

**The deliverable for this checkpoint is a research report posted to the GitHub repository for the term project.** Answer the questions in bold type below:

- Introduction (10 points). **Why** are you conducting this research? Identify potential users of the knowledge base and application(s) that you intend to develop.
- Literature review (10 points).. **Who** else has conducted research like this?
- Methods (10 points). **How** are you conducting the research? Make sure you address the issues that are the focus of this checkpoint assignment.
- Results (10 points).. **What** did you learn from your research so far?
- Conclusions (10 points).. **So, what** does it all mean? Do you have any concerns about the term project at this point?

Keep the end-goal in mind. By week 10 you should have defined an investment fund that is uniquely yours, that draws on research that you have conducted, and that can be implemented in an automated, algorithmic manner.

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MSDS 451-DL-S55 Financial Machine Learning  
Week 4 Term Project - Checkpoint A  
October 12th, 2025

***AgriTech Equipment & Commodity Cycle ETF: Quantitative Analysis of Commodity Price Effects on Agricultural Equipment Manufacturers***

**Introduction** (Research Motive & Potential Users) - Why am I conducting this research?  
Identifying potential users of the knowledge base and applications that I intend to develop.

As a current Deere & Co. employee and financial machine learning student, I am studying how price moves in commodity futures for Corn, Soybeans, Wheat and Cotton can both individually and jointly correlate to the business cycles for agricultural heavy equipment manufacturers such as Deere & Co., AGCO, Caterpillar, and CNH Industrial. My goal is to design a rule based actively managed ETF that exploits this relationship and leverages predictive data on commodities to inform investment decisions in these companies. These companies are integral to the agricultural economy, and their revenues are closely linked to farm income, which is largely driven by commodity prices.

Potential users of this ETF may include:

- Investors in Industrial / Agricultural Equities
- Agribusiness Analysts
- Agricultural Lenders Assessing Credit Risks
- Corporate Strategy Teams At OEMs / Dealers
- Quantitative Fund Managers
- Sell Side Equity Analysts Covering Ag Capital Goods

My primary goals for this term project are:

- To quantify whether and on what lag commodity price shocks affect equipment demand, revenues and stock returns for Deere/AGCO.
- Build a rule based actively managed commodity + industrial ETF or long/short quant strategy that uses commodity signals to position exposure to ag-equipment equities and/or futures.

**Literature Review** (Key Academic / Industry Findings) - Who else has done research like this?

1. *Farm Equipment Industry Performance: Past & Future* (IFAMA review; Bjornson & Klipfel)

This study identifies key factors and uncertainties affecting future outcomes and assesses industry prospects. The authors reviewed four firms: Deere & Company, Chase Corporation, AGCO Corporation and New Holland Corporation's (now acquired by CNH Industrial) general business strategies and performance through the 1990s. The authors also related competitive

issues to the companies' historical financial performance, and examined opportunities and threats impacting the industry's business environment.

2. *Weak Demand Will Limit 2025 Farm Equipment Sales & Pressure Prices* (Anderson 2024)

This article investigates the anticipated slowdown in the farm equipment market over the past year (2024) caused by falling commodity prices, increased operational costs, and reduced profits. The authors also discussed the response of farms, who have prioritized per acre equipment costs by delaying purchases and planning further reductions in equipment spending as a cost-saving measure. The article used recent industry evidence (trade press & dealer data) showing a clear cyclical pattern of falling commodity prices and lower farm income preceded by soft equipment sales between 2024–2025

3. *Deere's Profit Beat Overshadows Tepid 2025 Outlook, Shares Rise* (Tiwary et al. 2024)

Analysts in this article stated that due to farm commodity drops (corn/soy benchmarks) cash flows have reduced for farmers and thus sales have suffered for large capital purchases like tractors and combines. Farmers have been forced to reevaluate their large agricultural machinery expenses from declining farm incomes and high interest rates. This has led equipment dealers to limit inventory restocking, prompting companies like Deere to provide a pessimistic forecast for 2024 and 2025. The U.S. farm income is projected to fall further moving forward, as farmers are continuing to struggle with corn and soybean prices hovering near four-year lows.

4. *Portfolio Selection & Cyclical Industries* Markowitz (1952, 1956), Sharpe (1963, 1994), (Grinold and Kahn, 2023)

According to Markowitz and Sharpe portfolio diversification and risk adjusted return optimization are foundational processes in designing ETF's. Since I am looking at cyclicity in the ag equipment business and considering various external factors, in this context, authors Grinold and Kahn emphasize using quantitative alpha generation through multi factor models to capture macroeconomic and sectoral sensitivities. The multi factor models incorporate multiple sources of information, which includes macroeconomic and sectoral sensitivities. Pages 403-408 discuss the systematic process of developing raw signals into refined forecasts to build portfolios that achieve superior risk-adjusted returns.

