail, AP is classified in the Food Products Industry, and finally the Agricultural Products sub-industry.

The GICS description of Agricultural Products reads, “Producers of agricultural products. Includes crop growers, owners of plantations and companies that produce and process foods but do not package and market them. Excludes companies listed in the Forest Products sub-industry and those that package and market the food products classified in the Packaged Foods sub-industry.” Notable constituents of this group include Archer-Daniels-Midland Co., Bunge LTD, Corn Products International, Fresh Del Monte Produce, Darling International, and Cresud.

## Fertilizers & Ag Chemicals Description

The sub-industry is most broadly included in the Materials sector and the Materials Industry Group. In more detail, F&AC is classified in the Chemicals Industry, and finally the Fertilizers & Agricultural Chemicals sub-industry

The GICS description of F&AC reads, “Producers of fertilizers, pesticides, potash, or other agriculture-related chemicals not classified elsewhere”**.** Notable constituents include Potash Corp of Saskatchewan, Monsanto, Mosaic, Syngenta, Agrium, CF Industries Holdings Inc, Intrepid Potash Inc, Terra Industries Inc, Terra Nitrogen Co – LP, Scotts Miracle-Gro, and Intrepid Potash.

## Index Construction

All the raw data was downloaded identified by the three GICS code above from Compustat North America Monthly via Wharton Research Data Services. Compustat North America Monthly contains equity and financial statement data for more than 30,000 publicly held, active and inactive companies, dating back to 1961. Due to data availability, firm data was downloaded for the time period from April 1998 to July 2013. In Compustat, total monthly return for each is calculated as following:

$$R_t = \frac{\left(\frac{C_t}{AJEX_t} + \frac{D_t}{AJEX_t} + \left(\frac{P_t}{AJEX_t} - \frac{P_{t-1}}{AJEX_{t-1}}\right)\right)}{\frac{P_{t-1}}{AJEX_{t-1}}}$$

Where, $C_t$ = Cash Dividends in month t

$R_t$ = Total monthly return in month t

$D_t$ = Stock Dividends in time period

$P_t$ = closing price at end of month

$AJEX_t$ = Represents ratio that enables one to adjust per-share data as well as share data for all stock splits and stock dividends that occur subsequent to the end of a given period. This is done so shares return is not miscalculated when the company announces a split or reverse split.

Total monthly return for each stock is pre-calculated in the database and can be downloaded directly. In addition to total monthly return, monthly data including month-end closing stock price, shares outstanding were downloaded to form a value-weighted index by GICS group. Three different groups were queried based on their GICS code. Before constructing return for each sub-industry, additional data modification was necessary to form a US-based index. Therefore one identification item in Compustat North America called stock exchange code was also downloaded. In my analysis, only stocks traded on the three major stock exchanges (NYSE, ASE, and NASDAQ) and

OTCBB (Over-the-Counter Bulletin Board) are included. Therefore stocks that are not available to investors (listed as 'subsidiary/private', 'non-traded company or security', 'consolidated parent or tracking stock company'), stocks traded in other exchanges (Toronto Stock Exchange, Montreal Stock Exchange or pink sheet) are excluded from my analysis.

Next step is to construct return for each sub-industry, the value weighted return index follows the formula below:

$$Industry\ Return_t = \sum_{i=1}^{n} R_{t,i} * W_{t-1,i}$$

$R_{t,i}$ refers to monthly return of individual stock at month t, $W_{t-1,i}$ refers to capitalization weight of individual stock in the previous month. Weight in the previous month is used because investors could only adjust their portfolio using existing information and in this case investors adjust their portfolio each month according to the capitalization in the previous month. Market capitalization for each firm is calculated by multiplying close stock price by common shares outstanding. Then dividing each firm's market capitalization by the total market capitalization in the sub-industry at month t calculates $W_{t,i}$ the market capitalization weight at month t.

