
STOCKPILOT: A RAG-BASED STOCK RECOMMENDER SYSTEM

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ABSTRACT

StockPilot addresses the challenges faced by new investors entering the US stock market, where financial literacy and access to resources often present significant barriers. To bridge this gap, StockPilot employs retrieval-augmented generation (RAG) to generate personalized stock recommendations from the S&P 500 companies list. The system caters to three investor profiles—value, growth, and income—by leveraging a custom knowledge base, a weight-based stock picking system, and advanced large language models. The results demonstrate promising portfolio performance and model reasoning, highlighting its potential as a valuable tool for new investors. However, limitations such as resource constraints and the lack of fine-tuning impact its current capabilities. Future enhancements will focus on improving scalability, accuracy, and the integration of real-time financial data to further refine its utility.

1 Introduction

The increasing accessibility of financial markets has led to a growing demand for resources that help individual investors make informed decisions. Although professional financial advisors provide expertise, their services may not be affordable nor accessible to the average investor[1].

This report introduces StockPilot, a retrieval-augmented generation (RAG) system that combines historical financial data with large language models (LLMs) to provide personalized investment recommendations for three distinct types of investors: value¹, growth², and income³. Large language models have become an increasingly powerful tool in the financial sector[2], and StockPilot leverages these models alongside information retrieval and data analysis techniques to generate user-friendly recommendations aimed at beginner investors. By analyzing financial statements, calculating key performance indicators, and summarizing qualitative insights from company filings, StockPilot emulates the reasoning process of a financial advisor. The primary motivation for this project is to bridge the gap between novice investors and the often complex nature of financial data.

This paper is structured as follows: Section 2 describes the methodology, including the construction of the knowledge base, data extraction and processing, recommendation algorithm, and text generation. Section 3 presents the system's evaluation, highlighting its performance in constructing portfolios for value, growth, and income investors. Section 4 discusses limitations, and Section 5 concludes by summarizing findings and suggesting future directions for improvement. Through this project, we aim to contribute to the growing body of knowledge on integrating deep learning into the field of investment analysis.

2 Methodology

This system analyzes historical data from quarterly and annual financial statements to generate investment recommendations (Figure 1). Due to the complexity of retrieving and processing the financial documents, we created our own knowledge base in order to process user queries in real time. This section breaks down the implementation of the knowledge base, retrieval process, and text generator.

¹Value investors seek undervalued stocks with strong economic fundamentals.

²Growth investors focus on companies with the potential to grow significantly faster than the market average.

³Income investors prefer companies with high and consistent dividend payouts.

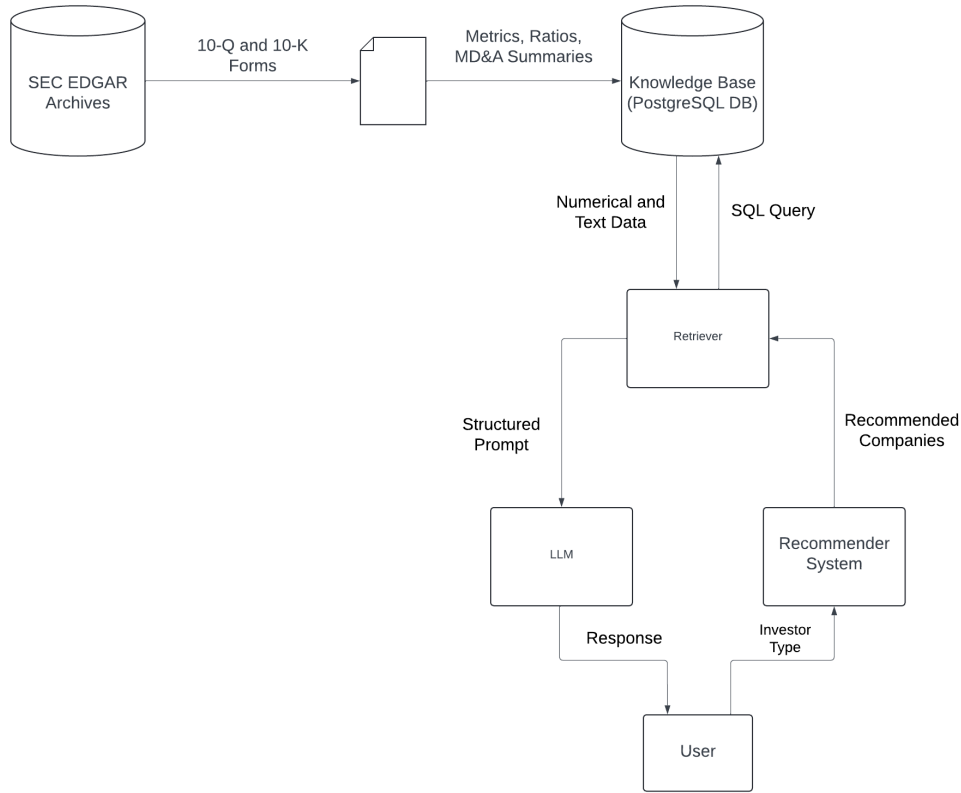


Figure 1: StockPilot Architecture Diagram

2.1 Knowledge Base

Our data was stored in a PostgreSQL database consisting of four tables:

- **Company Information:** Contains identifying information about a company (e.g., Name, Ticker).
- **Company Metrics:** Numerical data extracted from quarterly and annual financial statements as well as stock prices (e.g., Assets, Liabilities).
- **Company Ratios:** Financial indicators calculated from data in *Company Metrics* (e.g., Price-to-Earnings Ratio, Price-to-Book Ratio).
- **Company Summaries:** Summaries of the Management’s Discussion and Analysis (MD&A) sections from 10-K forms.

