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Equities: An Exploration of Sector Rotation: S&P 500

Finance 496 – Prof. Frenzel

Part 1: Overview and Executive Summary

Miller Capital ("The Firm") is in the process of developing a sector rotation model based on a 100% allocation to 10 sectors of the S&P 500 Index, excluding Real Estate. Many investors and firms have a diversified portfolio including U.S. Equities, or stocks, (the reason for utilizing the 10 S&P 500 indexes), Fixed Income (Bonds), Real Estate and International Equities. However, most of the portfolio of Miller Capital is allocated to U.S. Equities which is the specialty of the firm. The portfolio is based on a long-only equity strategy, which aims to optimize Sharpe Ratio based on Sector Allocation within the S&P 500 indexes.

For those less experienced with the investment environment, a brief overview: the S&P 500 is a broad stock market index that tracks the top 500 most valuable publicly traded companies listed on United States exchanges. Within this index, companies are categorized into different "sectors," which silo companies into different products and services. Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Telecommunications and Utilities. A famous company within the consumer staples company might be Campbell's, the soup company. An iconic information technology company is Apple, a well-known industrials company would be Lockheed Martin. And so on and so forth. Other key terminology will be revisited and explained throughout.

Part 2: Economic Thesis and Rationale:

The firm decided to pursue a strategy that incorporated for the following reasons:

1. An investment strategy of sector rotation allows an investor to capitalize on changes in the business cycle, dependent on a certain economic indicator(s), or on the individual investor's market analysis. If the investor, or the model they are utilizing indicates that a time of economic growth is coming, then they will allocate more of their funds, or capital, to sectors and industries that perform very well in times of economic growth. Conversely, if an investor and/or model predicts a time of economic contraction or recession, they may recommend or decide to allocate more capital to sectors and industries that outperform the broader market in times of economic stress.

2. Using sector rotation, the investor minimizes what is known as unique risks, or risks inherent to an individual company. By investing in a sector or industry at large, the investor almost automatically achieves some level of diversification of their assets, and while may not be able to achieve returns

equal to those of high-flying companies in the sector, they will mitigate potential downsides from underperforming companies simultaneously, and assuming their model is right, allocating more capital to a sector that will be outperforming the broader market anyway.

3. A sector rotation strategy can serve to generalize the performance of an overall sector. Like the second economic thesis point above, sector rotation is beneficial in that the economics and economic drivers for companies in the same sector are usually very similar, if not the same. It drives home the idea that, while possible, it is very difficult for a company to succeed if the underlying economic principles upon which their business model is founded are not favorable. To simplify, assume that tomorrow that Apple released the greatest iPhone ever made. While undoubtedly impressive, if the underlying financial conditions of Apple's consumers were unfavorable, circumstances change. Principles such as Maslow's Hierarchy of needs would suggest that customers would forego the iPhone. Alternatively, they would focus on essentials like nutrition and shelter, and delay the gratification of the latest and greatest invention until a later time.

Well-established financial services firms like Fidelity, DWS (formerly of Deutsche Bank), Fisher Investments and State Street Global Advisors have all published research supporting the ideas of a sector rotation strategy or model. Fidelity discusses the cyclicality of the economy in their research, while DWS focuses more so on searching for value within the sectors. Fisher provides an in-depth analysis of each sector as well as specific economic indicators for each of them. State Street is unique in that they offer a suite of Exchange Traded Funds (ETFs) available to retail investors. Direct links to the sources can be found below in the references.

Part 3: Sector Breakdown

For the rotation between sectors, Miller Capital will provide a brief overview of each sector, and why they are classified as such in the ensuing tests. All definitions are derived from those at Fisher Investments. Sectors are classified as either growth or defensive. Growth sectors (in a nutshell) tend to outperform when there are positive underlying economic fundamentals, whereas defensive, or countercyclical stocks,

outperform the market when the opposite is true (hence the names defensive and countercyclical).

Consumer Discretionary: Products and Services within this sector are usually catered directly to the end user, and are economically elastic, to an extent. This may include subsectors like retail, jewelry, and durable goods, like cars and refrigerators. Historical performance of this sector is highly levered to economic growth and spending, which is why this sector is classified as a **growth** sector.