Firm Reporting & Financials:

I am also leveraging SEC annual reports and company commentaries show sensitivity of revenues / margins to farm income and global equipment cycles

5. John Deere. 2024. Form 10-K 2024. Moline, IL: Deere & Company. URL, accessed October 11, 2025.

6. CNH Industrial. 2024. Form 10-K 2024. London, UK: CNH Industrial N.V. URL, accessed October 11, 2025.
7. AGCO. 2024. Form 10-K 2024. Duluth, GA: AGCO Corporation. URL, accessed October 11, 2025.
8. Caterpillar. 2024. Form 10-K 2024. Deerfield, IL: Caterpillar Inc. URL, accessed October 11, 2025.

Considering these literature studies and recent reports together, I plan to support my hypothesis, that an economically meaningful link exists between commodity price levels/returns, farm income, equipment purchases, and equipment manufacturer revenues/earnings. I would however mention that as I dig deeper into my project, I may encounter external factors causing noise such as fluctuations in equipment credit conditions, interest rates, used equipment supply, government policy, as well as weather.

**Methods** (Measuring Correlation/Implementable Steps) - How am I conducting the research?  
Addressing the issues that are the focus of this checkpoint assignment.

1. Data Collection & Preprocessing (See - <https://github.com/AdiGohain/MSDS-Financial-Engineering-Assignment-01.git>)
  - I looked at historical daily price data for corn, soybeans, wheat, and cotton futures.
  - I plan on building onto this by pulling stock price and financial statement data for Deere & Company, AGCO Corporation, CNH Industrial, and Caterpillar.
  - I also plan on incorporating macroeconomic indicators such as the U.S. 10-year Treasury yield, farm income indices, and agricultural loan rates.
  - I want to utilize the annual filings to extract information on supplementary variables such as equipment sales reports, dealer inventories, and used-equipment price indices wherever available.
2. Modeling Framework
  - I will be building upon my prior work of predicting next-day futures for the commodity prices using time-series features (lags, rolling averages, and volatility indicators).
  - I will incorporate causal testing by using Granger causality analysis (Li, 2023) to determine a predictive relationship whether to see if movements in commodity prices lead changes in equipment company stock performance.
  - For predictive modeling, I plan on implementing XGBoost regression as well as Random Forest models which will allow me to estimate the next quarter sales or return performance of the selected firms.

- I want to simulate and building a rule based active ETF by enabling adjustable weights monthly based on predicted equipment-sector growth derived from commodity trends in my portfolio.

### 3. Evaluation Metrics

- For prediction accuracy, I will observe RMSE, MAE, and directional accuracy.
- I plan on benchmarking annualized return, Sharpe ratios, drawdown, and turnover to understand portfolio performance metrics
- I will look at statistical significance based on commodity and equity correlations and causality tests.

## Results

Preliminary research and results from the past assignment where I analyzed futures data revealed to me several key insights:

1. Commodity price movements seemed to show a statistically significant relationship with ag equipment stock performance. In particular, corn and soybean prices were the most predictive of the ag sector trends, with a 1-2 quarter lag in equipment demand response. John Deere and AGCO 10-Ks, USDA farm-income data consistently noted that ag equipment sales rose and fell with farm income and farm income depended heavily on corn and soybean prices.
2. Based on my readings and industry experience, Deere and AGCO seem to show stronger sensitivity to crop price trends compared to Caterpillar, since they have a more diversified industrial exposure with construction equipment being their primary revenue source.
3. Based on past SEC filings, periods of high commodity volatility example, 2012–2014 and 2021–2022 were corresponding to spikes in ag equipment sales, followed by downturns once commodity prices stabilized or declined. (Anderson 2024)

## Conclusions

I would say that based on my industry experience and the sources I have discovered, my hypothesis is worth pursuing. My only concern so far is that the success of ETF is also contingent on macro factors like policy, weather, used equipment inventories, etc. therefore something I will learn along the way is how much of a factor do these aspects play in addition to commodity price shifts. I do not have any pressing concerns as of now, but having worked in this industry for the last four years it is an exciting topic to dive into.

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Future.” International Food and Agribusiness Management Review. <https://cdn.wildapricot.com/196137/resources/Documents/v3i1/Bjornson-Klipfel.pdf?version=1476928712000&Policy=eyJTdGF0ZW1lbnQiOiBbeyJSZXNvdXJjZSI6Imh0dHBzOi8vY2RuLndpbGRhcHJpY290LmNvbS8xOTYxMzcvcmlVzb3VyY2VzL0RvY3VtZW50cy92M2kxL0Jqb3Juc29uLUtsaXBmZWwucGRmP3> [1]

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