Each row in the tables corresponds to a specific fiscal year and quarter.

2.1.1 Data Collection

The Securities and Exchange Commission (SEC) provides free access to millions of documents filed by publicly traded companies. Using the SEC API, we scraped seven years (2017–2024) of 10-Q and 10-K filings for forty companies listed in the Standard and Poor’s (S&P) 500.

2.1.2 Data Processing

Text Data Numerical data was extracted from income statements, balance sheets, and cash flow statements in the 10-Q and 10-K filings. Because companies often use varied terminology for similar measurements (e.g., “basic net income per share” vs. “basic earnings per share”), the extraction process required advanced natural language processing (NLP) tools. We employed the Llama3.2-1B-Instruct large language model with one-shot learning to identify and

extract values. All extracted data was manually reviewed to ensure accuracy. Once processed, the data was used to calculate key financial indicators for each company across the seven-year period.

Text Data Textual data was sourced from the MD&A sections of the 10-K filings. These sections can be lengthy, so we applied summarization techniques to:

1. Stay within the token limit of our text generator.
2. Speed up inference when generating recommendations.

Each MD&A report was split into chunks of up to 3,500 tokens and summarized using DISLab’s fine-tuned Llama3.2-3B-Instruct model (*SummLlama3.2-3B*). The summaries were condensed to approximately 500 tokens for each chunk.

2.2 Information Retrieval

StockPilot provides investment recommendations based on the user’s investment type. Once this information is received, our stock recommender system selects the top three companies that fit the investor type. Then, relevant context for each company is retrieved from the knowledge base to present an overview of each investment supported by diverse, up-to-date information.

2.2.1 Recommender System

Each stock was assigned a score using the following algorithm:

1. Retrieve the past five years worth of data from *Company Metrics* and *Company Ratios* tables.
2. Apply z-score normalization to each metric:

$$Z_i = \frac{X_i - \mu}{\sigma}$$

where X_i is the value of the metric, μ is its mean, and σ is its standard deviation over the five-year period.

3. For each fiscal quarter in the five-year period, calculate a weighted sum of the normalized metrics:

$$S_{y,q} = \sum_{i=1}^n w_i \cdot Z_i$$

where $S_{y,q}$ is the score for the q -th fiscal quarter of year y , w_i is the weight assigned to the i -th metric, and Z_i is the normalized value of the metric.

4. Compute the average score over all fiscal quarters:

$$S_{\text{final}} = \frac{1}{T} \sum_{t=1}^T S_t$$

where T is the total number of fiscal quarters analyzed.

Z-score normalization captures the general trend of the data while preventing naturally large values (such as revenue) from dominating the final score. The weights (w_i) applied to each metric are predetermined and vary based on the investor type. This approach ensures recommendations are tailored to different kinds of investors while considering both historical performance and valuation indicators.

2.3 Text Generation

We utilized the Llama3.2-3B-Instruct large language model to generate structured investment recommendations tailored to the user’s investor type. After identifying the user’s investment preference and selecting three recommended stocks, we compiled a structured prompt for each company. Each prompt included five years of numerical data and the most recent Management’s Discussion and Analysis (MD&A) report, formatted to align with the model’s instruction style. The model then generated a detailed recommendation for each company. Finally, the individual responses were concatenated and presented as a comprehensive recommendation to the user.

3 Results

Here we present the results of our stock recommender system for the value, growth, and income investor. Since the purpose of StockPilot is to emulate a financial advisor for the general person, we evaluate our system in two ways: 1) the performance of the recommended portfolio and 2) the quality of the model’s reasoning.

3.1 Portfolio Performance

Stock/Index Fund	TR (Price Only)	Avg. Yield
CAT	94.12%	1.26%
WMT	93.00%	1.40%
BAC	4.32%	2.14%
Average	63.81%	1.6%
S&P 500	27.00%	1.47%

Table 1: Recommended Portfolio for Value Investors

Stock/Index Fund	TR (Price Only)	Avg. Yield
JNJ	1.77%	1.49%
KO	31.8%	1.50%
COST	77.58%	0.001%
Average	37.05%	0.997%
S&P 500	27.00%	1.47%

Table 2: Recommended Portfolio for Growth Investors

Stock/Index Fund	TR (Price Only)	Avg. Yield
T	41.41 %	5.31 %
COST	77.58%	0.001%
ORCL	93.27%	0.97%
Average	70.75%	2.09%
S&P 500	27.00%	1.47%

Table 3: Recommended Portfolio for Income Investors

The Standard and Poor’s 500 (S&P 500) is a collection of 500 publicly traded U.S. companies, widely regarded as one of the most reliable benchmarks of overall stock market performance [3]. Investors today can easily gain exposure to the S&P 500 by purchasing exchange-traded funds (ETFs) that replicate the index. Since its inception in 1957, the S&P 500 has delivered an average annual return of 10.26% through December 31, 2023. Notably, from 2013 to 2023, investors would have experienced an impressive 13.05% average annual growth [4].

