SUSTAINABLE VALUE INVESTING USING THE BLACK-LITTERMAN MODEL

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Introduction

In an era characterized by unprecedented technological advancements and rapid societal changes, our modern world is experiencing an acceleration of change like never before. Drawing upon discussions shared in our classes, we recognize the inherent growth potential of ESG-focused startups. However, we also acknowledge the cyclicality of growth stocks, and we understand that growth doesn't always equate to superior returns. Value stocks often offer compelling opportunities. In response to this resulting uncertainty propelled by the rapid pace of growth, this paper proposes the integration of a traditional value investing strategy with Environmental, Social, and Governance (ESG) investing. By implementing the Black-Litterman model, we have optimized our portfolio to reflect market weightings, ensuring a diversified investment approach. Then by using the performance metrics of this optimized portfolio, we scrutinized its returns to gain insights into the effectiveness of our methodology.

Investment Strategy

Our investment strategy combines a traditional value investment approach of passive screening merged with ESG scoring. This focus is derived from the underlying approach that integrates traditional value investing to identify undervalued stocks along with a focus on long-term ESG considerations.

Traditional Value Investing

The realm of value investing aims to identify undervalued stocks that sell at a discount to their intrinsic value. This strategy is based on the underlying presumption that the market does not always reflect a company's true worth due to various factors, which include factors such as market volatility and investor sentiment. Investors expect the market to eventually recognize the true value of the stock and fix its mispricing. Historically, value investing has shown success, driven by its outperformance and resilience during periods of market downturns and the cyclical nature of the market (Markowicz, 2018). As quoted on the performance of the Russell 1000 Value Index, value stocks consistently demonstrate a tendency to mirror the performance of growth stocks, with an added cushion of stability. Traditional Value Investing entails 3 main strategies: Passive Value Investing; Contrarian Investing; and Activist Value Investing (Detailed in Appendix 1)

Environmental, Social, and Governance Factors

While the concept of ESG investing originated in the early 1960s, it was further substantiated in the mid-2000s when ESG factors were increasingly correlated to investment returns and a much more predictable market (United Nations, 2004). ESG investing has since seen exponential growth in recent years which is primarily derived from the increasing prevalence and awareness of issues such as climate change, humanities, social equality, and corporate governance (Depresio, 2023). Today, experts forecast that ESG assets are expected to soar to $50 trillion by

2025, accounting for over a third of the projected $140.5 trillion in total global assets under management (Amir, 2023).

Traditional value investing has its drawbacks, such as the risk of falling into value traps, where undervalued companies fail to realize their full potential, leading to declining stock prices (Stefan, 2019). Additionally, the value proposition driven by value investing relies on market inefficiencies, which become harder to exploit as markets become more efficient. Moreover, there has been an increase in fear and skepticism surrounding ESG investing with the term "ESG" often misunderstood and politicized (Binnie, 2023). Hence, our investment strategy aims to mitigate the downsides of traditional values investing and the skepticism surrounding ESG by incorporating a dual approach. We aim to combine rigorous value investing principles through comprehensive value and ESG screens to identify undervalued companies with strong ESG practices– encompassing sustainability practices, and good social governance principles. This approach not only aims to promote the long-term performance of the portfolio but will also increase resilience across the cyclicality of the market.

Implementation of Investment Strategy

Our investment strategy employs passive value investing to screen for specific financial metrics customized to align with the objectives of the pension fund. To do that, we utilized a set of 'Value Screens' (Appendix 2) with the following criteria:

- **Current Price to Book Ratio (P/B) < 1**
    - A low P/B ratio tells that the company's market value is lower than its net asset value. Low price to book ratio is generally regarded as a reliable indicator for undervalued companies (Damodaran, 2012)
- **Current Price to Earnings Ratio (P/E) < 18**
    - A low P/E ratio means that a stock's price is low relative to its earnings. A low P/E ratio is essential for picking undervalued companies as it implies that a stock is at a discount relative to its earnings.
- **Current Enterprise Value/ EBITDA Adjusted <= 10**
    - EV/EBITDA helps in assessing how efficiently a business operates concerning its valuation while also accounting for its debt levels. A low EV/EBITDA ratio indicates strong operational earnings in comparison to the company's overall value, suggesting both operational profitability and an efficient use of capital (Ganupa, 2020).
- **Dividend Indicated Yield - Net > 2**
    - High dividend yield stocks ensure that the pension fund receives stable and reliable cash flows necessary for fulfilling pension payouts. Companies that regularly distribute high dividends are typically well-established and financially sound, helping in reducing the potential risk of investment.

After following the initial screening process, we focused our search on North American equities, resulting in a screening of 1200 securities. We then sorted this data based on their respective Bloomberg ESG scores. Finally, we curated a final stock portfolio consisting of 9 securities (Appendix 3) across North America equipped with strong ESG practices according to their BESG scores. Combining value screens with ESG scores helps in further aligning our value proposition to the pension fund's values and objectives.

Black Litterman Model Integration

Our portfolio uses the Black Litterman model to assign weights to the screened stocks. The standard mean-variance efficient weights calculated from the efficient market hypothesis are adjusted to take into account investor views to produce the final weights in our investment strategy. Quantitatively, each investor view comes in the form of a score, ranging from 0 to 1. In our application, these represent value scores, derived from four different value indicators: price-to-earnings ratio, price-to-book ratio, enterprise value to earnings before interest, taxes, depreciation, and amortization ratio (EV/EBITDA) and dividend yield. The score can be thought of as a confidence level resulting from a particular indicator.

For example, for the price-to-book ratio, a function was designed to initialize the score as 1, and slowly decay to 0 as the ratio increases if the company develops and our value-investing strategy is realized. On the contrary, if the price-to-book ratio decreases, the function liquidates the position rather quickly and with a tight margin of error. It is this design of scoring functions that allows our portfolio to quickly respond if a company does not perform as expected by our value investing strategy. The equally weighted combination of scores for the four aforementioned indicators serves as a failsafe and a way of reducing volatility -- an alignment of the stock's performance in all four is needed for any significant changes to occur to the weights.

In-Depth ESG Analysis

The screening was supplemented with an in-depth ESG analysis of the top three most heavily weighted stocks in our portfolio. The initial ESG screen using scores from Bloomberg is relatively general and focused on managing downside risk. Our analysis (Appendix 4) focused heavily on governance factors because, based on class discussions, good governance often leads to positive environmental and social outcomes as well. Each of the top three heaviest-weighted stocks, Posco Holdings (NYSE: PKX), Prudential Financial (NYSE: PRU), and Signet Jewelers (NYSE: SIG) demonstrated excellence in a different area of Governance, which speaks to the diversification of our portfolio from an ESG performance lens.