Consumer Staples: Staples are goods used by the end consumer that are considered more inelastic in nature (think household paper products, frozen foods, etc. Because of their inherent inelasticity, and overall relative economic stability, consumer staples are classified as a **defensive** sector.

Energy: Although diversifying more recently into renewable energy which is more levered to economic performance, the energy sector has historically been defined by different types of oil companies, such as Exxon Mobil. Energy is classified as a **defensive** sector in this research, as it is not broadly correlated to market movements, more so to underlying commodity prices. However, this is a gross generalization, and means that the designation of this sector as defensive is a bit of a red herring, but Miller Capital felt it more appropriate than assigning it a growth sector.

Financials: Companies in this sector provide financial services, from banking and lending to financial technology and beyond. A famous example? J.P. Morgan. Wells Fargo. Bank of America. This sector is interesting, in that it has a very high correlation to broader market movements. Since an increase in financial services activity can mean investors are gearing up for activity, frequently financial services rise and fall with major indexes. Because of this, the firm decided to designate it a **growth** sector.

Health Care: As the name implies, this sector includes companies providing products and services related to health care. Since viruses and bacteria don't really have a sense of how stock markets work, you tend to get sick irrespective of how much you've gained in your portfolio. Since the products and services are inelastic, the sector is designated as countercyclical, or **defensive.**

Industrials: Arguably the most diverse of the sectors, industrials encompass many different industries, mostly involved in some way with the conversion of raw materials into products and/or services in some way. Transportation, aerospace and defense, and

janitorial services all fall within the industrials sector. As mainly business to business offerings, the Industrials sector is sensitive to economic shifts, since firms tend to buy more when underlying economics are favorable. Consequently, Miller Capital assigns this as a cyclical, or **growth** sector.

Information Technology: The fastest growing sector in recent years, information technology represents a service or product that simplifies something or another. This could be a device, a software, an attachment, or innovation. The designation of this sector has already been given away a bit, hasn't it? **Growth.**

Materials: The materials sector involves the sourcing of raw materials and chemicals from the earth. This is an extremely economically sensitive industry, since they rely a great deal on debt to finance their very expensive operations and equipment costs. Although they have high exposure to commodity prices, they are very heavily reliant on the supply and demand of their product offerings. This is assigned a **growth** sector designation.

Telecommunications: Companies in the telecommunications sector monetize the electronic signals that enable mass communication in some form or another, whether it be through infrastructure or more recently, cloud services. This sector used to have a much more elastic product offering but has become almost commoditized in recent years. In the age of information, telecommunications are assigned a **defensive** designation.

Utilities: You want your power on? You want your water to run? You pay your utilities bill. Need we elaborate? This is a highly inelastic product and service offering. Utilities is a **defensive** sector.

Part 4: Introducing the Factor, and the Goal of the Portfolio

Now, we have our sectors. It's time to construct the model. Miller Capital decided to utilize Google Colab, a Python interface, to build this factor portfolio. But how do we know when to rotate? Here is where we introduce our factor: The Consumer Price Index (CPI). For all intents and purposes, CPI serves as a proxy for inflation. When considering economic analysis (especially in the United States), the Federal Reserve often uses CPI to gauge whether the economy is overheating and tries to keep it at around a 2% target. If the CPI rises, the Federal Reserve may decide to act and raise interest rates to curb

economic activity, and historically has often resulted in a recessionary economic environment. It is, for this reason, that Miller Capital decided to use CPI as the factor for the portfolio. Miller Capital decided to structure the model for the portfolio based on CPI change month-over-month (when CPI data is released by the Bureau of Economic Analysis). If the M-o-M change was positive after aiming for a 2% base (in which capital would be distributed equally among the sectors), then the model would increase. The opposite would happen if CPI change M-o-M were negative: the model would increase allocation to growth sectors, since a decreasing inflation rate means undervalued growth sectors, and potential incoming economic growth. If Cpi increased M-o-M, then each of the defensive sectors would be overweighted by 2% each, with the growth sectors being underweighted by 2% each. The opposite was the case when CPI decreased M-o-M.

Part 5: The Benchmark

Now, we need something to compare the portfolio to (the benchmark). For this analysis, we assume a traditional 60/40 portfolio. For those who may be unfamiliar, a 60/40 portfolio is a famous and frequently used portfolio style that constitutes 60% equity holdings (stocks) and 40% fixed income (bonds) holdings. While by no means a perfect strategy, it was selected as a benchmark due to its widespread use and general success in allocating into riskier and less-risky investments.