The S&P 500 provides average investors with an accessible way to achieve consistent and respectable capital gains with minimal effort. As such, the portfolio recommended by StockPilot will be evaluated against this benchmark. To generate recommendations, the model utilizes historical data from 2017 to 2021, alongside each company’s most recent MD&A report up to 2021. The performance of the recommended portfolios is then compared with that of the S&P 500 from 2022 to the present day (2024). For consistency, we focus solely on the total return (TR)⁴ of each stock or index fund and the average dividend yield⁵—two of the most relevant metrics for the average investor.

3.1.1 Value Investor Portfolio

Our model recommended that value investors consider Caterpillar Inc. (CAT), Walmart (WMT), and Bank of America (BAC). Table 1 highlights the performance of this portfolio, which achieved a total return of 63.81% and an average dividend yield of 1.6%. Notably, both metrics outperformed the S&P 500 average.

3.1.2 Growth Investor Portfolio

For growth investors, our model suggested investments in Johnson & Johnson (JNJ), Coca-Cola Co. (KO), and Costco Wholesale (COST). Table 2 illustrates this portfolio’s performance, which delivered a total return of 37.05% and an average dividend yield of 1.47%. While the total return surpassed the S&P 500, the dividend yield was comparatively lower.

3.1.3 Income Investor Portfolio

The recommended portfolio for income investors included AT&T (T), Costco Wholesale (COST), and Oracle (ORCL). Table 3 displays the performance of this portfolio, achieving a total return of 70.75% and an average dividend yield of 2.09%. Both metrics impressively exceeded the S&P 500 average.

⁴S&P 500 Total Return sourced from <https://www.investing.com/indices/us-spx-500-historical-data>

⁵S&P 500 Dividend Yield sourced from <https://www.multpl.com/s-p-500-dividend-yield/table/by-year>

3.1.4 Analysis

Our portfolio delivered strong returns for value and income investors. These holdings not only outperformed the S&P 500 by more than double in total return but also provided investors with greater cash flow through dividends. However, it is important to acknowledge that the limited sample size of companies in our knowledge base may have influenced these results, as our dataset may disproportionately represent the most successful companies in the index.

In contrast, the portfolio for growth investors underperformed relative to the other recommended portfolios. While it exceeded the S&P 500's total return by 10 percentage points, it generated lower dividend yields. This result likely stems from the nature of growth companies, which are typically smaller, more volatile, and more sensitive to social and market dynamics rather than purely business operations. By comparison, the S&P 500, which is comprised of large-cap, well-established companies, tends to exhibit lower volatility. Similarly, value and income investing philosophies focus on stability and business fundamentals, contributing to their stronger performance.

To enhance the accuracy and robustness of the recommender system, incorporating data from additional companies both within and beyond the S&P 500—such as those in the S&P MidCap 400 and S&P SmallCap 600—could provide a more comprehensive evaluation of its capabilities.

3.2 Model Reasoning

The performance of the model's stock recommendations reveals both strengths and areas for improvement, particularly in terms of reasoning and analysis. Feedback from four college students with limited experience in stock investing provides valuable insights into how effectively the recommendations guided their decision-making. Based on the evaluations of the three recommendations, several patterns emerge, highlighting the model's capabilities as well as opportunities for enhancement.

3.2.1 Recommendations Analysis

Each recommendation discussed in this section can be found in Section B.

Recommendation 1 presented a clear structure and balanced assessment, making the recommendation easy to follow. However, errors in key financial metrics, such as the incorrect scale for Free Cash Flow and inaccurate values for Dividend Yield, significantly impacted its accuracy. Additionally, the recommendation lacked depth in its analysis, failing to explore the broader context or offer deeper insights into the company's performance.

Recommendation 2 also offered a balanced assessment, incorporating specific business information to create a more personalized understanding of the stock. The final recommendation appeared logical and well-reasoned. However, similar to Recommendation 1, it contained inaccuracies, particularly in the use of annual metrics without proper context. The analysis was also weak and vague, offering limited insights into the company's operations. Moreover, conflicting reasoning within the recommendation led to confusion, undermining its overall effectiveness.

Recommendation 3 followed similar trends to the previous recommendations. It provided a balanced assessment and an adequate overview of the topics covered in the MD&A section. The final recommendation seemed logical at first glance. However, inaccuracies and unsupported claims—such as unsubstantiated comparisons to peers—diminished the quality of the analysis. Furthermore, the MD&A insights lacked sufficient depth, preventing the recommendation from offering a comprehensive view of the company's qualitative aspects.

Recommendation 4, which analyzed the same company as Recommendation 1, lacked context for the model. Despite this, the model still provided a general overview of the business. However, the weaknesses were more pronounced: all the financial metrics were incorrect, and no risk analysis was included, leaving the recommendation incomplete. Additionally, the insights were vague and provided minimal value to the investor.