Introduction to Benchmark

We used the iShares Russell 1000 Value Index ETF as our benchmark as it aligns closely with the composition and objectives of our portfolio which focuses on undervalued stocks with high ESG ratings. The Russell 1000 Value Index encompasses a broad spectrum of companies across

various sectors and industries which offers institutional investors, and pension funds like yourself with diversification benefits (iShares, n.d.). By selecting this index, not only do we ensure that our benchmark represents the overall market which focuses on undervalued stocks, but also those companies with notable sustainability practices in their value proposition. This guarantees the capability of our portfolio's performance to be evaluated within the context of a wider market dynamic.

Portfolio Performance

Our analysis detailed in Appendices 12 & 13 shows that our equally weighted portfolio has consistently underperformed the benchmark index. This trend is primarily due to the benchmark's heavy exposure to sectors that have shown consistent growth throughout the years. Despite this, our portfolio has seen moments of outperformance, notably achieving close to 23.23% outperformance against the benchmark propelled by the strength exhibited by select stocks within the Materials and Consumer Discretionary sectors. This strong outperformance underscores our effectiveness in structuring our strategic security selection and sector rotation within our investment approach. Our security selection has shown resilience and enhanced returns even within an equally weighted portfolio.

In contrast, our Black-Litterman model-generated adjusting weights portfolio has consistently outperformed our benchmark, as outlined in Appendices 7 & 8. Over the 5-year period, our portfolio managed to secure a 67.75% outperformance in comparison to the benchmark index, driven notably by the performances within the Consumer Discretionary and Healthcare sectors (122% and 282.79% respectively). This is no different than our performance within a shorter-term horizon. Over a 3-year period and the past year, our portfolio demonstrated a 17.50% and 51.12% outperformance against the benchmark, primarily led by the Consumer Discretionary Sector.

Portfolio Risk & Mitigation

As outlined in Appendix 9, our portfolio, with limited stock diversification, exhibits a higher total risk as compared to our benchmark. There consists an active risk of 14.70 which signifies a moderate to high level of active management risk, as expected due to our underlying value proposition. As previously mentioned, while our portfolio aims for higher potential returns due to the utilization of the Black-Litterman Model, they also entail increased volatility. Despite this, our value and ESG-focused approach maintains factor risks comparable to the benchmark. As outlined in Appendices 10 & 11, these risks include Beta Risks, Residual Volatility, Size, Valuation, and Earnings Yield.

The high ***Beta*** risk in our portfolio exhibits a high sensitivity to market movements, offering the potential for increased returns during market expansion but also enhanced volatility. To mitigate this risk, we have implemented a low correlation factor within our security selection to enhance

downside protection against market volatility. Driven by our focus on investing in undervalued stocks, our portfolio also faces high ***Residual Volatility.*** While it is true that this will exhibit greater volatility, we believe that this exposure will provide us with future opportunities for active management to generate alpha through our strategic stock selection and risk management strategies that we have implemented.

Additionally, our portfolio's exposure to ***Size*** risk greatly reflects our strategic allocation across varying market capitalizations. Our focus on smaller to mid-sized companies is driven by the outlook of growth potential which will be of an advantage for investors in securing long-term potential in outperforming the market. Our portfolio also faces heightened ***Valuation*** risk due to the relative market cap of our security selection. We aim to mitigate downside risk and capture upside potential to emphasize long-term value creation for our investors.

Lastly, our portfolio's exposure to ***Earnings Yield*** risk emphasizes our investment philosophy of investing in undervalued companies with strong earnings potential. This view positions us for enhanced growth and valuation expansion. Our focus on undervalued opportunities supports long-term shareholder value and a stable cash flow for the pension fund.

Conclusion

This memorandum has presented an innovative investment strategy that integrates traditional value investing principles with ESG considerations. This approach delivers sustainable long-term returns while addressing the evolving needs of investors. Through the implementation of the Black-Litterman model, we have optimized our portfolio to reflect market weightings, ensuring a diversified investment approach that balances risk and return. Our portfolio's performance proves the effectiveness of our methodology, with both equally weighted and Black-Litterman model-adjusted portfolios demonstrating significant outperformance against the benchmark. Despite challenges such as increased market efficiency and skepticism surrounding ESG investing, our strategy has shown resilience and the ability to capitalize on opportunities across various sectors and market conditions.

Looking ahead, our commitment remains steadfast in delivering stable outperformance for our investors while mitigating portfolio risks through a forward-thinking approach that combines value and ESG investing. By doing so, we are committed to protecting investors from market downturns, enabling sustained wealth accumulation, benefiting from market cyclicality, and providing the pension fund with the competitive edge to navigate the complexities of the modern investment landscape.

Appendix

Appendix 1: Value Investing Strategies

Passive Investing	A strategy that uses financial metrics such as low price to earnings, low price to book, and high dividend yields to filter for undervalued stocks (Damodaran, 2012)
Contrarian Investing	A strategy which focuses on going against prevailing market trends and looking for undervalued stocks that the market has neglected (Chen, 2022)
Activist Value Investing	a strategy that entails identifying poorly run companies and acquiring a high equity stake in them to push for change within the company (Wall Street Prep, n.d.)

Appendix 2: Value Screening Detailed Criteria

Screens	Explanation
Current Price- to- Book (P/B) Ratio < 1	A low P/B ratio indicates that the company's market value is lower than its net asset value This ratio acts as a reliable indicator to assess undervalued companies (Damodaran, 2012). A P/B ratio < 1 is based on the fact that the stock price is below the book value of the company.
Current Price to Earnings (P/E) Ratio < 18	A low P/E ratio signifies that a stock's price is low relative to its earnings. A low P/E ratio indicates that companies are selling at a discount relative to their earnings. A P/E Ratio < 18 is used to screen for stocks with a lower-than-average P/E ratio of 20 (Stash, 2022).
Current Enterprise Value/EBITDA (adj) <= 10	A low EV/EBITDA ratio is necessary to indicate strong operational earnings in comparison to the company's overall value, this suggests both operational profitability and an efficient use of capital (Ganupa, 2020). EV/Ebitda < 10 are seen as healthy (Maverick, 2022).
Dividend Indicated Yield - Net > 2	High dividend yield stocks ensure that the pension fund receives stable and reliable cashflows necessary for fulfilling pension payouts. Companies that regularly distribute high dividends are typically well-established and financially sound, helping in reducing the potential risk of investment.