Part 6: Original Testing and Results

When first exploring this strategy, Miller Capital attempted to understand how an optimal sector rotation strategy would have performed as a buy and hold, with perfect hindsight. This strategy was originally built out in excel, using a solver tool to allocate among the sectors for a period from Jan 01, 2010, to Dec 31, 2019. For the optimization process, Miller Capital built a covariance matrix (pictured here).

	HEALTHCARE	INFOTECH	UTILITIES	CONSDISCR	CONSSTAP	TELECOM	FINANCIALS	MATERIALS	INDUSTRIALS	ENERGY
HEALTHCARE	0.00037756	0.0003197	0.000159	0.00031084	0.0001994	0.00021	0.00034455	0.0003211	0.000324496	0.00032
INFOTECH	0.000319669	0.0005625	0.000153	0.00044116	0.0002302	0.000245	0.00044636	0.0004591	0.000444887	0.00044
UTILITIES	0.000158834	0.0001529	0.00033	0.00015563	0.000175	0.000173	0.00015017	0.0001531	0.000170403	0.00016
CONSDISCR	0.000310836	0.0004412	0.000156	0.00047101	0.0002265	0.00026	0.00044389	0.000433	0.000431381	0.00042
CONSSTAP	0.000199357	0.0002302	0.000175	0.00022652	0.0002425	0.000203	0.00023018	0.0002198	0.000234475	0.00022
TELECOM	0.000209765	0.0002449	0.000173	0.00026039	0.0002029	0.000428	0.00028788	0.0002608	0.000272834	0.00029
FINANCIALS	0.000344554	0.0004464	0.00015	0.00044389	0.0002302	0.000288	0.00066449	0.000525	0.000524243	0.00052
MATERIALS	0.000321149	0.0004591	0.000153	0.00043304	0.0002198	0.000261	0.00052501	0.0006575	0.000523855	0.00057
INDUSTRIALS	0.000324496	0.0004449	0.00017	0.00043138	0.0002345	0.000273	0.00052424	0.0005239	0.000545023	0.00051
ENERGY	0.000323562	0.0004375	0.00016	0.00042014	0.0002242	0.00029	0.00051644	0.0005654	0.000507527	0.00079

Following the construction of the matrix, the infrastructure for the optimization was built out, where weights were assigned to the individual sectors, and so the weights once optimized would sum to 100% (effectively, the fund utilizing the strategy is assumed to allocate 100% of its funds into the strategy). Miller Capital then calculated average returns for each sector, to be used as a proxy in the optimization calculation. Following this, the following metrics were calculated: Weekly Return, Weekly Variance, Weekly Standard Deviation, Total Return, and Total Standard Deviation. The firm decided to optimize the ideal buy and hold portfolio based on Sharpe Ratio.

	weight	return
HEALTHCARE	0.246171183	0.0024747
INFOTECH	0.185234203	0.0031053
UTILITIES	0.167615008	0.0015589
CONSDISCR	0.36301698	0.0029984
CONSSTAP	0.037962627	0.0017757
TELECOM	0	0.0011117
FINANCIALS	0	0.0021955
MATERIALS	0	0.0015852
INDUSTRIALS	0	0.0022787
ENERGY	0	0.0005041
10	1.000000000	

Weekly Ret	0.00260158
wkly variance	0.000314893
weekly stdev	0.017745222
total return	1.352821859
total st dev	0.404653322
rfr	0.03
sharpe ratio	**3.269025083**

When Calculating Sharpe Ratio, which the calculation for the optimization for the portfolio was based on, Miller Capital assumed a risk-free rate of 3%. When optimized, Miller Capital found a Sharpe Ratio of 3.27.
Within this calculation, the optimal asset allocation was as follows:

25% Allocation to Health Care
19% Allocation to Information Technology
17% Allocation to Utilities
36% Allocation to Consumer Discretionary
4% Allocation to Consumer Staples
0% allocation was determined for the following sectors:
Telecommunications, Financials, Materials, Industrials, and Energy.