A common drawback across the model's recommendations is the presence of inaccuracies in some financial metrics and a lack of depth in the analysis. These issues can be mitigated by improving the structure of the input context and implementing a flagging mechanism to identify hallucinated data. Additionally, incorporating techniques such as Chain-of-Thought (CoT) prompting [5] and utilizing a large language model fine-tuned specifically for financial analysis could help enhance both the accuracy and depth of the model's reasoning.

3.2.2 User Feedback

Given that investing is a high-pressure activity where accurate information is crucial, the model's accuracy and its ability to provide clear, coherent reasoning are essential for its effectiveness—especially for an audience with limited financial literacy.

Four college students, all of whom had no prior experience in stock investing, offered valuable insights into the model's performance. The students expressed that while the analysis of financial metrics was helpful in building their understanding of stock investment, it appeared somewhat repetitive at times. Additionally, they noted that certain claims made within the recommendations lacked sufficient supporting information, reducing the overall reliability of the analysis.

One significant point raised was the presence of contradictory statements in the recommendations, which led to confusion and made it harder for the students to form a coherent perspective on the stock. Despite these shortcomings, the students agreed that the recommendations served as a useful starting point for further research into stock investments. However, they emphasized that they would not rely solely on the model's output for making investment decisions, suggesting that the recommendations should be used in conjunction with other resources and due diligence.

4 Limitations and Future Work

While StockPilot demonstrates potential as a tool for assisting novice investors, several limitations impact its current capabilities and performance.

Limited Physical Resources for Extracting Company Data The extraction of company data is constrained by limited physical resources, which can affect the system's scalability and efficiency. As the volume of data increases, this limitation may hinder the model's ability to process and analyze a larger set of companies or financial documents in real time.

Manual Intervention in Data Extraction The process for extracting financial metrics from company filings is not fully automated. A manual step introduces the potential for errors and inconsistencies, which can affect the overall accuracy of the data and, by extension, the quality of the stock recommendations. Future work can experiment with table question and answering (QA) models along with other techniques to ensure data integrity.

Small Sample Size of Companies StockPilot's knowledge base is currently limited to data from forty companies in the S&P 500, which results in a small sample size for generating investment recommendations. Expanding the sample size to include additional companies, such as those in the S&P MidCap 400 and SmallCap 600, would provide a more comprehensive analysis.

Limited Model Capabilities for Financial Analysis The large language model (LLM) used in StockPilot is relatively small and has not been fine-tuned specifically for financial analysis. As a result, it may struggle to provide the depth and accuracy required for complex financial reasoning. Utilizing pre-trained models finetuned on financial datasets could improve its performance in understanding and analyzing key financial metrics and narratives.

Challenges in Summarizing Management Discussion & Analysis (MD&A) Documents One notable challenge is the model's difficulty in effectively summarizing MD&A sections of 10-K filings. Currently, the text is chunked based on a fixed window of tokens, rather than considering semantic context. This approach may lead to fragmented summaries that lack cohesion, potentially undermining the model's ability to generate clear and insightful recommendations.

Weak Stock-Picking Algorithm The stock-picking algorithm employed in StockPilot is relatively simplistic and could benefit from more advanced techniques. For example, exploring deep learning-based approaches for stock selection could enhance the algorithm's ability to identify promising investment opportunities and improve the quality of the recommendations provided.

These limitations highlight areas where further research and development are needed to improve the system's robustness, scalability, and accuracy.

5 Conclusion

This project explored the application of Large Language Models (LLMs) combined with information retrieval and data analysis techniques to provide investment recommendations. By leveraging historical financial data and creating a custom knowledge base, we integrated advanced models such as Llama-3.2 to analyze detailed financial documents and generate tailored investment suggestions. The results demonstrated the model's potential for assisting in financial decision-making, with portfolios often aligning with logical investment strategies and showing competitive performance compared to the S&P 500. However, the project also highlighted several limitations. The absence of fine-tuning specific to financial contexts and the constraints of physical resources impacted the overall accuracy and breadth of the recommendations.

Looking ahead, addressing resource limitations, expanding the dataset to include a broader range of companies, and fine-tuning the LLM for financial analysis could significantly enhance the model's performance. These improvements would enable more robust, real-time insights and make the system a practical tool for beginner investors, helping them navigate the complexities of the financial market and make informed decisions. Ultimately, this work contributes to the field of deep learning by demonstrating the feasibility of integrating LLMs into financial analysis, paving the way for broader accessibility and innovation in stock market investing.