Appendix 3: Portfolio Composition Black Litterman Model (**9** Final Security Selection)

Black Litterman Model Stock Selection				
Ticker	**Name**	**Company Description**	**Sector**	**Sub- Sector**
TSQ US Equity	TOWNSQUARE MEDIA INC	Townsquare Media, Inc. is a digital media and digital marketing solutions company. The Company's integrated and diversified products and solutions enable local, regional and national advertisers to target audiences across multiple platforms, including digital, mobile, social, video, streaming, e-commerce, radio and events.	Communication Services	Advertising Agencies
PRU US Equity	PRUDENTIAL FINANCIAL INC	Prudential Financial, Inc. is a financial services provider and global investment manager. The Company offers a range of financial products and services, including life insurance, annuities, retirement-related products and services, mutual funds, and investment management.	Financial Services	Insurance - Life
SPTN US Equity	SPARTANNASH CO	SpartanNash Company is a food solutions company. It is engaged in distributing grocery products to a diverse group of independent and chain retailers, its corporate-owned retail stores, and United States military commissaries and exchanges; as well as operating a fresh produce distribution network and its Family private label brand.	Consumer defensive	Food Services
ODP US Equity	ODP CORP/THE	The ODP Corporation is a holding company that provides business services and supplies, products and digital workplace technology solutions to small, medium-sized, and enterprise businesses.	Consumer Cyclical	Specialty Retail
NWL US Equity	NEWELL BRANDS INC	Newell Brands Inc. is a global consumer goods company. The Company operates in three segments: Home and Commercial Solutions, Learning and Development, and Outdoor and Recreation.	Consumer Defensive	Household & Personal Products
SIG US Equity	SIGNET JEWELERS LTD	Signet Jewelers Ltd is a Bermuda-based holding company. The Company is a retailer of diamond jewelry. Its segments include North America, International and Other. The North America segment operates across the United States and Canada	Consumer Cyclical	Luxury Goods
OMI US Equity	OWENS & MINOR INC	Owens & Minor, Inc. is a global healthcare solutions company providing essential products and services that support care from the hospital to the home. The Company operates through two segments: Products & Healthcare Services and Patient Direct.	Healthcare	Medical Distribution
PKX US Equity	POSCO HOLDINGS INC	Posco Holdings Inc, formerly Posco, is a Korea-based company principally engaged in the manufacture and distribution of steel products. The Company operates its business through four segments. The Steel segment produces and sells steel products such as hot rolled steel, cold rolled steel, stainless steel, among others	Basic Materials	Steel
KT US Equity	KT CORP	KT Corp is a Korea-based company that mainly provides telecommunication services. The Company operates its business through four segments. The Information and Communications Technologies segment is engaged in providing telecommunication services to individual, home, corporate customers and the convergence business.	Communication Services	Telecom Services

Appendix 4: ESG analysis of the top three most heavily weighted stocks in our portfolio

	Posco Holdings (PKX)	**Prudential Financial (PRU)**	**Signet Jewelers (SIG)**
Industry	Steel	Insurance	Diamond Jewellery
Refinitiv ESG Rating	85/100	70/100	63/100
Overall Governance Score	**73**	**62**	**82**
Management Score	***73***	***53***	***86***
Board Gender Diversity, Percent	31	71	90
Total Senior Executives Compensation	95	94	70
Shareholders Score	***86***	***73***	***98***
Equal Shareholder Rights	51	54	53
Director Election Majority Requirement	78	77	62
CSR Strategy Score	***54***	***85***	***39***
CSR Sustainability Reporting	59	76	58
CSR Sustainability External Audit	61	94	86

Appendix 5: Portfolio Stock Weights from Black Litterman Model

	Stocks Weights								
Date	KT	NWL	ODP	OMI	PKX	PRU	SIG	SPTN	TSQ
2018-03-31	0.12343	0.07114	0.10297	0.05715	0.21504	0.16938	0.1133	0.05956	0.08804
2018-06-30	0.12436	0.07129	0.11049	0.05999	0.21297	0.15723	0.11195	0.06222	0.08949
2018-09-30	0.12281	0.07345	0.11022	0.06183	0.21172	0.16388	0.10934	0.05647	0.09028
2018-12-31	0.12363	0.07832	0.09903	0.06092	0.20872	0.18277	0.11052	0.04991	0.08617
2019-03-31	0.12242	0.08633	0.09596	0.06205	0.20149	0.18251	0.11434	0.05033	0.08455
2019-06-30	0.10766	0.09047	0.09441	0.06489	0.20618	0.17748	0.12252	0.05391	0.08248
2019-09-30	0.11165	0.09176	0.09662	0.05843	0.20012	0.18276	0.12584	0.05623	0.07661
2019-12-31	0.11342	0.09382	0.09831	0.05604	0.19708	0.17933	0.1331	0.05317	0.07572
2020-03-31	0.10237	0.10322	0.09015	0.04406	0.19178	0.24208	0.12789	0.0238	0.07465
2020-06-30	0.09756	0.1091	0.07894	0.04446	0.18675	0.26197	0.12987	0.01839	0.07296
2020-09-30	0.09315	0.10931	0.07392	0.04702	0.18076	0.27231	0.13553	0.01882	0.06918
2020-12-31	0.08538	0.10628	0.07258	0.04497	0.16998	0.29219	0.13671	0.02074	0.07117
2021-03-31	0.09097	0.09098	0.08651	0.04637	0.1793	0.26613	0.13495	0.02174	0.08304
2021-06-30	0.09226	0.08896	0.07389	0.04658	0.18703	0.26815	0.13211	0.0222	0.08882
2021-09-30	0.09553	0.09083	0.07197	0.04861	0.19584	0.26867	0.12953	0.01631	0.08271
2021-12-31	0.09672	0.09165	0.06955	0.04939	0.1988	0.26819	0.12851	0.01681	0.08038
2022-03-31	0.1012	0.08683	0.07146	0.05756	0.19647	0.24081	0.14556	0.03242	0.06769
2022-06-30	0.10787	0.08069	0.08075	0.06076	0.2109	0.21906	0.13794	0.04162	0.06041
2022-09-30	0.10967	0.09095	0.08656	0.06135	0.21002	0.18935	0.1419	0.04492	0.06527
2022-12-31	0.11425	0.09375	0.08264	0.07408	0.21014	0.17167	0.14197	0.04833	0.06316
2023-03-31	0.11033	0.09412	0.08332	0.07802	0.19812	0.17368	0.14723	0.05001	0.06517
2023-06-30	0.10751	0.10114	0.07918	0.0845	0.20044	0.17174	0.14432	0.05095	0.06023
2023-09-30	0.10343	0.0976	0.07555	0.09355	0.21747	0.16398	0.1477	0.05228	0.04843
2023-12-31	0.10123	0.10123	0.07486	0.09219	0.2278	0.15544	0.14397	0.04836	0.05494
2024-03-31	0.10231	0.11774	0.07424	0.08779	0.23201	0.14941	0.13083	0.04733	0.05834

