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PERFORMANCE OF DIA AND FORWARD-LOOKING OPTIMAL PORTFOLIOS OF DOW STOCKS

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ABSTRACT

Purpose- This paper compares the performance of DIA, trailing optimal portfolio and forward-looking optimal portfolio constructed from a pool of DOW stocks, applying a modified contrarian portfolio construction to the forward-looking optimization. The modified contrarian optimization of this study is based on the premise that loser stocks, in the short run, would have reversal performance and become winner stocks in the short-run future. The investigative question is: Do forward-looking optimal portfolios of DOW stocks perform better than trailing optimal portfolios of DOW stocks in the short run after DJIA hit the year's lowest point in 2022?

Methodology- To answer the investigative question, this study compares the short-run performance of forward-looking optimal portfolios with the performance of trailing optimal portfolios. Elton, Gruber, and Padberg (1987) originally introduced the optimal portfolio technique.

Findings- The primary focus was on the case related to September 30, 2022, when DJIA hit the lowest level in 2022. To get the trend analysis of the cases of DJIA hitting the lowest level of the year, this study examined two comparable findings, having examined the performance properties of trailing vs. forward-looking optimal portfolios using the same method. One examined the case related to March 23, 2020, and another examined the case related to December 24, 2018. It finds a robust performance of DIA compared to the performance of two forms of optimal portfolios. It also finds that forward-looking optimal portfolios performed better than trailing optimal portfolios regarding the average performance of three cases.

Conclusion- It concludes the potential usefulness of DIA as evidence of the market efficiency of DOW stocks. At the same time, forward-looking optimal portfolios for short-run investment in DOW stocks are a viable alternative to investing in the DIA.

Keywords: Portfolio choice, portfolio optimization, event studies, DIA, DOW stocks
JEL Codes: G11, G14, G17

1. INTRODUCTION

This study examines the portfolio performance of DOW stocks and DIA (SPDR Dow Jones Industrial Average ETF) as a proxy of the Dow Jones Industrial Average (DJIA) Index after the event date of September 30, 2022, when DJIA hit its lowest point of 2022. In this study, "winners" mean top-half component performers beating DIA (i.e., performance ranks 1 through 13), and "losers" mean bottom-half performers not beating DIA (i.e., performance ranks 14 through 30) during the first half of the sample period. The reason for including the rank 14th stock in the loser group is that the DIA happens to be the rank 14 in this study if DIA were included in the ranking, so when ranking only 30 index components, the loser stocks mean the components underperforming DIA, the DJIA proxy. It analyzes the performance of the conventional, backward-looking (trailing) optimal portfolio constructed from the pool of 30 Dow stocks, using the daily data sample period from July 27, 2022, to September 30, 2022. As an alternative, it also analyzes the performance of the forward-looking optimal portfolio, using the same sample period, based on a contrarian premise, constructed from the pool of 17 loser-DOW stocks during the first half of the sample period.

This paper is organized as follows: the next section explains forward optimal portfolios; the second section is a literature review; the third section describes the investigative design and methodology; the fourth section explains the findings, the concluding section sets forth a conclusion and further study. Four figures with corresponding tables presenting this study's critical descriptive and analytical statistics are placed in the findings section. The references section is placed last.

2. FORWARD OPTIMAL PORTFOLIOS EXPLAINED

The premise of contrarian investing is that investing the same way everyone else thinks leads to wrong investing. That is, it is contrary to the herd instinct. In a way, contrarian investing is consistent with value investing in that the contrarian invests in mispriced investments that are undervalued by the market. An early pioneer of implementing a contrarian premise in active portfolio investment was Economist John Maynard Keynes (Chambers & Dimson, 2013). For example, Keynes was an early contrarian investor when he managed the endowment for King's College, Cambridge, from the 1920s to '40s in the sense that while most endowments invested primarily on land and fixed-income securities, Keynes invested heavily in common stocks and outperformed the UK stock market. French and Dreman Value Management (2010) have advocated contrarian investing, focusing on low P/E ratio stocks. In the classic study, Dreman demonstrates that Low-P/E stocks have outperformed the S&P 500 and high-P/E stocks in the last five decades (1960s ~2000s).