## Capital Asset Pricing Model

The capital asset pricing model asses the systematic risk of assets. It follows the formula below:

$$\boldsymbol{r_t - r_{ft} = \alpha + \beta(r_{mt} - r_{ft}) + e}$$

$r_t$ = the industry return at month t

$r_{mt}$ = the market return at month t

$r_{ft}$ = the 1 month Treasury risk-free rate

α = excess return

The coefficient $\beta$ measures the level of systematic risk for each sub-industry. Monthly risk-free rates and market risk premiums ($\boldsymbol{r_{mt} - r_{ft}}$) used in the Capital Asset Pricing Model regression are downloaded from downloaded from Compustat North America via Wharton Research Database. Risk-free rates used are 1 month Treasury bill rates and are extracted from Ibbotson Associates data. The market risk premium is calculated as market return less the 1 month risk-free rate. Fama/French factor is used as the market return, which is used by a lot of previous research. It is calculated by Dr. French and Dr. Fama, using a value-weighted return for all New York Stock Exchange, NASDAQ, and American Stock Exchange equities. Their return methodology follows a similar format as the method I used in this paper. The only difference is that Fama/French factor adjust their portfolio each year instead of each month. S&P 500 returns series in the result part is also downloaded from Compustat North America.

# CHAPTER 4: RESULTS AND CONCLUSION

By following the methodology discussed in the previous section, the following summary descriptive statistics were calculated for each GICS sub-industry group. Table 1 presents summary statics of all returns for three sub-industry groups. Results are presented from 1998/05 to 2013/07. Also correlation between different tables is presented. Then graphs for returns and detailed sub-industry composition is presented for each industry. For each industry a table presents the 10 largest companies in each sub-industry dated 7/31/2013, the most recent period for forming the index portfolio, and provides a frame of reference to the constituents of the sub-industry. A graph of all return series provide a more visual way to exam return over time compared with S&P 500. Finally simple compound is presented. The simple compound table displays the simple compound returns of the value-weighted index and return for farmland, calculated from different starting period day as specified in the table to 7/31/2013, and for a frame of reference is compared to the S&P 500, which is a general equity performance barometer used in the finance industry. This index consists of the largest 500 equities in the US economy, and comprises 75% of the equity market capitalization in the United States. Farmland return data was downloaded from National Council of Real Estate investment Fiduciaries. All of these firms are included in the Fama-French market return category, which is more inclusive but not as widely cited as the S&P 500.

Table 2. Summary Statistics of Return (%)

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Food & Meat | 183 | 0.85 | 4.40 | -13.02 | 13.61 |
| Chemicals | 183 | 1.24 | 8.34 | -30.39 | 22.32 |
| Ag products | 183 | 0.76 | 6.90 | -19.64 | 22.37 |

Table 3. Correlations between different groups

| | Food | Chemicals | Ag Products | S&P 500 |
|---|---|---|---|---|
| Food | 1 | | | |
| Chemicals | 0.37 | 1 | | |
| Ag Products | 0.42 | 0.44 | 1 | |
| S&P 500 | 0.51 | 0.56 | 0.34 | 1 |

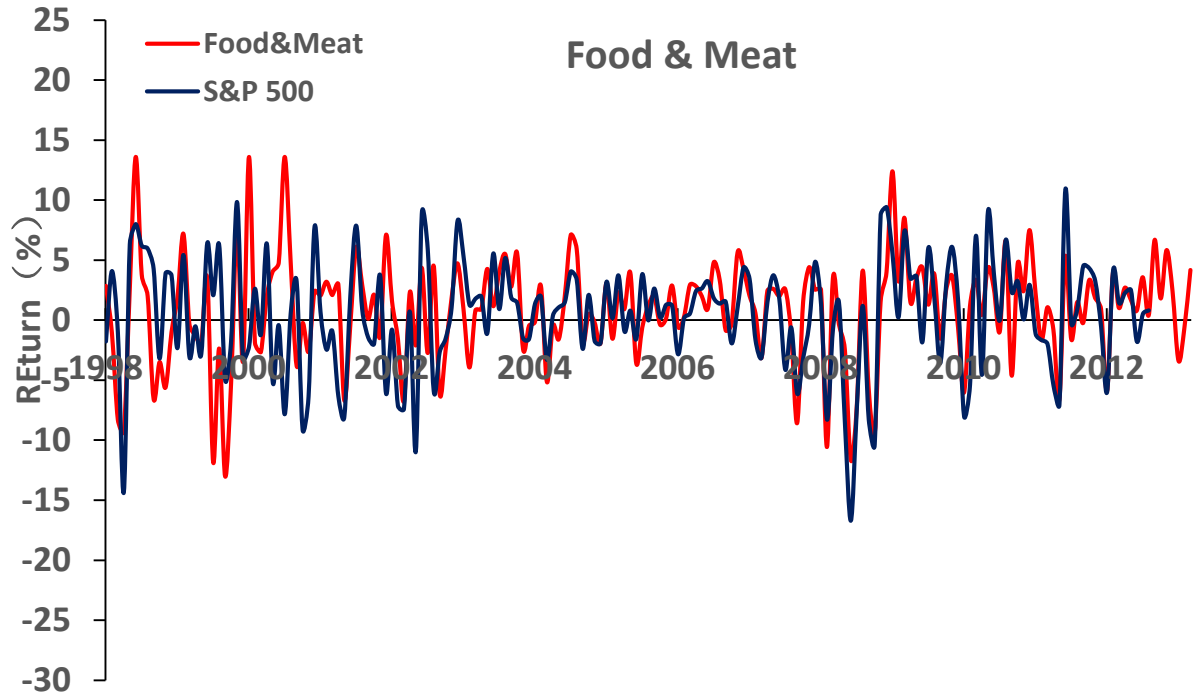
This table shows the summary statistics of return for all three industries. Agricultural chemicals has the largest standard deviation and mean. It also correlates with the S&P 500 to the biggest extent, which suggests that it might not be a good counter cyclical investment option. Food and Meat group has smallest vitality but it correlates with the S&P 500 in moderate level. Agricultural products group shows the lowest correlation with the S&P 500, but it also has lowest mean return. The correlation between different sub-industries are relatively smaller than the correlations with S&P 500 except agricultural products.