Appendix 6: Normalized Average Value Factors from Black Litterman Model

	Averaged Scores								
Date	TSQ	PRU	SPTN	ODP	NWL	SIG	OMI	PKX	KT
3/31/2018	0.88784	0.87881	0.884978	0.898766	1	0.838534	0.845772	0.888244	0.863208
6/30/2018	0.99928	0.89644	0.869664	0.799082	0.938656	0.83264	0.833716	0.894898	0.885034
9/30/2018	0.918044	0.892733	0.898486	0.734761	0.705684	0.842517	0.820162	0.895477	0.839813
12/31/2018	0.939076	0.883218	0.898995	0.881981	0.845763	0.869048	0.84051	0.970027	0.914966
3/31/2019	0.894518	0.898204	0.945801	0.918119	0.508163	0.876052	0.855561	0.906062	0.929575
6/30/2019	0.838438	0.995304	0.905942	0.994583	0.509182	0.863109	0.844096	0.812219	0.665893
9/30/2019	0.933132	0.952864	0.859337	1	0.504813	0.878913	0.844367	0.840653	0.836184
12/31/2019	0.90429	0.945564	0.84716	0.936733	0.505379	0.836245	0.851899	0.872683	0.894838
3/31/2020	0.926882	0.909683	0.930894	0.760476	0.496983	0.896463	0.866018	0.875142	0.905869
6/30/2020	0.879991	0.878288	0.878222	0.751699	0.499285	0.904587	0.841386	0.865232	0.849094
9/30/2020	0.827428	0.82865	0.860682	0.73897	0.424729	0.837593	0.837284	0.87037	0.804616
12/31/2020	0.762502	0.620945	0.821879	0.726278	0.433026	0.770407	0.86745	0.849087	0.74645
3/31/2021	0.496959	0.861075	0.819358	0.5	0.63647	0.799078	0.863667	0.828635	0.737833
6/30/2021	0.446965	0.860065	0.779514	0.695643	0.676225	0.81916	0.848662	0.795908	0.738162
9/30/2021	0.630284	0.882335	0.837631	0.71278	0.711769	0.861552	0.862214	0.765811	0.72801
12/31/2021	0.639126	0.901914	0.833293	0.722565	0.686086	0.862659	0.920004	0.758119	0.746396
3/31/2022	0.677817	0.866969	0.833929	0.721565	0.687625	0.86588	0.897306	0.737081	0.741914
6/30/2022	0.709736	0.912968	0.864676	0.727338	0.715714	0.916121	0.897799	0.70606	0.727687
9/30/2022	0.717921	0.900064	0.926096	0.768747	0.731318	0.966506	0.899138	0.775602	0.732531
12/31/2022	0.721979	0.882814	0.938286	0.749791	0.737602	0.903454	0.913557	0.824504	0.734431
3/31/2023	0.965134	0.845562	0.935895	0.749202	0.745231	0.836208	0.927024	0.823463	0.736459
6/30/2023	0.831223	0.856507	0.831665	0.766504	0.737015	0.807263	0.924975	0.861503	0.721113
9/30/2023	0.478605	0.854485	0.805063	0.756928	0.741245	0.61915	0.907079	0.870566	0.728709
12/31/2023	0.43831	0.859164	0.80666	0.708911	0.735729	0.662058	0.901515	0.872391	0.730854
3/29/2024	0.422319	0.859549	0.831688	0.780917	0.472147	0.776944	0.887122	0.872391	0.730248

Appendix 7: Performance Analysis of Portfolio (Black Litterman Weights) vs Benchmark

IBM Equity | PORT | Related Functions Menu — Message

1) View | 2) Actions | 3) Settings | 4) Trade Simulation | 5) Workspace — Portfolio & Risk Analytics

Intraday | Holdings | Characteristics | VaR | Scenarios | Tracking Error/Volatility | Performance | Attribution

Main View | Total Return | Statistical Summary

DRAG EXCEL vs ISHARES RUSSE by GICS Sectors in USD — As of 04/19/24

Version MAC Unit Percentage

Name	% End Wgt			Tot Rtn 1D			Tot Rtn MTD			Tot Rtn YTD		
	Port	Bmrk	+/-	Port	Bmrk	+/-	Port	Bmrk	+/-	Port	Bmrk	+/-
DRAG EXCEL	100.00	100.00	0.00	1.15	0.62	0.53	-7.61	-4.75	-2.86	-7.46	3.79	-11.25
Communication Services	17.26	4.58	12.68	-0.21	0.93	-1.13	-4.57	-5.14	0.57	-0.57	2.56	-3.13
Consumer Discretionary	29.96	4.81	25.15	0.95	-0.13	1.07	-8.28	-8.67	0.39	-14.12	-2.34	-11.78
Consumer Staples	4.43	7.91	-3.48	2.34	1.21	1.13	-2.67	-1.70	-0.97	-13.35	4.88	-18.23
Energy		8.51	-8.51		1.11	-1.11		0.65	-0.65		14.55	-14.55
Financials	17.43	22.63	-5.20	1.76	1.60	0.16	-5.78	-4.60	-1.18	7.95	7.92	0.02
Health Care	12.20	14.06	-1.86	3.03	0.84	2.20	-10.54	-6.17	-4.37	28.65	-0.24	28.88
Industrials		14.30	-14.30		-0.19	0.19		-4.38	4.38		6.92	-6.92
Information Technology		8.95	-8.95		-1.56	1.56		-9.31	9.31		-3.04	3.04
Materials	18.71	4.83	13.88	0.70	0.00	0.70	-9.98	-3.80	-6.18	-25.36	3.41	-28.77
Real Estate		4.43	-4.43		0.41	-0.41		-8.39	8.39		-9.22	9.22
Utilities		4.88	-4.88		1.49	-1.49		-0.45	0.45		4.72	-4.72
Not Classified		0.11	-0.11		0.00	0.00		0.18	-0.18		1.03	-1.03

Actions | Export | Settings

Workspace: New Workspace — Default

DRAG EXCEL

Intraday | Positions | Aggregate | Trend | Aggregate w/ Returns | Attribution | TEV

Aggregate w/ Returns Navigator

Report Definition

Portfolio: DRAG EXCEL

Benchmark: ISHARES RUS

Differences

Universe Settings

Currency: Default (USD)

As of: 04/19/24

Classification: GICS Sectors

Date Ranges

Add

Selected Dates

- 1D
- YTD
- Last 1Y
- Thu Jan 04 2018 to Previou
- Fri Jan 04 2019 to Previous
- Tue Jan 04 2022 to Previou