Applying the premise of value investing or contrarian investing, this study constructs contrarian portfolio optimization based only on the pool of loser-Dow stocks. This proxy contrarian optimal portfolio construction is referred to as "forward-looking portfolio optimization," which is the operational definition in this study. It is contrary to conventional or trailing portfolio optimization, which is based only on the historical properties of components of the portfolio pool.

3. LITERATURE REVIEW

The weakness of the trailing optimal portfolio construction is that it favors high-performance stocks in terms of the return per unit of risk among the components of the portfolio pool based on historical data. As evidenced by this study, the conventional optimal portfolio failed to capture any high-performance stocks in the second half of the sample period. The conventional optimal portfolio construction based on past performance does not guarantee comparable results in the short-run future. Thus, the empirical evidence of this study on the trailing optimal portfolio supports the notion of SEC Rule 156 (2024), which says, "It is unlawful for any person, directly or indirectly, by the use of any means or instrumentality of interstate commerce or of the mails, to use sales literature which is materially misleading in connection with the offer or sale of securities issued by an investment company …" This is why the SEC (2024) requires funds to tell investors that "a fund's past performance does not necessarily predict future results." Providing evidence for the SEC requirement, Blake, Elton, and Gruber (1993) showed that, on average, bond funds underperform passive fixed-income indexes by an amount roughly equal to expenses and that there is no evidence that past performance can predict future performance.

Markowitz (1952) states, "The process of selecting a portfolio may be divided into two stages. The first stage starts with observation and experience and ends with beliefs about the future performances of available securities. The second stage starts with the relevant beliefs about future performances and ends with the portfolio choice." Markowitz proposed an alternative rule: Investors should consider expected return desirable and variance of return undesirable. This rule emphasizes the trade-off between risk (variance) and reward (expected return). In Markowitz's second stage, this paper expects the potentially inferior performance of the trailing optimal portfolio in terms of return per unit of risk, so it explores a forward-looking optimal portfolio proxy of DOW stocks constructed from the pool of 17 losers of DOW stocks during the first sub-sample period. Then, it compares the performance of the forward-looking optimal portfolio with the performance of the trailing optimal portfolios of DOW stocks during the second sub-sample period for back-testing. This paper also explores a similar comparison with DIA, the DJIA index proxy for the same subperiods, to examine the degree of market efficiency during the worst day, September 30 of the year 2022 event.

The Efficient Market Hypothesis (EMH) suggests that security prices fully reflect all relevant information, making it impossible to beat the market consistently. Practical evidence of this EMH is that passively invested in a market index fund like DIA outperforms managed portfolios such as optimal portfolios presented in this paper. For example, Johnson (2021) reports that "In general, actively managed funds have failed to survive and beat their benchmarks, especially over longer time horizons; only 25% of all active funds topped the average of their passive rivals over the ten years ended June 2021; long-term success rates were generally higher among foreign-stock, real estate, and bond funds and lowest among U.S. large-cap funds. The S&P Indices versus Active (SPIVA) scorecard, which tracks the performance of actively managed funds against their respective category benchmarks, recently showed that 79% of fund managers underperformed the S&P last year. It reflects an 86% jump over the past ten years."

The inferior performance of the trailing optimal portfolio would be a practical issue despite the theoretical breakthrough of Markowitz's mean-variance portfolio optimization (Markowitz, 1952). The practical issue is that past performance is no guarantee for future performance, as explained in the previous paragraph. For example, Bielstein and Hanauer (2017) suggest using the ICC (Implied Cost of Capital) based on analysts' earnings forecasts as a forward-looking return estimate to overcome such a practical issue. Another possibility is, as suggested by Jagannathan and Ma (2003), to focus on the minimum variance portfolio (MVP) construction, which would mitigate the estimation errors. However, deriving the ultimate optimal portfolio from the MVP construction could be even more challenging. If the forward-looking optimal portfolio proxy in this study is utilized

effectively, it could capture the winners of the second half of the sample period of this study. Such forward-looking optimal portfolio construction would aim to capture winners in the second sub-sample period in the short run.