What follows is the tuition behind these results:
When maximizing Sharpe Ratio, the optimizer would seek to expand additional returns per unit of risk. Information Technology and Consumer Discretionary are highly levered to overall economic performance, with Information Technology being more so, and Consumer Discretionary performance towing the market line a bit closer. Healthcare, Utilities and Consumer Staples are more defensive sectors, and typically outperform in a bear market. They are less volatile and mitigate some risks in the event of an economic slowdown or contraction.

This was a sufficiently attractive result to encourage Miller Capital to pursue the strategy further. However, this first test run was based purely on a perfect scenario basis, with no rebalancing based on a factor. In the second round of tests, the firm tried something a bit different, to observe how the portfolio of sector's would behave under a non-fundamental indicator: moving averages.

Part 7: Second Round of Tests: Moving Averages

In this sector rotation portfolio model, short (50-day) and long (200-day) moving averages are used to detect momentum and guide investment decisions. A short moving average that exceeds the long moving average signals a buy opportunity, indicating upward momentum, while the opposite scenario suggests a sell, indicating downward momentum. These signals, derived from the moving averages, help determine optimal entry and exit points in different sectors, aiming to capitalize on their expected performance. The strategy utilizes these trends along with Sharpe ratio optimization to allocate investments across sectors efficiently, attempting to maximize returns relative to risk.

This version of the model (the first coded in Colab/Python), represents more of a momentum strategy than a rotation based on economic indicators. It is less of a marriage of qualitative and quantitative investing, which is the goal of Miller Capital. Instead, it was much more of a quantitative model, and now the goal was to merge the first two strategies and incorporate an economic factor as well. (Spoiler alert, it did not result in how Miller Capital thought it would).

Part 8: Before the Final Model: Data Cleaning and Sourcing

As we approach a discussion of the end results, Miller Capital feels it is prudent to be transparent about the collection and cleaning of the data. All data used in this analysis was sourced from Bloomberg Terminals. The data for each portion of the test was analyzed for the time frame from Jan 01, 2000, to Dec 31, 2019. All price data is initially input into a data frame in Excel as the ending price data from said week (for the sector prices and for the benchmark index prices, S&P 500 Index and LBUSTRUU Index U.S. bond index). For CPI, data is released monthly by the Bureau of Economic Analysis. To account for this, when new CPI data was released, the number was rolled forward week-over-week to match the index and sector data frequency. Consequently, the portfolio model is "rebalanced" monthly. Finally, the portfolio model calculated daily changes in each sector and normalized the initial values to 0, to ensure a simpler visual and numerical analysis could be conducted at the conclusion of the tests. Cumulative returns were tabulated, and then displayed. From the above data and model, the model calculated the following portfolio metrics.

Part 9: Final Test Results

METRICS	BENCHMARK	PORTFOLIO
Total Return	141.82%	159.68%
Annualized Return	4.52%	4.89%
Sharpe Ratio	0.62	0.37
Volatility (Ann.)	16.60%	35.42%
Max Drawdown	-31.71%	-73.20%
Beta (To B.M.)		1.95
Alpha (To B.M.)		17.86%

The visualized returns of the portfolio compared to the benchmark can be found here (Cumulative Portfolio Returns in Blue, Benchmark Returns in Green):
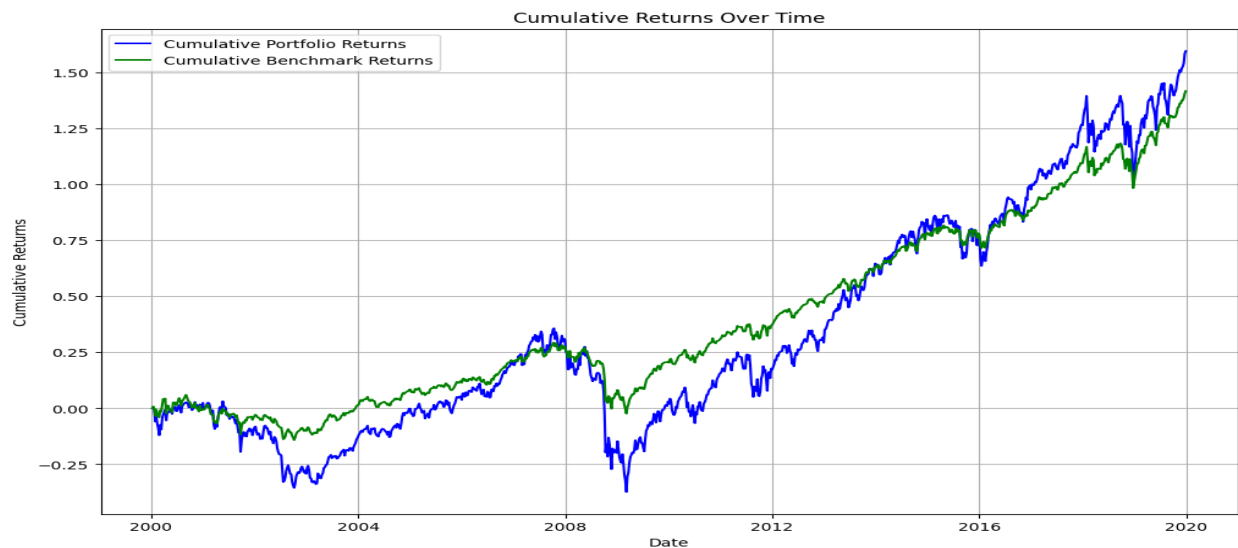