Preview Dates

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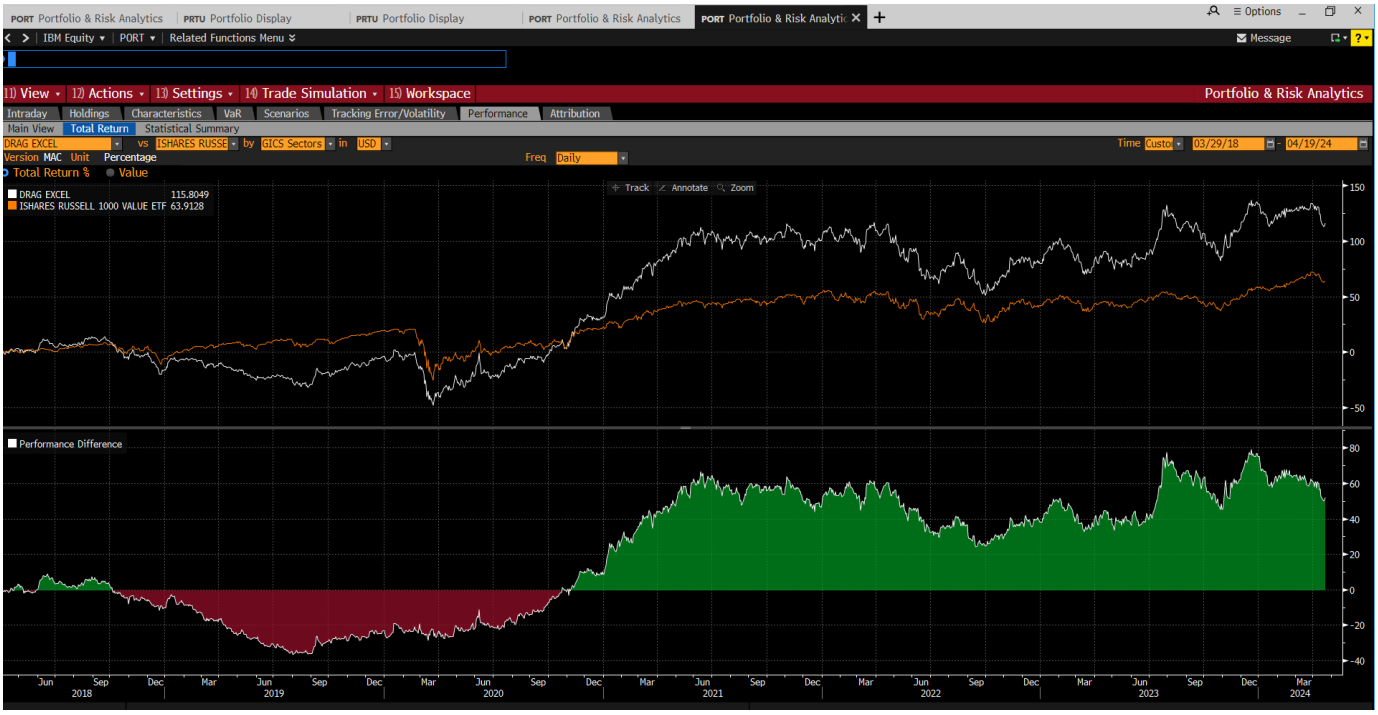
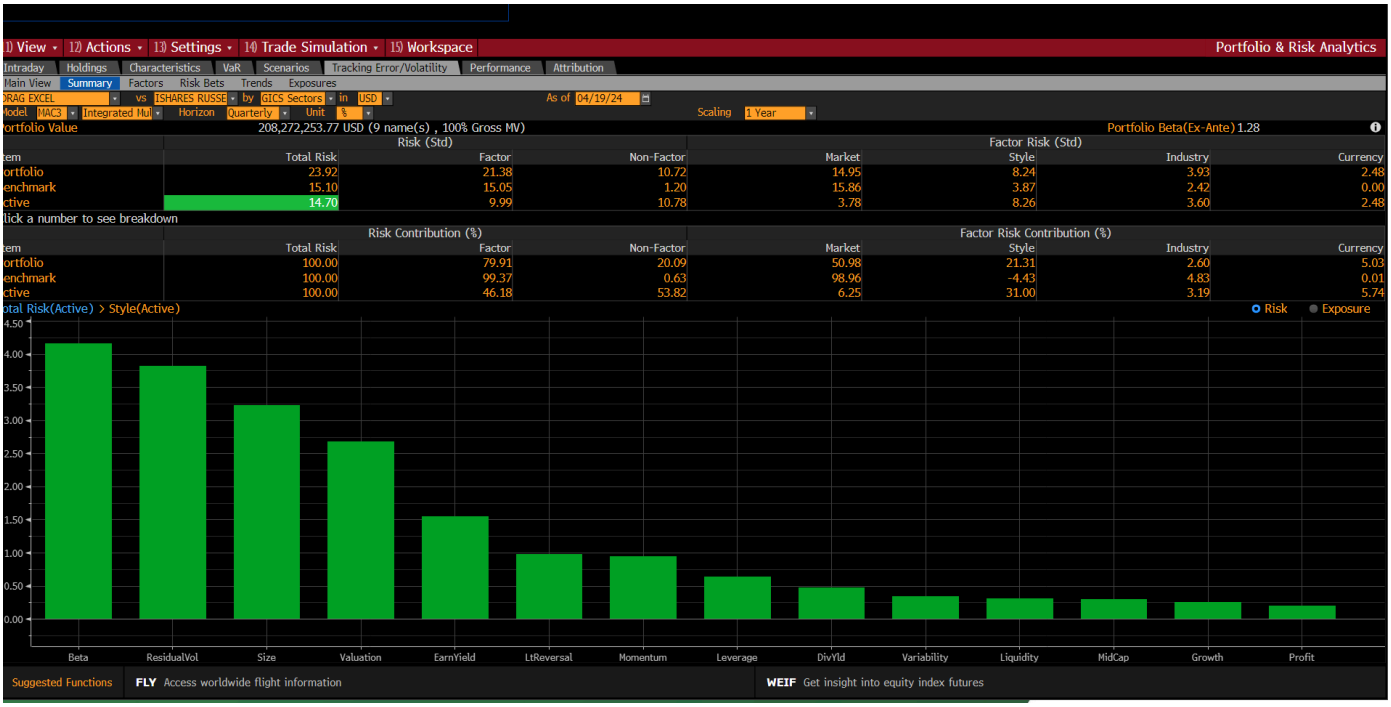
	Total Rtn																	
	1D			YTD			Last 1Y			01/04/18-04/19/24			01/04/19-04/19/24			01/04/22-04/19/24		
Class	Port	Bmrk	Diff	Port	Bmrk	Diff	Port	Bmrk	Diff	Port	Bmrk	Diff	Port	Bmrk	Diff	Port	Bmrk	Diff
Total	1.15	0.62	0.53	-7.46	3.79	-11.25	28.90	11.40	17.50	108.27	57.16	51.12	139.12	71.39	67.74	2.77	5.61	-2.84
Not Classified		0.00	0.00		1.03	-1.03		1.37	-1.37		43.29	-43.29		46.98	-46.98		6.20	-6.20
Energy		1.11	-1.11		14.55	-14.55		-1.04	1.04		71.59	-71.59		106.28	-106.28		76.68	-76.68
Materials	0.70	0.00	0.70	-25.36	3.41	-28.77	77.82	10.76	67.06	8.09	50.52	-42.43	56.00	84.70	-28.69	26.05	5.70	20.35
Industrials		-0.19	0.19		6.92	-6.92		21.33	-21.33		70.65	-70.65		111.61	-111.61		17.52	-17.52
Consumer Discretionary	0.95	-0.13	1.07	-14.12	-2.34	-11.78	20.27	16.79	3.48	100.11	23.28	76.83	122.27	49.63	72.65	-18.09	-12.04	-6.05
Consumer Staples	2.34	1.21	1.13	-13.35	4.88	-18.23	-21.18	-1.40	-19.78	49.61	57.89	-8.27	30.70	73.44	-42.75	-17.30	3.53	-20.82
Health Care	3.03	0.84	2.20	28.65	-0.24	28.88	-1.33	-5.15	3.82	63.77	69.37	-5.60	282.79	62.66	220.12	-43.91	-3.06	-40.85
Financials	1.76	1.60	0.16	7.95	7.92	0.02	10.07	14.89	-4.81	42.27	53.70	-11.43	69.08	77.19	-8.11	8.74	5.80	2.94
Information Technology		-1.56	1.56		-3.04	3.04		36.13	-36.13		74.24	-74.24		78.52	-78.52		-6.76	6.76
Communication Services	-0.21	0.93	-1.13	-0.57	2.56	-3.13	23.11	40.87	-17.76	85.88	51.37	34.51	72.39	46.80	25.59	7.96	5.37	2.59
Utilities		1.49	-1.49		4.72	-4.72		-7.13	7.13		55.25	-55.25		45.59	-45.59		-0.37	0.37
Real Estate		0.41	-0.41		-9.22	9.22		12.65	-12.65		23.40	-23.40		28.02	-28.02		-23.58	23.58