4. INVESTIGATIVE DESIGN AND OPTIMAL PORTFOLIO CONSTRUCTION METHODOLOGY

The daily stock price data is adjusted for stock splits and dividends for the sample periods. The daily data for portfolio optimization are collected for DIA and 30 Dow components for 46 days before September 30, 2022. This section provides an operational and workable framework for constructing optimal portfolios of components. The application incorporates the capital asset pricing model, ways to find the excess return to risk ratios and unsystematic risk measures. It finds specific weights for the optimal portfolio of components. It follows a sequence of steps to find the portfolio of components.

This study also examines the performance properties of DIA (SPDR et al.) as a proxy of the Dow Jones Industrial Average (DJIA) Index since the DIA as a market proxy is required in the optimization process. The technique used for finding the optimal portfolio was initially introduced by Elton, Gruber, and Padberg (1987) (EGP technique). The essential steps of the EGP technique are as follows. First, find the "excess return to beta ratios" for components and rank them from highest to lowest. This will rank the components in relative performance based on return per unit of systematic risk contained. Second, the nonmarket variance of each component is calculated by calculating the variance of the market proxy, or Dow Jones Industrial Average Index proxy, DIA (SPDR Dow Jones Industrial Average ETF). Then, it sets the cutoff ratio to include those components that qualify for the optimum mix. The optimum mix will consist of all components for which the individual component's "excess return to beta" ratio exceeds the cutoff rate. The model finds the individual component's C ratio by solving a mathematical objective function to maximize the tangency slope of excess return to the component's risk measure with the constraint that the sum of the proportions of individual components included in the mix equals one. The optimum cutoff ratio (C') is determined by finding the last individual component's C ratio, which is less than its "excess return to beta" ratio in the list of descending order of the excess return to beta ratios. After finding the qualified components for the optimum mix using the cutoff ratio (C'), calculate the percentage weight of each component for the optimal portfolio. The percentage of a component (Xi) in the optimum portfolio is:

$$X_i = Z_i / \sum_{i=1}^{n} Z_i * 100 \quad (1)$$

where:

$$Z_i = [\beta_i/\sigma_{ei}^2] * [TI_i - C'] \quad (2)$$

Where:

σ_{ei}^2= nonmarket variance of a component.

TI_i = Treynor Index of component = $(R_i-R_f)/ \beta_i$,

R_f = risk-free rate,

R_i = the rate of return of component,

β_i = the systematic risk of component,

C' = the optimum cutoff ratio.

After finding two separate, i.e., trailing and forward-looking optimal portfolios constructed from the Dow stocks as of September 30, 2022, this paper examines the performance of the trailing optimal portfolio and the forward optimal portfolio during the sub-sample period of 46 days after the event date of September 30, 2022.