Part 10: Analysis of Portfolio Results

While the new portfolio was able to generate alpha over the benchmark, it came with significant drawbacks. When rebalanced based on changes in CPI, the portfolio was significantly more volatile and assumed unnecessary risk to generate said alpha (excess returns divided by the units of risk of the portfolio is known as the *Sharpe Ratio*. Since the portfolio had a lower Sharpe Ratio than the benchmark, this indicates that, based on additional risk taken, the portfolio would not have been the optimal choice. Needless to say, a portfolio comprising of exclusively S&P 500 stocks would've outperformed the portfolio on both a returns basis and a return-risk basis.

When observing the portfolio returns visually, it becomes clear that in times of economic stress, such as the early 2000s and the 2008 financial crisis, the portfolio significantly underperforms the benchmark portfolio, and outperforms the benchmark in times of economic growth and relative stability. While this is not damning evidence of the strategy's failure in terms of robustness, it certainly opens the door to discussion of potential improvements to be made.

Part 11: Monte Carlo Analysis

Distribution of Final Portfolio Values After One Year
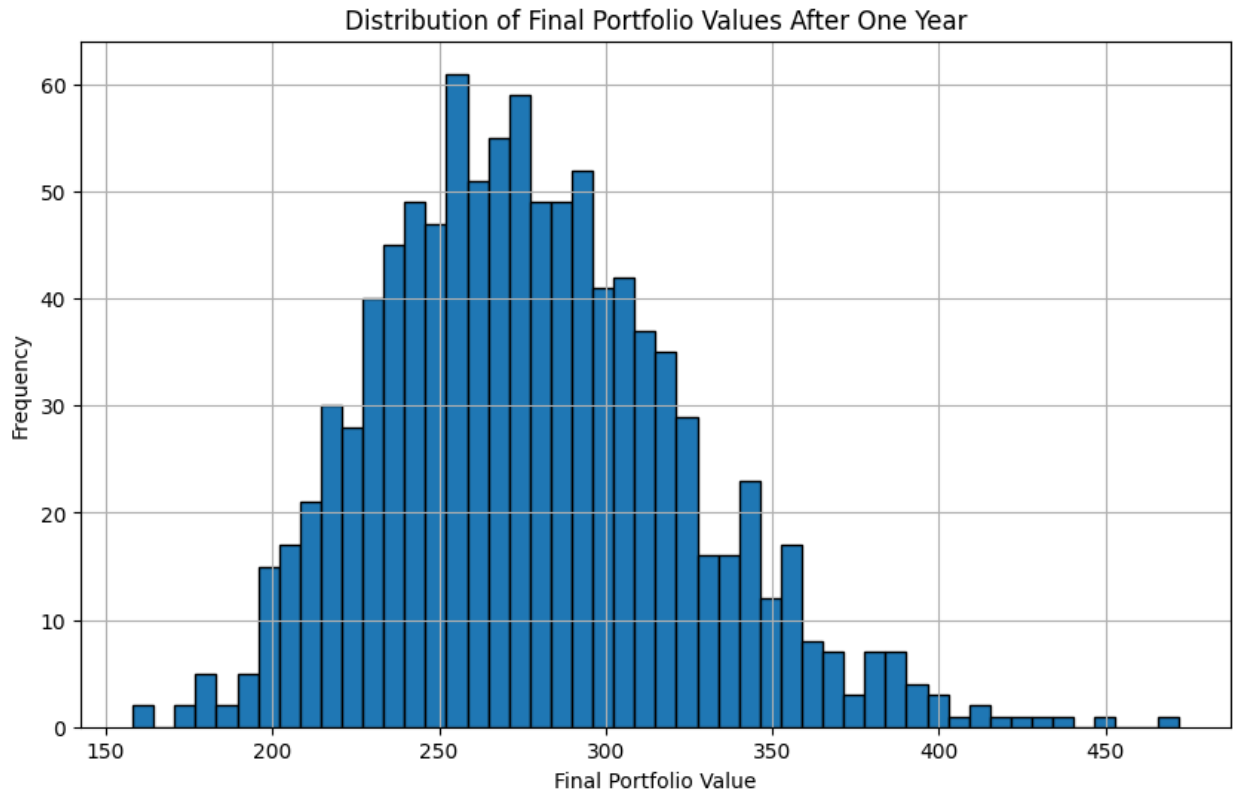
Pictured above is Monte Carlo Analysis, which was utilized to forecast the expected returns of the portfolio for one year after it concluded. A slightly long-left tail is observed. The forecasts were higher than what transpired in fiscal year 2020.