Appendix 8: Performance Analysis (Black Litterman Weights) Chart vs Benchmark



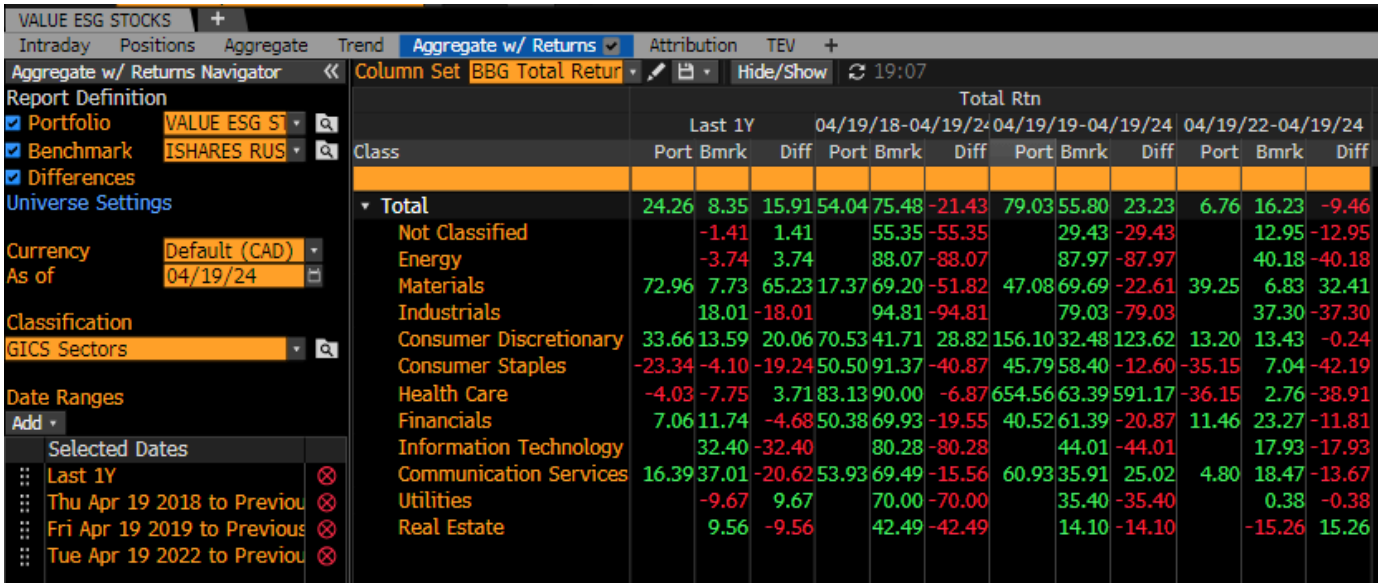
Appendix 9: Active Risk Volatility of Portfolio (Black Litterman Weights) vs Benchmark

Appendix 10: Style Risk Volatility of Portfolio (Black Litterman Weights) vs Benchmark



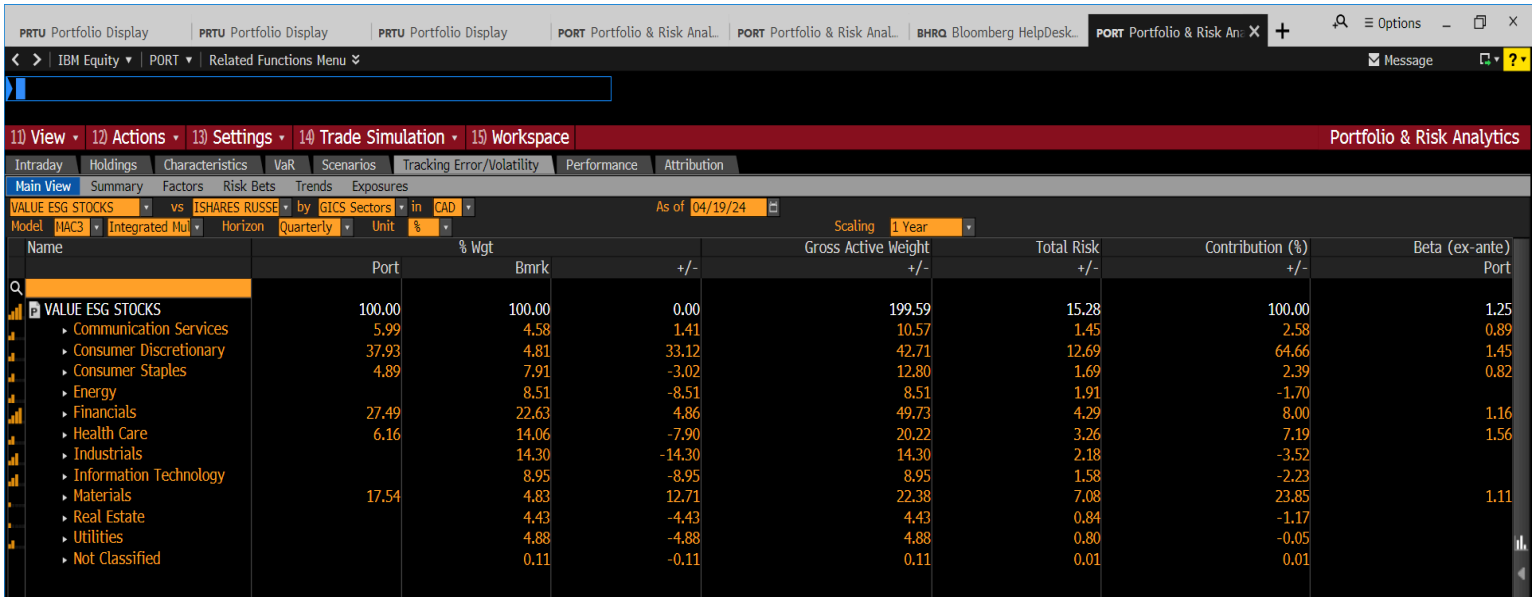
Appendix 11: Industry Risk Volatility of Portfolio (BL Weights) vs Benchmark