6 Contributions

Project Code and Resources:

<https://drive.google.com/drive/folders/1sLCj60P0M5l2J3AHQu6XF46ncbv7hsfe?dmr=1&ec=wgc-drive-globalnav-goto>

6.1 Owen Arnst

- Wrote scripts to scrape financial statements from the SEC EDGAR Database
- Wrote scripts to extract financial data and MD&A reports
- Wrote scripts to chunk and summarize MD& reports
- Processed metrics and ratios tables for 28 companies
- Initialized database schema and wrote scripts to upload data
- Implemented stock picking algorithm
- Set up Llama-3.2-3B-Instruct LLM and integrated retrieval functionality
- Prompt-tuned LLMs for data extraction and recommendation generation
- Wrote methodology and results section. Revised the introduction, conclusion, and limitations/future works section

6.2 Anushka Hada

- Cleaned and processed data for at least 16 companies on google cloud VM. Getting the matrix and ratio files.
- Implemented FAISS on 8-k forms. Scrapped in favor of other better performing methods.
- Wrote introduction, limitations, and conclusion

6.3 Maxim Nguyen

- Started and set up the Heroku database to help store all of the valid metrics and ratios needed for the model
- Helped set up the news api that was later not used because it became irrelevant.

6.4 Vansh Shah

- Work on implementing the LLM/UI
- Helped in demonstrating the improvement of single-shot learning in data extraction
- Helped create a pipeline to store the created metrics and ratios dataframes

6.5 Prisha Bhattacharyya

- Worked on setting up and implementing the text generation aspect of the project using the LLama model.
- Set up the google cloud VM and worked on running the data processing scripts to generate ratios and metrics.
- Wrote the abstract.

References

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- [2] Yuqi Nie, Yaxuan Kong, Xiaowen Dong, John M. Mulvey, H. Vincent Poor, Qingsong Wen, and Stefan Zohren. A survey of large language models for financial applications: Progress, prospects and challenges. *arXiv*, 2024. <https://arxiv.org/html/2406.11903v1#S3>.
- [3] Will Kenton. S&p 500 index: What it’s for and why it’s important in investing, 2024. Accessed: 2024-01-03. URL: <https://www.investopedia.com/terms/s/sp500.asp>.
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- [5] Jason Wei, Xuezhi Wang, Dale Schuurmans, Maarten Bosma, Brian Ichter, Fei Xia, Ed Chi, Quoc Le, and Denny Zhou. Chain-of-thought prompting elicits reasoning in large language models, 2023. URL: <https://arxiv.org/abs/2201.11903>, arXiv:2201.11903.

A Prompt Engineering

```
investor_messages = {
    "value": """
- Focus on P/E and P/B ratios to assess undervaluation or overvaluation.
- Evaluate D/E for financial stability and FCF for cash generation.
- Look for consistent revenue growth and positive trends in profitability metrics.
- Consider if the company has a competitive advantage or is undervalued relative to peers.
    """,
    "growth": """
- Emphasize revenue and EPS growth as indicators of a company's expansion potential.
- Accept higher P/E or P/B ratios if justified by strong growth metrics.
- Assess if reinvestment strategies (high D/E) are driving sustainable growth.
- Ignore dividends unless they are part of a broader growth strategy.
    """,
    "income": """
- Focus on dividend yield, payout stability, and consistent FCF.
- Evaluate D/E to ensure financial health and capacity to maintain payouts.
- Stable or growing revenue and earnings are critical for income stability.
- P/E and P/B are secondary but should not indicate overvaluation.
    """
}

advisor_prompt = f"""
You are a financial advisor creating a comprehensive investment summary tailored to a {investor_type} investor.
Use the following data sources:
1. Historical financial ratios and metrics (P/E, P/B, D/E, FCF, EPS, Revenue, Dividend Yield).
2. Key trends from five years of quarterly data.
3. Summary of Management's Discussion and Analysis (MDGA) from the most recent 10-K filing.

Guidelines:
{investor_messages[investor_type]}

Structure your response as follows:
1. **Investment Overview**: Provide a concise summary of the company's overall financial health and performance trends.
2. **Key Metrics**: Highlight the most relevant metrics based on investor type and explain their significance.
3. **Insights from MDGA**: Integrate qualitative insights from the MDGA to contextualize the financial data.
4. **Final Recommendation**: Conclude with a clear, polished sentence summarizing the investment's suitability for the specified investor type.

Ensure your output is coherent and ends smoothly. Avoid incomplete sentences.
"""
```