Part 12: Pitfalls of the Final Portfolio, and Possible Future Improvements

One factor: A glaring shortcoming of the strategy is the use of a sole factor for rebalancing/adjusting the weights of the portfolio. While Miller Capital was planning to utilize PCE as a secondary indicator for the portfolio, the firm found a great deal of correlation and similarity between CPI and PCE, with CPI frequently overshadowing the changes in PCE changes, so the premise of including PCE was eventually abandoned. While it could be used in the future as a supplementary indicator, Miller Capital feels at this time that its use as a primary indicating factor is not appropriate. The normalization of the factor also to a slightly higher value may be prudent: inflation rarely crept below 2%, so there is a significant possibility that growth sectors were neglected throughout the model. Building out the codebase to adapt for more economic indicators is recommended to test robustness and resilience to economic strife in the future.

A second debilitating factor in the model is that it only incorporates along-only equity strategy. This means that, if the market and/or the model were predicting an economic contraction, there would be no means to capitalize on the expected downside. An incorporation of a short-selling strategy, even utilizing academic assumptions, could prove fruitful.

The designations of Growth vs Defensive sectors were assumptive to an extent and may have altered potential outcomes of the model. For instance, CPI was likely not an applicable indicator in many ways for energy, or for periods of growth in the market. Again, here we would recommend incorporating more factors to diversify the risk of one sole factor determining portfolio allocations. Speaking of diversification, it would be highly recommended installing more risk-neutral assets into the portfolio to diversify risk and provide other growth opportunities. For instance, the real estate sector was left out of this analysis due to its similarity to the financials sector and because of its non-equity-like behavior at times. This was meant to be a study in the behavior of equity sectors. Diversification is always preferable, and bringing in other asset classes would likely improve both the overall performance and the metrics of the portfolio.

Part 13: Current Economic Analysis, and Outlook for the Strategy

Current market trends indicate some causes for concern among investors. Sticky inflation has prompted the U.S. Federal Reserve to change course and begin pushing the narrative of higher interest rates for longer. Based on historical information, if CPI were still high above 2% as it is (somewhat) right now, then the recommendation would be to allocate more towards defensive sectors. However, this analysis is investor-specific, and analysis beyond one economic factor, like CPI or GDP is recommended. Other trends, however, point toward some irrationality in the market, and perhaps even a higher risk tolerance among investors, as they prepare to deploy capital even in a higher interest rate environment. Then again, more bearish sentiment arises from other economic indicators like retail sales data (a good individual indicator for a sector like consumer discretionary), and low consumer confidence (published by the University of Michigan).

Sources and References

https://corporatefinanceinstitute.com/resources/career-map/sell-side/capital-markets/healthcare-sector/

Bloomberg

4 Institutions:
Fidelity
DWS (Deutsche)
Fisher Investments (10 Sector Reports, One Linked Here)
State Street Global Advisors
*Note: Generative AI was utilized in the construction of the codebase.