## Packaged Food& Meats

Table 4. Packaged Foods & Meats Market Capitalization by Company for 10 Largest Firms, 2013/07/31

| Name | Capitalization($MIL) | Percentage |
|---|---|---|
| NESTLE SA/AG | 217612.73 | 30.88% |
| UNILEVER NV | 68606.27 | 9.73% |
| MONDELEZ INTERNATIONAL INC | 217612.73 | 7.92% |
| UNILEVER PLC | 52146.94 | 7.40% |
| KRAFT FOODS GROUP INC | 33635.17 | 4.77% |
| GENERAL MILLS INC | 33324.72 | 4.73% |
| KELLOGG CO | 24361.35 | 3.46% |
| INDUSTRIAS BACHOCO SAB DE CV | 24102.00 | 3.42% |
| BRF SA | 18697.10 | 2.65% |
| HERSHEY CO | 15491.80 | 2.20% |

Figure 1. Return Series of Packaged Foods & Meats Market




As table 4 shows, packaged food & meats are the most fragmented industry compared to the other two. Although Nestle dominated the industry, other companies have relatively equal weight in this industry ranging from 2.2 percent to 9.7 percent. As figure 1 shows compared to S&P 500 the volatility for packaged food & meat is relatively small.

## Fertilizers and Agricultural Chemicals

Table 5. Fertilizers & Ag Chemicals Capitalization by Company for 10 Largest Firms, 2013/07/31

| Name | Capitalization($MIL) | Percent |
|---|---|---|
| MONSANTO CO | 52660.51 | 38.38% |
| POTASH CORP SASK INC | 25140.71 | 18.32% |
| AGRIUM INC | 12701.47 | 9.26% |
| MOSAIC CO | 12206.24 | 8.90% |
| CF INDUSTRIES HOLDINGS INC | 11621.04 | 8.47% |
| SYNGENTA AG | 7360.68 | 5.36% |
| TERRA NITROGEN CO -LP | 4029.74 | 2.94% |
| SOC QUIMICA Y MINERA DE CHI | 3486.12 | 2.54% |
| SCOTTS MIRACLE-GRO CO | 3100.63 | 2.26% |
| CVR PARTNERS LP | 1618.39 | 1.18% |