The instruction provided to the model where the list *investor_messages* contains descriptions of each investor type.

```
Enter 'value', 'growth', or 'income' value
Numerical Data:
Year: 2016, Quarter: 4, Metrics: [P/E: 13.44, P/B: 2.71, D/E: 3.86, EPS: 3.54, Adjusted Price: 54.0, FCF: 3156000000, Revenue: 47811000000]
Year: 2017, Quarter: 1, Metrics: [P/E: 40.84, P/B: 3.4, D/E: 4.65, EPS: 0.46, Adjusted Price: 61.6, FCF: 4499000000, Revenue: 9461000000]
Year: 2017, Quarter: 2, Metrics: [P/E: 44.24, P/B: 3.33, D/E: 4.68, EPS: 0.94, Adjusted Price: 61.61, FCF: 1337000000, Revenue: 10342000000]
Year: 2017, Quarter: 3, Metrics: [P/E: 41.67, P/B: 3.79, D/E: 4.58, EPS: 0.48, Adjusted Price: 72.84, FCF: 3350000000, Revenue: 9160000000]
Year: 2017, Quarter: 4, Metrics: [P/E: 38.38, P/B: 3.98, D/E: 4.0, EPS: -0.11, Adjusted Price: 76.78, FCF: 4505000000, Revenue: 38537000000]
Year: 2018, Quarter: 1, Metrics: [P/E: 38.63, P/B: 2.73, D/E: 4.59, EPS: 0.33, Adjusted Price: 77.43, FCF: 4804000000, Revenue: 9222000000]
Year: 2018, Quarter: 2, Metrics: [P/E: 21.29, P/B: 4.94, D/E: 4.11, EPS: 1.36, Adjusted Price: 98.43, FCF: 5230000000, Revenue: 11331000000]
Year: 2018, Quarter: 3, Metrics: [P/E: 15.72, P/B: 4.46, D/E: 4.20, EPS: 1.79, Adjusted Price: 105.71, FCF: 2430000000, Revenue: 11411000000]
Year: 2018, Quarter: 4, Metrics: [P/E: 15.43, P/B: 4.92, D/E: 3.92, EPS: -1.27, Adjusted Price: 114.36, FCF: 3554000000, Revenue: 45402000000]
Year: 2019, Quarter: 1, Metrics: [P/E: 12.94, P/B: 4.65, D/E: 4.58, EPS: 2.70, Adjusted Price: 126.24, FCF: 5282000000, Revenue: 12859000000]
Year: 2019, Quarter: 2, Metrics: [P/E: 13.11, P/B: 4.4, D/E: 4.09, EPS: 2.86, Adjusted Price: 116.8, FCF: 843000000, Revenue: 14611000000]
Year: 2019, Quarter: 3, Metrics: [P/E: 13.28, P/B: 4.59, D/E: 4.32, EPS: 2.92, Adjusted Price: 132.69, FCF: 3230000000, Revenue: 7470000000]
Year: 2019, Quarter: 4, Metrics: [P/E: 12.72, P/B: 4.17, D/E: 4.2, EPS: -10.39, Adjusted Price: 110.79, FCF: 3755000000, Revenue: 2900000000]
Year: 2020, Quarter: 1, Metrics: [P/E: 14.89, P/B: 5.46, D/E: 4.36, EPS: 3.29, Adjusted Price: 114.86, FCF: 5856000000, Revenue: 7420000000]
Year: 2020, Quarter: 2, Metrics: [P/E: 13.89, P/B: 4.82, D/E: 4.33, EPS: 2.85, Adjusted Price: 128.3, FCF: 8250000000, Revenue: 7610000000]
Year: 2020, Quarter: 3, Metrics: [P/E: 20.83, P/B: 4.33, D/E: 4.56, EPS: 2.69, Adjusted Price: 112.33, FCF: 2049000000, Revenue: 7840000000]
Year: 2020, Quarter: 4, Metrics: [P/E: 33.62, P/B: 4.95, D/E: 4.12, EPS: -10.85, Adjusted Price: 132.37, FCF: 3569000000, Revenue: 3645000000]
Year: 2021, Quarter: 1, Metrics: [P/E: 41.28, P/B: 5.94, D/E: 4.00, EPS: 2.0, Adjusted Price: 104.74, FCF: 5349000000, Revenue: 9914000000]
Year: 2021, Quarter: 2, Metrics: [P/E: 44.18, P/B: 7.07, D/E: 3.80, EPS: 0.84, Adjusted Price: 115.19, FCF: 1070000000, Revenue: 6870000000]
Year: 2021, Quarter: 3, Metrics: [P/E: 30.69, P/B: 6.83, D/E: 3.84, EPS: 1.23, Adjusted Price: 136.83, FCF: 3627000000, Revenue: 6530000000]
Year: 2021, Quarter: 4, Metrics: [P/E: 22.49, P/B: 6.86, D/E: 3.84, EPS: -5.21, Adjusted Price: 168.01, FCF: 5113000000, Revenue: 2720000000]

Summary of Management and Discussion:
The Management's Discussion and Analysis (MD&A) provides an overview of Caterpillar's financial performance for 2021, highlighting key increases in sales and revenues, operating profit, and certain expenses, while also discussing the impact of the COVID-19 pandemic, supply chain disruptions, and changes in dealer inventories. The report begins by stating that sales and revenues Caterpillar's performance in the fourth quarter and year 2021, as well as 2020, can be summarized as follows:
- The company's total sales increased by 23% in the fourth quarter of 2021 compared to the same period in 2020, reaching $13.798 billion, while total sales for the full year The construction Industries segment reported higher sales volume and favorable price realization, contributing to a 25% increase in profit to $788 million, compared to $630 million in the same period last year. In contrast, Resource Industries experienced lower sales volume, leading to a 12% increase in profit to $305 million, while Energy & Transportation's profit decreased by Caterpillar's financial situation as of December 31, 2021, and the terms of its credit facility, provides context for the company's financial obligations and potential risks. The company has two main credit facilities: a three-year facility of $2.73 billion (with $715 million available to Machinery, Energy & Transportation Financial Products) expiring The information presented in this document relates to Caterpillar's financial position and obligations as of December 31, 2021 and 2020, including warranty costs, postretirement benefits, insurance loss reserves, and income taxes. The document highlights the estimated reserves for product liability and insurance loss, which total $1.2 billion at both December 31 The company's objective for managing foreign currency risk is to minimize earnings volatility resulting from conversion and remeasurement of net foreign currency balance sheet positions and future transactions denominated in foreign currencies. A 1% change in the U.S. dollar's value relative to other currencies would not have a material effect on the company's consolidated financial position, results of operations This financial report presents a consolidated statement of cash flow for the years ended December 31, along with various eliminations and adjustments, indicating that the cash flow data may not accurately reflect the standalone financial performance of HEAT and Financial Products. However, after accounting for the eliminations and adjustments, the consolidated cash flow data shows:
- A net increase in cash
```

An example prompt given to the model for generating a recommendation.