5. FINDINGS

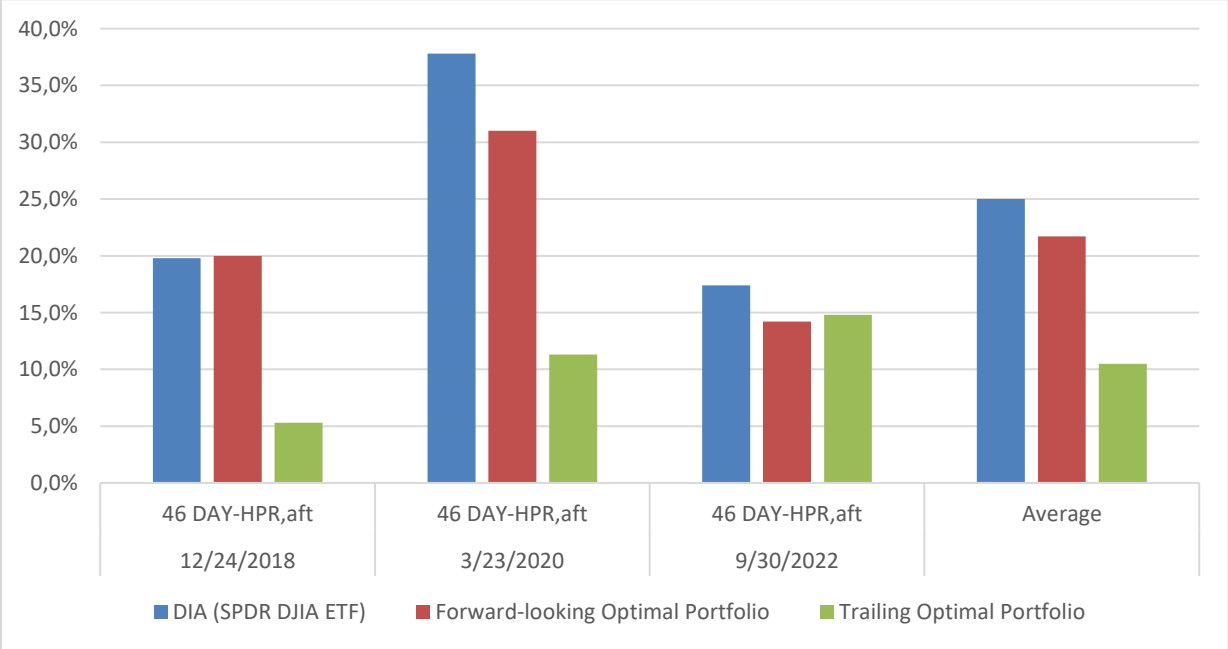
Is the performance of the forward-looking optimal portfolios of stocks superior to that of the trailing optimal portfolios of DOW stocks? The answer is inconclusive if one considers the holding period return after the worst day of the 2022 case alone. As shown in Figures 1 & 2 and Tables 1 & 2, the HPR aft for the forward-looking EGP Optimal Portfolio (+14.2%) is slightly lower than the HPR,aft for the trailing EGP Optimal Portfolio (+14.8%). Interestingly, both HPR,afts are inferior to the HPR, aft of DIA (+17.4%). As shown in the last column of Table 2, the weighted-average performance rank of the Forward-looking portfolio was 21; the weighted-average performance rank of the Trailing portfolio was 20. Both are inferior to the rank of DIA (18). All portfolio components of the Trailing portfolio had lower group performance ranks in the second sub-sample period than in the first sub-sample period, i.e., 17 ranks lower. On the other hand, only two out of four components of the Forward portfolio have lower performance ranks in the second sub-sample period than in the first sub-sample period. The Forward portfolio had lower group performance ranks in the second sub-sample period than in the first, i.e., four ranks lower. The actual performance of the trailing optimal portfolio during the second half was +14.8%, which is inferior to the DIA's performance of +17.4%. The trailing optimal portfolio was a group winner in the first half (the group rank, 3). However, the trailing optimal portfolio was a group loser in the second half (group rank, 20). Because the performance of the trailing EGP optimal portfolio

is inferior to that of DIA, the practical usefulness of conventional backward-looking optimal portfolio construction has some limitations. Its hindsight is excellent, but its foresight is not great, at least in the short run. Nevertheless, the V-shaped recoveries of all three portfolios shown in Figure 2 are visibly dramatic.