Figure 2. Return Series of Fertilizers & Ag Chemicals Market

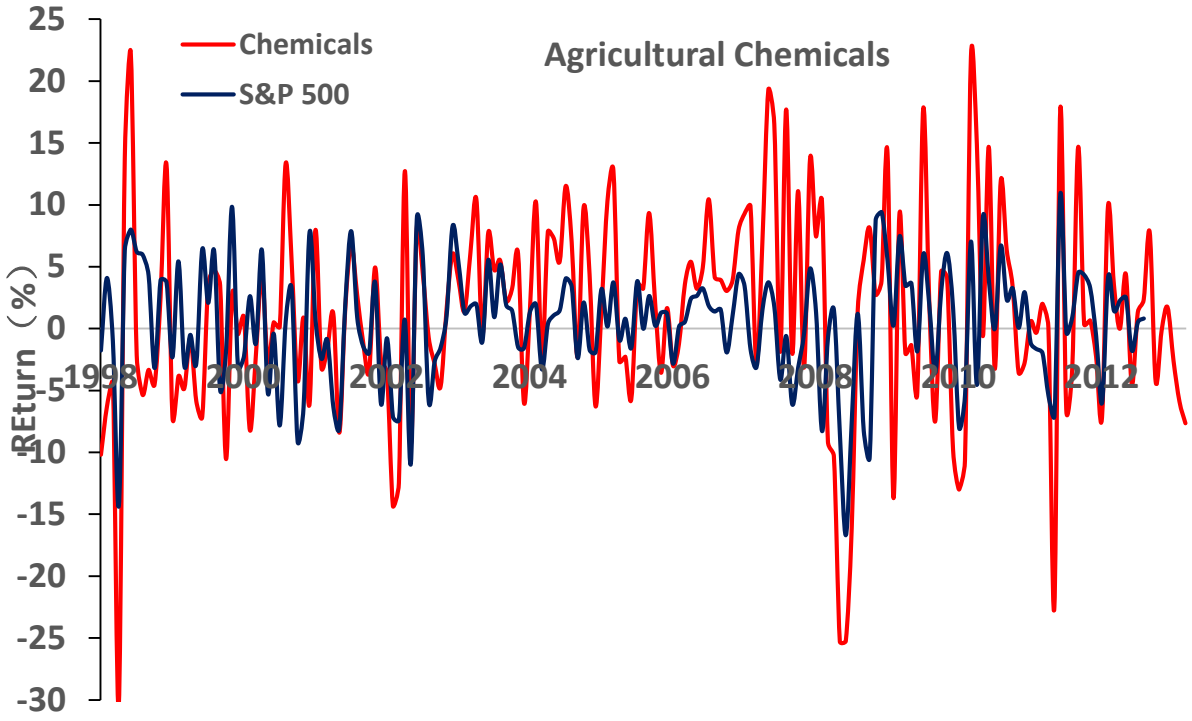



Table 5 reflected that fertilizers & Ag Chemicals relies heavily on Monsanto and Potash as the capitalization shows. The top ten companies almost account all of the market share. Figure 2 shows the return volatility is very big and the return often moves together with the general market.

## Agricultural Products

Table 6. Agricultural Products Capitalization by Company for 10 Largest Firms, 2013/07/31

| Name | Capitalization($MIL) | Percentage |
|---|---|---|
| ARCHER-DANIELS-MIDLAND CO | 24034.82 | 44.27% |
| BUNGE LTD | 11178.41 | 20.59% |
| LE GAGA HOLDINGS LTD -ADR | 8464.11 | 15.59% |
| INGREDION INC | 5206.05 | 9.59% |
| DARLING INTERNATIONAL INC | 2399.40 | 4.42% |
| FRESH DEL MONTE PRODUCE INC | 1555.76 | 2.87% |
| ALICO INC | 334.49 | 0.62% |
| LIMONEIRA CO | 298.59 | 0.55% |
| BRASILAGRO CIA BRAS DE PROP | 271.37 | 0.50% |