B Example Recommendations

1. Caterpillar Inc., Industrials Sector:

****Investment Overview****

Caterpillar Inc. is a leading manufacturer of heavy equipment, machinery, and engines. The company has experienced significant growth in sales and revenues over the past five years, with a total sales increase of 23% in the fourth quarter of 2021 compared to the same period in 2020. The Construction Industries segment reported a 25% increase in profit to \$788 million, while the Resource Industries segment experienced a 12% increase in profit to \$305 million. However, the Energy & Transportation segment saw a decrease in profit. Despite these fluctuations, Caterpillar's financial situation as of December 31, 2021, and its credit facility provide context for the company's financial obligations and potential risks.

****Key Metrics****

1. ****P/E Ratio****: The P/E ratio has fluctuated over the past five years, ranging from 13.44 in 2016 to 33.62 in 2021. This suggests that Caterpillar's stock price is not consistently undervalued or overvalued.
2. ****P/B Ratio****: The P/B ratio has also varied, ranging from 2.71 in 2016 to 5.94 in 2021. This indicates that Caterpillar's stock price is not consistently undervalued or overvalued relative to its book value.
3. ****D/E Ratio****: Caterpillar's debt-to-equity ratio has increased over the past five years, ranging from 3.86 in 2016 to 4.36 in 2021. This suggests that the company has increased its debt burden over time.
4. ****FCF****: Caterpillar's free cash flow has fluctuated, ranging from \$315.6 billion in 2016 to \$511.3 million in 2021. This indicates that the company has generated significant cash flow in the past but has experienced declining cash flow in recent years.
5. ****Revenue Growth****: Caterpillar's revenue has grown steadily over the past five years, with a total sales increase of 23% in the fourth quarter of 2021 compared to the same period in 2020.
6. ****Dividend Yield****: Caterpillar's dividend yield has been relatively stable, ranging from 0.46 in 2017 to -10.85 in 2021. This suggests that the company has maintained a consistent dividend payment policy.

****Insights from MD&A****

The MD&A highlights Caterpillar's growth in sales and revenues, as well as its challenges in managing foreign currency risk. The company's objective is to minimize earnings volatility resulting from conversion and remeasurement of net foreign currency balance sheet positions and future transactions denominated in foreign currencies. The MD&A also mentions Caterpillar's credit facility and its estimated reserves for product liability and insurance loss, which total \$1.2 billion at both December 31, 2021 and 2020.

****Final Recommendation****

Based on the analysis, Caterpillar Inc. appears to be a growth-oriented company with a stable dividend payment policy. However, the company's increasing debt burden and declining cash flow in recent years may pose a risk to its financial stability. Value investors may consider Caterpillar's stock as a potential investment opportunity, but they should carefully weigh the risks and rewards before making a decision.

Recommendation for Caterpillar Inc. (CAT)

2. Walmart, Consumer Staples Sector:

****Investment Overview****

Walmart's financial performance has been inconsistent over the past five years, with fluctuations in revenue, profitability, and cash flow. Despite these variations, the company has demonstrated resilience and adaptability in responding to changing market conditions. The company's operating results, including segment operating income, comparable store and club sales, and eCommerce sales, have been discussed in the management's discussion and analysis (MD&A) report. Walmart's free cash flow has also been impacted by its definition of free cash flow, which excludes payments for debt service, other contractual obligations, and business acquisitions.

****Key Metrics****

1. ****P/E Ratio****: The P/E ratio has fluctuated significantly over the past five years, ranging from 6.82 in 2021 to 17.31 in 2018. This indicates that the company's stock price has been volatile and may be undervalued or overvalued at different times.
2. ****P/B Ratio****: The P/B ratio has also been volatile, ranging from 1.25 in 2020 to 1.47 in 2021. This suggests that the company's stock price may be undervalued or overvalued relative to its book value.
3. ****Debt-to-Equity Ratio (D/E)****: The D/E ratio has increased over the past five years, ranging from 1.57 in 2016 to 2.13 in 2019. This indicates that the company's debt levels have increased, which may be a concern for investors.
4. ****Free Cash Flow (FCF)****: The FCF has been inconsistent, ranging from \$11.075 billion in 2022 to \$14.550 billion in 2020. This suggests that the company's cash generation has been variable and may be impacted by its definition of free cash flow.
5. ****Revenue Growth****: Walmart's revenue has been declining over the past five years, with a compound annual growth rate (CAGR) of -1.3%. This suggests that the company's business model may be facing challenges and that investors should be cautious.