There were two comparable findings, having examined the performance properties of trailing vs. forward-looking optimal portfolios using the same method. One examined the case related to March 23, 2020, when DJIA hit the lowest level in 2020. Another examined the case related to December 24, 2018, when DJIA hit the lowest level in 2018. Table 1 compares all three cases. Surprisingly, the performance of DIA turns out to be the best among the three compared. The average performance measures of all three cases are shown in the last column. DIA is the best performer (+25%), the forward-looking optimal portfolio is the second-best performer (+21.7%), and the trailing optimal portfolio is the worst (+10.5%). The finding of the comparatively superior performance of DIA is meaningful because it could mean a technical investment advantage, particularly after the worst day event.

Figure 3 and Table 3 show properties of the trailing optimal portfolio constructed as of September 30, 2022. It consists of WMT, JNJ, TRV, UNH, and MRK, with the top allocation being WMT (34.95% of the portfolio weight). As shown in Table 2, three out of five were loser stocks during the second half of the sample period. Figure 4 and Table 4 also show the forward-looking optimal portfolio constructed as of September 30, 2022. It consists of KO, MCD, VZ, and V, heavily favoring KO (55.4% of the portfolio weight). As shown in Table 2, the actual performance of the forward-looking optimal portfolio during the second half was +14.2%, which is inferior to the DIA's performance of +17.4%. The forward-looking optimal portfolio was a group loser in the first half (17) and a group loser in the second half (21). On the other hand, the trailing optimal portfolio was a decisive group winner in the first half (3) but a group loser in the second half (20). Therefore, the forward-looking optimal portfolio performed better than the trailing optimal portfolio in a relative sense if one considers the entire sample period.

Figure 1: Comparative Performance Properties of DIA, Forward-Looking and Trailing EGP Optimal Portfolios of DOW Stocks during 46 Days after Each of Three Event Days



Notes: 46 DAY-HPR, aft = Holding Period Return for 46 days after the lowest DJIA index level of the year.

Table 1: Comparative Performance Properties of DIA, Forward-Looking and Trailing EGP Optimal Portfolios of DOW Stocks during 46 Days after Each Of Three Event Days

Index/Portfolio	12/24/2018	3/23/2020	9/30/2022	
	46 DAY-HPR, aft	46 DAY-HPR, aft	46 DAY-HPR, aft	Average
DIA (SPDR DJIA ETF)	19.8%	37.8%	17.4%	25.0%
Forward-looking Optimal Portfolio	20.0%	31.0%	14.2%	21.7%
Trailing Optimal Portfolio	5.3%	11.3%	14.8%	10.5%

Notes: 46 DAY-HPR, aft = Holding Period Return for 46 days after the lowest DJIA index level of the year.

Figure 2: Comparative Performance Properties of DIA, Trailing, and Forward-Looking EGP Optimal Portfolios during 46 Days before and after September 30, 2022