Appendix 12: Performance Analysis of Portfolio (Equally Weighted) vs Benchmark



Appendix 13: Performance Analysis Chart (Equally Weighted) vs Benchmark

Appendix 14: Volatility of Portfolio (Equally Weighted) vs Benchmark



Name	% Wgt			Gross Active Weight	Total Risk	Contribution (%)	Beta (ex-ante)
	Port	Bmrk	+/-	+/-	+/-	+/-	Port
VALUE ESG STOCKS	100.00	100.00	0.00	199.59	15.28	100.00	1.25
Communication Services	5.99	4.58	1.41	10.57	1.45	2.58	0.89
Consumer Discretionary	37.93	4.81	33.12	42.71	12.69	64.66	1.45
Consumer Staples	4.89	7.91	-3.02	12.80	1.69	2.39	0.82
Energy		8.51	-8.51	8.51	1.91	-1.70	
Financials	27.49	22.63	4.86	49.73	4.29	8.00	1.16
Health Care	6.16	14.06	-7.90	20.22	3.26	7.19	1.56
Industrials		14.30	-14.30	14.30	2.18	-3.52	
Information Technology		8.95	-8.95	8.95	1.58	-2.23	
Materials	17.54	4.83	12.71	22.38	7.08	23.85	1.11
Real Estate		4.43	-4.43	4.43	0.84	-1.17	
Utilities		4.88	-4.88	4.88	0.80	-0.05	
Not Classified		0.11	-0.11	0.11	0.01	0.01	

Appendix 12: Black Litterman Model Code

```
import yfinance as yf
from datetime import datetime
from dateutil.relativedelta import relativedelta

#tickers = ["TSQ", "PRU", "SPTN","ODP"]
tickers = [col for col in df.columns if col != 'Date']
# Define start date
#start_date = datetime(2018, 1, 1)

start_date = df.index[0]


# Subtract 2 years from the start date
start_date_minus_2_years = start_date - relativedelta(years=2)

# Download data
prices = yf.download(tickers, start=start_date_minus_2_years.strftime("%Y-%m-%d"), end=start_date.strftime("%Y-%m-%d"))['Adj Close']

prices.tail()
market_prices = yf.download("SPY", period="max")["Adj Close"] #baseline We might change this depending on the tickers
market_prices.head()
mcaps = {}
for t in tickers:
    stock = yf.Ticker(t)
    mcaps[t] = stock.info["marketCap"]
#caps

import pypfopt
pypfopt.__version__
from pypfopt import black_litterman, risk_models
from pypfopt import BlackLittermanModel, plotting
```

Appendix 13: Black Litterman Model Code (Continued)

```
num_rows = df.shape[0]
for row in range(num_rows) :
  start_date = df.index[row]
  start_date_minus_2_years = start_date - relativedelta(years=2)
  prices = yf.download(tickers, start=start_date_minus_2_years.strftime("%Y-%m-%d"), end=start_date.strftime("%Y-%m-%d"))['Adj Close']
  market_prices = yf.download("SPY", period="max")["Adj Close"] #baseline We might change this depending on the tickers
  mcaps = {}
  for t in tickers:
    stock = yf.Ticker(t)
    mcaps[t] = stock.info["marketCap"]
  S = risk_models.CovarianceShrinkage(prices).ledoit_wolf()
  delta = black_litterman.market_implied_risk_aversion(market_prices)
  market_prior = black_litterman.market_implied_prior_returns(mcaps, delta, S)
  current_market_prior_df = pd.DataFrame(data=market_prior, index=tickers, columns=['Prior'])
  market_prior_df.head()
  # prompt: make it such that market_prior_df ha columns of tickers
  current_market_prior_df = current_market_prior_df.transpose()
  current_market_prior_df
  # prompt: remove the row name prior and change it ro date
  current_market_prior_df.rename_axis('Date', axis=1, inplace=True)
  current_market_prior_df.head()
  current_market_prior_df.rename(index={current_market_prior_df.index[0]: start_date.date()}, inplace=True)
  current_market_prior_df
  market_prior_df = pd.concat([market_prior_df, current_market_prior_df])
  market_prior_df
market_prior_df.head()
```