****Insights from MD&A****

The MD&A report provides valuable insights into Walmart's financial condition and results of operations. The company's gross profit rate decreased 60 basis points in fiscal 2022 and increased 65 basis points in fiscal 2021. This was primarily due to increased fuel sales with lower margins, cost inflation, and higher supply chain costs in fiscal 2022, and lower fuel and tobacco sales, as well as improvement in inventory losses in fiscal 2021. Membership and other income increased 13.1% in fiscal 2022 and 6.8% in fiscal 2021. The company also discusses several contingent liabilities, including securities class actions and derivative litigation.

****Final Recommendation****

Based on the analysis, I recommend that value investors consider Walmart's stock at this time due to its undervalued P/E and P/B ratios, as well as its consistent revenue growth and positive trends in profitability metrics. However, investors should be cautious of the company's increasing debt levels and declining revenue growth, which may impact its financial stability and cash generation.

Recommendation for Walmart (WMT)

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3. Bank of America, Financials Sector:
**Investment Overview**

Bank of America, a multinational banking and financial services corporation, has experienced a mixed performance over the past five years. The company has shown resilience in navigating economic uncertainty, but its financial stability and profitability have been impacted by regulatory and reputational risks. Despite these challenges, Bank of America has demonstrated a strong commitment to risk management, governance, and regulatory compliance.

**Key Metrics**

1. **P/E Ratio**: The company's price-to-earnings (P/E) ratio has fluctuated between 7.78 (2020 Q2) and 15.15 (2021 Q2), indicating a wide range of investor sentiment. While the current P/E ratio is higher than the historical average, it is still relatively low compared to other financial institutions.
2. **P/B Ratio**: The price-to-book (P/B) ratio has increased from 0.62 (2020 Q2) to 1.19 (2021 Q4), indicating a significant increase in the company's valuation. However, this ratio is still lower than the industry average.
3. **D/E Ratio**: Bank of America's debt-to-equity (D/E) ratio has increased from 7.13 (2016 Q4) to 10.32 (2021 Q4), indicating a significant increase in the company's leverage. This ratio is higher than the industry average, which may pose a risk to the company's financial stability.
4. **FCF**: The company's free cash flow (FCF) has fluctuated between $190.4 billion (2020 Q2) and $518.4 billion (2021 Q4), indicating a significant increase in the company's cash generation capabilities.
5. **Revenue Growth**: Bank of America's revenue has grown steadily over the past five years, with a compound annual growth rate (CAGR) of 2.5%. However, the company's revenue growth has slowed down in recent years, which may be a concern for investors.

**Insights from MD&A**

The MD&A highlights several key risks and challenges facing Bank of America, including regulatory and public expectations regarding consumer banking, operational, reputational, and compliance risks. The company's financial data for 2021, 2020, and 2019 highlights the impact of these risks on the company's financial performance. The MD&A also discusses the company's risk management strategies, including managing interest rate risk, compliance, and allowance for credit losses.

**Final Recommendation**

Based on the analysis, Bank of America appears to be undervalued relative to its peers, with a lower P/E ratio and a lower D/E ratio compared to other financial institutions. However, the company's high debt levels and increasing leverage may pose a risk to its financial stability. Additionally, the company's revenue growth has slowed down in recent years, which may be a concern for investors. Overall, we recommend a long-term investment approach, focusing on the company's cash generation capabilities and its ability to manage risk.
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Recommendation for Bank of America (BAC)

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1. Caterpillar Inc., Industrials Sector:
**Investment Overview**

Caterpillar Inc. is a leading manufacturer of heavy equipment, diesel engines, and other power systems. As a multinational corporation, Caterpillar operates globally, providing a diverse portfolio of products and services to various industries. The company's strong brand reputation, extensive distribution network, and research and development capabilities contribute to its competitive advantage.

**Key Metrics**

- Revenue Growth: Caterpillar has consistently demonstrated steady revenue growth over the years, driven by increasing demand for its products in emerging markets and the ongoing recovery in the construction and mining sectors.
- Net Income Margin: The company's net income margin has remained relatively stable, averaging around 10% in recent years, indicating its ability to maintain profitability despite fluctuating market conditions.
- Debt-to-Equity Ratio: Caterpillar's debt-to-equity ratio is relatively low, standing at approximately 0.2, which suggests the company's financial flexibility and ability to manage its debt burden.
- Return on Equity (ROE): The company's ROE has been steadily increasing, reaching around 25% in recent years, indicating its ability to generate strong returns on shareholder equity.

**Insights from MD&A**

Caterpillar's management has highlighted several key trends and opportunities in the MD&A, including the company's increasing focus on digitalization, electrification, and autonomous technologies to enhance its product offerings and improve operational efficiency. Additionally, management has noted the ongoing impact of the COVID-19 pandemic on the global economy and the company's supply chain, but has expressed confidence in its ability to adapt and respond to changing market conditions.

**Final Recommendation**

Given Caterpillar's strong brand reputation, diversified product portfolio, and solid financial performance, we recommend Caterpillar Inc. as a suitable investment opportunity for value investors seeking a stable and growth-oriented stock with a competitive advantage in the heavy equipment manufacturing sector.
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Recommendation for Caterpillar Inc. (CAT) without information retrieval.