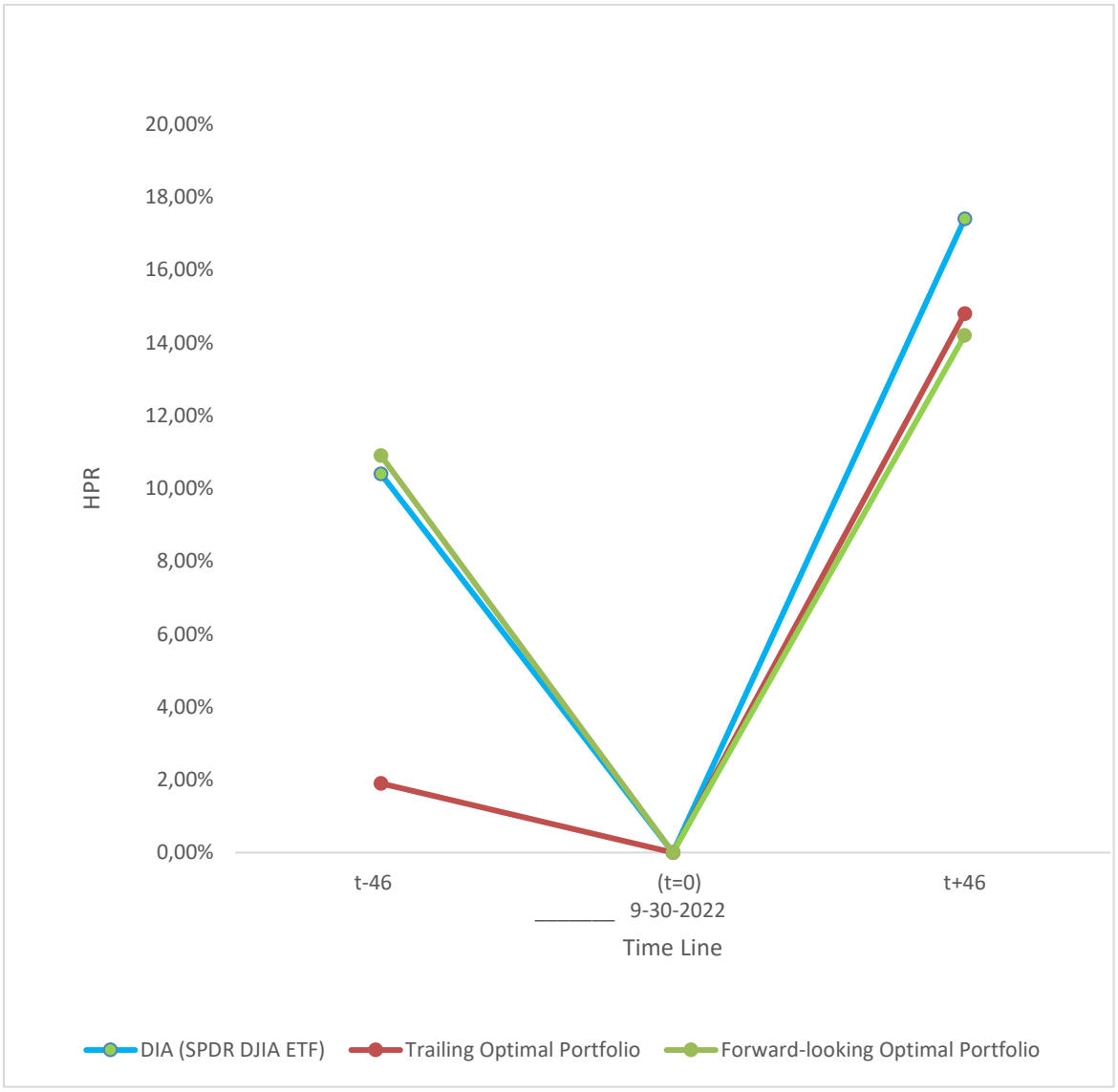


Table 2: Comparative Performance Properties of DIA, Trailing, and Forward-Looking EGP Optimal Portfolios during 46 Days before and after September 30, 2022

Index/Portfolio/Ticker	HPR,bef	HPR,aft	Rnk,bef	Rnk,aft
DIA (SPDR DJIA ETF)	-10.4%	17.4%	14	18
Trailing Optimal Portfolio Components & Weights:	-1.9%	14.8%	3	20
WMT (34.95%)	2.9%	15.6%	1	20
JNJ (28.07%)	-5.0%	8.5%	5	25
TRV (16.40%)	-3.1%	23.0%	3	11
UNH (11.66%)	-5.2%	7.1%	6	26
MRK (8.92%)	-4.8%	26.5%	4	8
Forward Optimal Port. Components & Weights:	-10.9%	14.2%	17	21
KO (55.40%)	-10.4%	14.0%	17	23
MCD (35.71%)	-10.4%	18.4%	15	15
VZ (8.76%)	-15.5%	-1.2%	25	29
V (.13%)	-15.4%	18.0%	24	16

Notes:
HPR = ((Ending Price – Beginning Price) + Dividend) / Beginning Price; however, in this study, the daily price data are already adjusted for dividends and stock splits, so the actual formula for HPR in this study is:
(Ending Adjusted Price – Beginning Adjusted Price) / Beginning Adjusted Price.
HPR,bef; Rnk,bef = Holding Period Return; Performance Rank for 46 days before SEPTEMBER 30, 2022, the benchmark day's lowest index level of the year.
HPR, aft; Rnk, aft = Holding Period Return; Performance Rank for 46 days after SEPTEMBER 30, 2022, the lowest index level 2022.
The performance measurements for DIA and optimal portfolios are rounded. Performance is based on closing prices adjusted for dividends and splits.