| | | |
|---|---|---|
| GRIFFIN LAND & NURSERIES INC | 163.75 | 0.30% |

Figure 3. Return Series of Agricultural Products Market

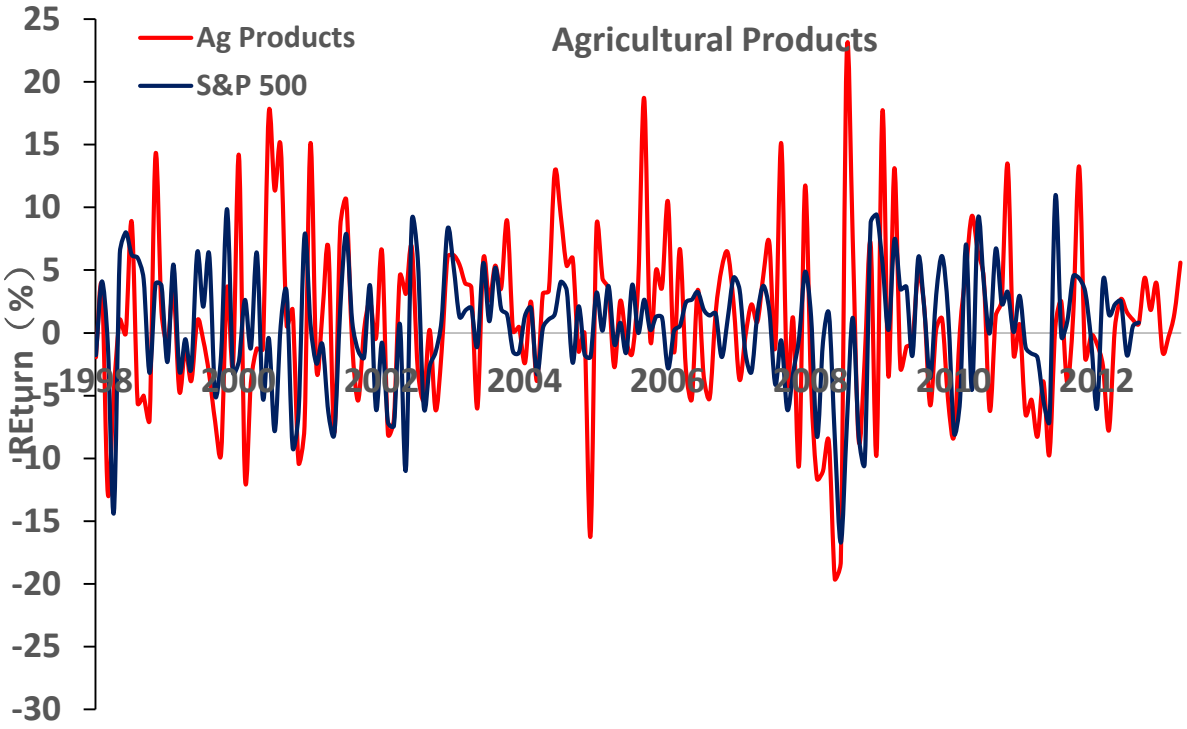



Table 6 shows that ADM and Bunge dominated agricultural products market in terms of capitalization. Last four companies in top ten companies have a weight less than one, which shows the industry return is mainly determined by ADM and Bunge. From the Figure 3 the rerun changes a lot over time and does not usually move in the same direction of the general market.

## Industry Comparison

Table 7. Simple Compounded Return ($)

| Starting Time | Food& Meat | Chemicals | Ag Products | Farmland | S&P 500 |
|---|---|---|---|---|---|
| 1998/05 | 3.93 | 5.03 | 2.61 | 6.31 | 1.73 |
| 2003/07 | 3.55 | 9.46 | 2.30 | 4.75 | 1.80 |
| 2008/07 | 1.92 | 0.65 | 0.80 | 1.88 | 1.24 |

Table 7 shows the amount of money an investor will receive if the investor invested one dollar at the beginning of each period. Due to financial crisis in 2008, the

money an investor could get back is lowest for all three industries if they entered the market at 2008. Agricultural chemicals changed the most over time, with a return of 9.46 dollars if an investor entered market in 2003. However, if an investor invested in agricultural chemicals in 2008, the investor will suffer great loss. Agricultural products remains relatively stable but the lowest return. The returns starting Food and meat group has the moderate return. But it outperformed both S&P 500 and farmland starting from 2008, suggesting that it may be a good investment option during recessions.

## Capital Asset Pricing Results

Table 8 Betas Starting Different Time

| Starting Time | Food & Meat | Chemicals | Ag Products |
|---|---|---|---|
| 1998/05 | 0.436 | 0.934 | 0.455 |
| 2003/07 | 0.641 | 1.047 | 0.649 |
| 2008/07 | 0.610 | 1.107 | 0.602 |

Table 8 shows the beta starting from different periods. Agricultural chemicals have the largest beta for all three different starting points. It is very close to 1 so agricultural chemicals group has the similar risk as the general market. The beta for other two groups are similar, which means they demonstrate similar systematic risk. The beta is around 0.45 starting from 1998 and then increased to around 0.65 starting from 2003, then it decreased a little to 0.61. The means the systematic risk for food & meat group increased. This number is less than 1 so it offers a lower systemic risk than the general market. However, as past literature suggested, beta for farmland is usually lower than 0.1 before 2002, went up to around 0.4 during 2006-2007 (Newell and Eves, 2007). Therefore, systemic risk of these three groups are larger than farmland.

## Conclusion

Over time, agribusiness stocks have larger returns generally compared to S&P 500. Fertilizers and chemicals group has the largest return compared to other two

groups but it also have the similar risk as the general market. The other two groups has relatively low return but also lower systemic risks. However, there is not enough evidence to justify that incorporating agribusiness stocks have less systemic risks than farmland.

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