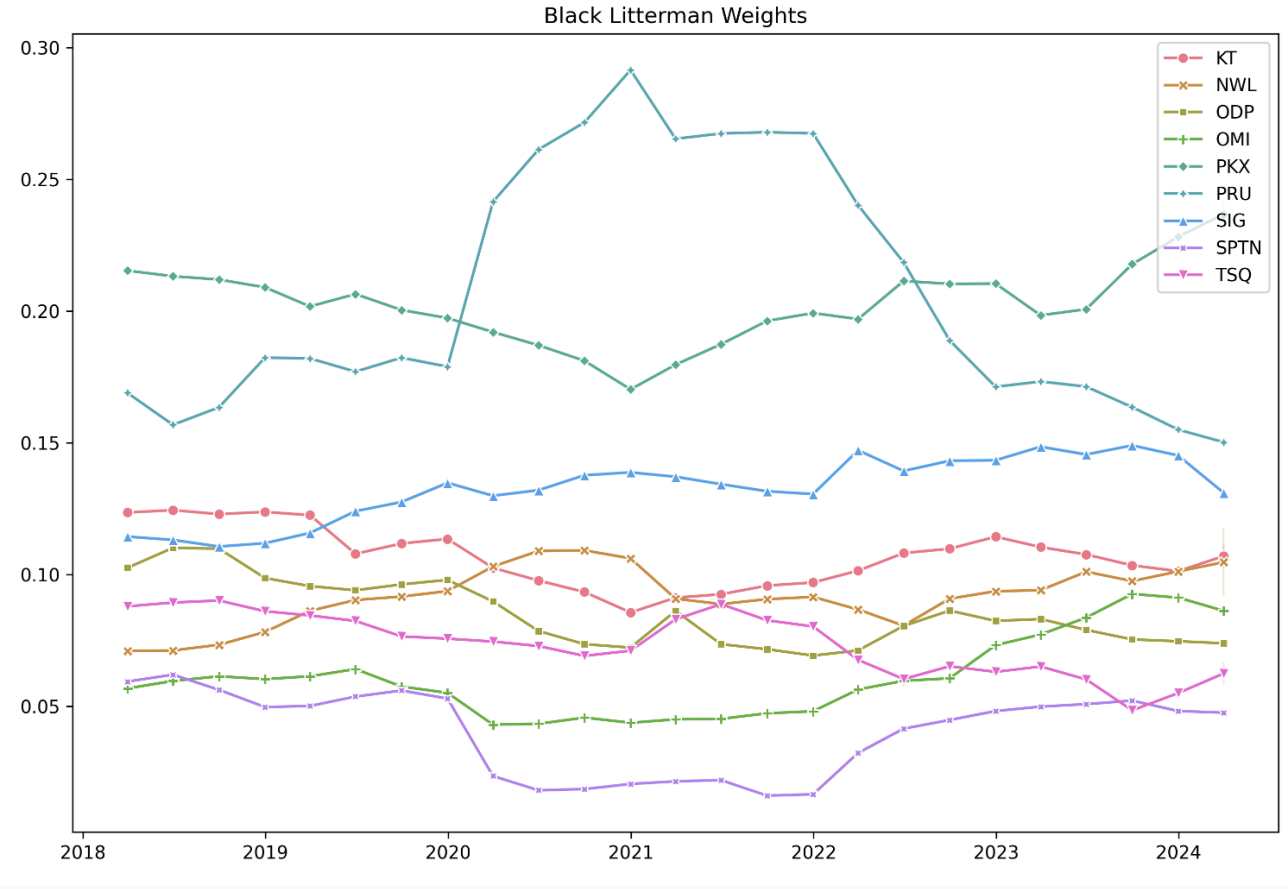
```
Value_viewdict = {
    "TSQ": 0.084,
    "PRU": 0.036,
    "NWL": 0.036,
    "SIG": 0.096,
    "OMI": 0.036,
    "PKX": 0.144,
    "KT": 0.144,
    "SPTN": 0.024,
    "ODP": 0.05,
}

ESG_confidences = [
    0.0,
    0.0,
    0.0,
    0.0,
    0.0,
    0.0,
    0.0,
    0.0,
    0.0,
]

Value_confidences=row_list

def BL_Plot(viewdict, confidences,title):
  bl = BlackLittermanModel(S, pi=market_prior, absolute_views=viewdict, omega="idzorek", view_confidences=confidences)
  # Posterior estimate of returns
  ret_bl = bl.bl_returns()
  ret_bl
  rets_df = pd.DataFrame([market_prior, ret_bl, pd.Series(viewdict)],
              index=[f"{title} Prior Returns", f"{title} Posterior Returns", f"{title} Views Returns"]).T
  rets_df
```

Appendix 14: Black Litterman Model Code (Continued)

```
for row in range(num_rows) :
  start_date = df.index[row]
  start_date_minus_2_years = start_date - relativedelta(years=2)
  prices = yf.download(tickers, start=start_date_minus_2_years.strftime("%Y-%m-%d"), end=start_date.strftime("%Y-%m-%d"))['Adj Close']
  market_prices = yf.download("SPY", period="max")["Adj Close"] #baseline We might change this depending on the tickers
  mcaps = {}
  for t in tickers:
    stock = yf.Ticker(t)
    mcaps[t] = stock.info["marketCap"]
  S = risk_models.CovarianceShrinkage(prices).ledoit_wolf()
  delta = black_litterman.market_implied_risk_aversion(market_prices)
  market_prior = black_litterman.market_implied_prior_returns(mcaps, delta, S)
  row_list = df.loc[df.index[row]].tolist()
  Value_confidences=row_list
  confidences= [(esg + value) / 2 for esg, value in zip(ESG_confidences, Value_confidences)] #average our confidences
  viewdict = {key: (ESG_viewdict[key] + Value_viewdict[key]) / 2 for key in ESG_viewdict} #average the two views
  bl = BlackLittermanModel(S, pi=market_prior, absolute_views=viewdict, omega="idzorek", view_confidences=confidences)
  ret_bl = bl.bl_returns()
  rets_df = pd.DataFrame([market_prior, ret_bl, pd.Series(viewdict)],
            index=["Prior Returns", "Posterior Returns", "Views Returns"]).T
  S_bl = bl.bl_cov()
  ef = EfficientFrontier(ret_bl, S_bl)
  ef.add_objective(objective_functions.L2_reg)
  ef.max_sharpe()
  weights = ef.clean_weights()
  current_weights_df = pd.DataFrame.from_dict(weights, orient='index', columns=['Weight'])
  current_weights_df=current_weights_df.T
  current_weights_df.index = [start_date]
  weights_df = pd.concat([weights_df, current_weights_df])

weights_df
```

```
[ ]  rets_df.plot.bar(figsize=(12,8));

#BL_Plot(ESG_viewdict, ESG_confidences,title="ESG")
#BL_Plot(Value_viewdict, Value_confidences,title="Value")

confidences= [(esg + value) / 2 for esg, value in zip(ESG_confidences, Value_confidences)] #average our confidences
viewdict = {key: (ESG_viewdict[key] + Value_viewdict[key]) / 2 for key in ESG_viewdict} #average the two views


bl = BlackLittermanModel(S, pi=market_prior, absolute_views=viewdict, omega="idzorek", view_confidences=confidences)
# Posterior estimate of returns
ret_bl = bl.bl_returns()
ret_bl
rets_df = pd.DataFrame([market_prior, ret_bl, pd.Series(viewdict)],
            index=["Prior Returns", "Posterior Returns", "Views Returns"]).T
#rets_df
#rets_df.plot.bar(figsize=(12,8));

from pypfopt import EfficientFrontier, objective_functions
S_bl = bl.bl_cov()
ef = EfficientFrontier(ret_bl, S_bl)
ef.add_objective(objective_functions.L2_reg)
ef.max_sharpe()
weights = ef.clean_weights()
#pd.Series(weights).plot.pie(figsize=(10,10));
#plt.title('Portfolio Weights')
#from pypfopt.plotting import plot_weights
#plt.title('Portfolio Weights')
#plot_weights(weights)
#ef.portfolio_performance(verbose = True, risk_free_rate = 0.009)
# prompt: convert weights into a df

import pandas as pd
weights_df = pd.DataFrame.from_dict(weights, orient='index', columns=['Weight'])
```

Appendix 15: Adjusting Portfolio Composition Weights (BL Model)



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