Figure 3: Properties of Trailing EGP Optimal Portfolio of DOW Stocks as of September 30, 2022

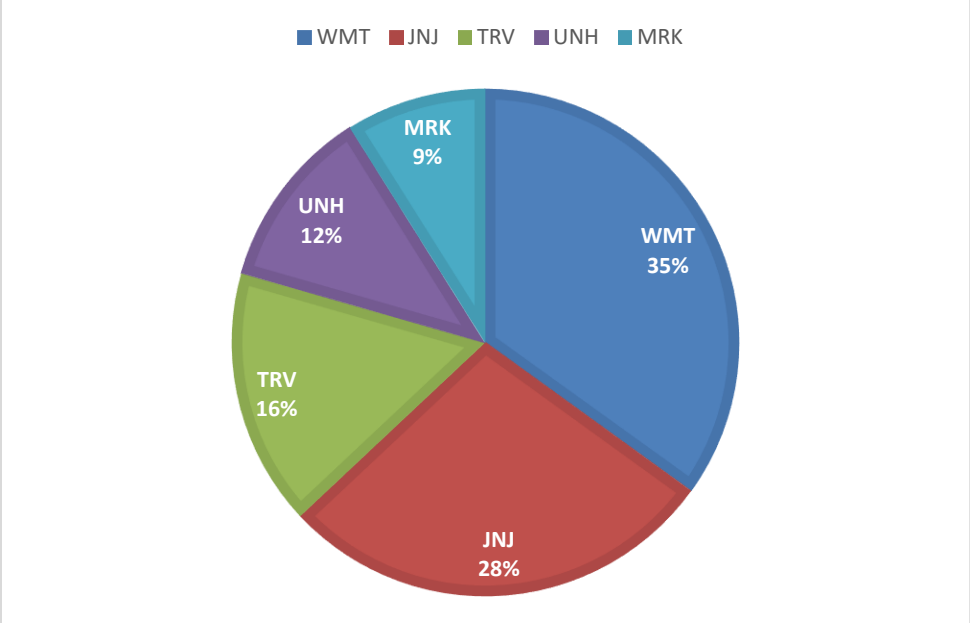


Table 3: Properties of Trailing EGP Optimal Portfolio of DOW Stocks as of September 30, 2022

Ticker	Wi
WMT	34.95%
JNJ	28.07%
TRV	16.40%
UNH	11.66%
MRK	8.92%

Notes: Expected Return Relative: .999641; Standard Deviation: .009436; Reward to Standard Deviation: -.038000; Correlation Coefficient: .50; Wi = Portfolio weight of component i.

Figure 4: Properties of Forward-Looking EGP Optimal Portfolio of DOW Stocks as of September 30, 2022

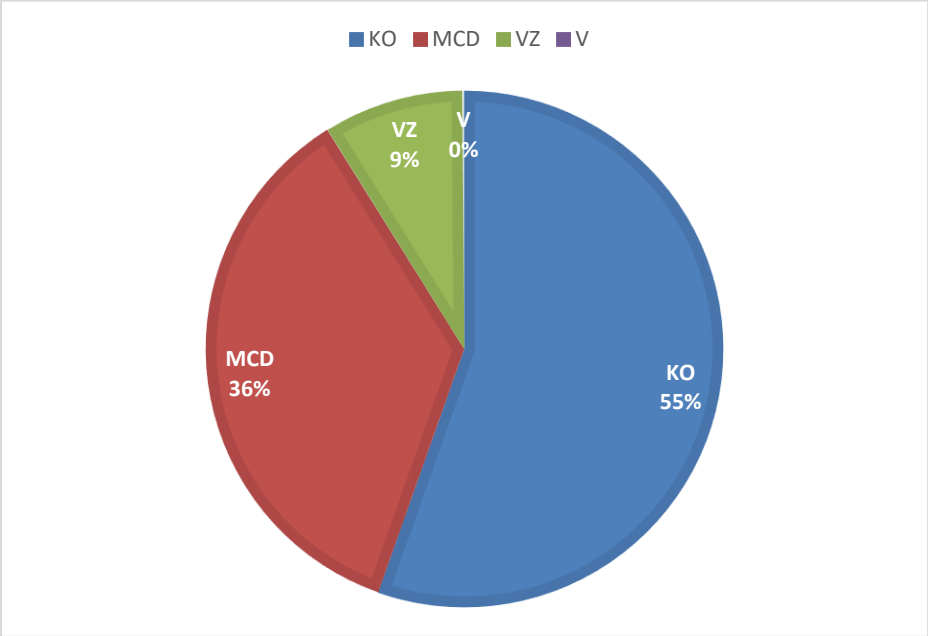


Table 4: Properties of Forward-Looking EGP Optimal Portfolio of DOW Stocks as of September 30, 2022

Ticker	Wi
KO	55.40%
MCD	35.71%
VZ	8.76%
V	.13%

Notes: Expected Return Relative: .997555; Standard Deviation: .009930; Reward to Standard Deviation: -.246216; Correlation Coefficient: .55; Wi = Portfolio weight of component i.

Figure 3 and Table 3 show the portfolio properties of the trailing EGP optimal portfolio, and Figure 4 and Table 4 show the portfolio properties of the forward-looking EGP optimal portfolio. Due to the heavy downturn of DJIA during the first half of the sample period before the worst-day event of 2022, the expected return relative was poorly low, less than 1 for both portfolios. The standard deviation of the trailing optimal portfolio (0.009436) was slightly lower than that of the forward-looking optimal portfolio (0.009930). The reward-to-standard deviation ratio for the trailing optimal portfolio was better than that of the forward-looking optimal portfolio. The correlation coefficient (0.50) for the trailing optimal portfolio was lower than the same property for the forward-looking optimal portfolio (0.55). So, all of the individual properties of the

trailing optimal portfolio were better than the matching measures of the forward-looking optimal portfolio for the 2022 case.

6. CONCLUSION AND FURTHER STUDY

The positive reversal performance during the second half of the sample period after the September 30, 2022, event was apparent in all three: DIA, trailing optimal portfolio, and forward-looking optimal portfolio. The unexpected finding was the comparatively robust performance of DIA compared to the performance of two forms of optimal portfolios. It is fair to say that the worst-day events preserved the pricing efficiency of DOW stocks during the sample periods. That is, it is possible that the worst-day events did not disrupt the market efficiency for DOW stocks. This is because DIA, the market proxy of the DJIA index, performed the best, beating both forward-looking and trailing optimal portfolios in 2022 and, on average, of all three cases, as shown in Table 1. The only exception in Table 1 was that DIA performance in 2018 (+19.8%) was slightly lower than that of the forward-looking optimal portfolio in the same year (+20.0%). Therefore, DIA could give a winning opportunity to invest in DOW stocks after the worst day of the year event in the short run.

At the same time, forward-looking optimal portfolios for short-run investment in DOW stocks are a viable alternative to investing in the DIA, as evidenced by their performance superior to the performance of the trailing optimal portfolios on average. This study finds the usefulness of forward-looking portfolio optimization; however, it suggests a caveat of using trailing portfolio optimization for practical investment purposes. For further study, it would be worthwhile to consider a better fair value estimation in search of a better forward-looking portfolio optimization based on a more effective return-risk premise.

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