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Description of A New Method for Measuring Directional Risk in Investment Portfolios

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Abstract

This article describes a single financial ratio ("Optimized Directional Risk Ratio") which reflects both an instrument's downside risk as well as its overall return. By using the ODRR, investors and fund managers can more readily and precisely perceive which combinations of financial instruments, and in which proportions, stand to maximize returns while minimizing the investor's risk. The ODRR can be calculated for any given time period of two months or more where there is at least one month with an observed positive return for a financial instrument, and one or more months of negative returns. Two-year, three-year, and five-year timeframes are logical time periods for calculation of the ODRR.

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1. Introduction

This article describes a new method for measuring investment portfolio risk. The directional risk ratio described herein ('optimized directional risk ratio' or "ODRR") offers advantages to prevailing risk measurement methods. By using the ODRR, investors and fund managers can more readily and precisely perceive which combinations of financial instruments, and in which proportions, stand to maximize returns while minimizing the investor's risk.

2. The Limitations of Prevailing Risk Measurement Methods

Six of the methods most commonly utilized for measuring investment risk are: volatility; standard deviation; the Sortino Ratio; the Sharpe Ratio; and Morningstar's Risk and Rating measurement systems. Each of these methods suffers from appreciable limitations.

2.1 Volatility

The formula for an financial instrument's daily volatility is computed by taking the square root of the variance of an financial instrument's daily price.[1] (VixFAQ.com, 2022). Annualized volatility is calculated by multiplying the daily volatility by the square root of 252, which represents the number of trading days in a year.[2] Volatility is one of the most predominant risk assessment measures.

The primary limitation of volatility as a risk assessment tool is that it does not measure the direction of changes in an financial instrument's price.[3] (Macroption.com, 2023). This is clearly a material limitation, as knowing merely that a stock, portfolio of stocks, or fund, will swing wildly both up and down offers only limited salient information about the attractiveness of a putative investment to a retail investor or fund manager.

2.2 Sortino and Sharpe Ratios

The Sortino Ratio[4] is defined as $\frac{r_p - r_f}{\sigma_d}$ (Morningstar, 2023),

where r_p equals portfolio return for a given investment period, r_f equals risk-free rate of return, and σ_d equals the standard deviation of negative returns to the portfolio.[5] (Moller and Askeljung, 2020).

The Sharpe Ratio is defined as $\frac{r_p - r_f}{\sigma_p}$

where Rp= portfolio return, r_f is the risk-free rate of return, and σ_p is the standard deviation of the portfolio's excess return.[6] σp is calculated by: 1) taking the return variance from the average return in each incremental period, squaring it, and summing the squares from each of the incremental periods; 2) dividing the sum by the number of incremental time periods; and 3) taking the square root of the

quotient.[7] (Fernando, 2023).
The Sortino and Sharpe Ratios are each a function of an ever-changing independent variable: the risk-free rate of return. Said risk-free rate of return is itself a function of the federal funds rate. But unless an investor is considering a portfolio wholly comprised of treasury bills or certificates of deposit - or instruments likewise closely tethered to the prevailing interest rate - the risk-free-rate-of-return is a wholly exogenous variable to any contemplated investment in equities. What an investor ought truly be concerned with are the returns a given investment portfolio (or stock, or fund) will generate - and with what downside volatility - relative to *other investment portfolios of similar makeup*. Expressed slightly differently, where the investor's (and fund manager's) concern should lie is with what return (and downside volatility) a given portfolio or fund will generate as compared to a portfolio (or fund) with incrementally-varying composition compared to the fund contemporaneously under consideration.[8]

2.3 Standard Deviation

Standard deviation is defined as $\sqrt{\frac{\Sigma (r_i - r_{avg})^2}{n-1}}$

where r_i = actual rate of return, r_{avg} = average rate of return, and n = number of time periods. Like volatility, standard deviation does not does not differentiate between *upward* and *downward* variance.
Volatility, standard deviation, and the Sharpe and Sortino Ratios share the limitation that they are comparably inaccessible to laypersons and ordinary investors. As well, specific to the Sharpe, Sortino, (and Calmar) Ratios, and standard deviation itself, calculating standard deviation is a calculation step (and mathematical concept) which is comparably inaccessible to retail investors.

2.4 Morningstar Ratings

Morningstar's risk-rating system is specific to, and limited to, funds. Morningstar designates funds "Low [Risk]"; "Below Average [Risk]"; "Average [Risk]"; "Above Average"; and "High [Risk]." Morningstar classes 10% of tracked funds as 'Low' risk, 22.5% as Below Average, 35% as Average, 22.5% as Above Average risk, and 10% as High risk.[9] (Morningstar, 2023). Morningstar's classifications and the proportions assigned to each are thus subjective since the overall risk of the total pool of funds tracked by Morningstar may change over time, but Morningstar's five risk categories (and the proportion of funds segmented into each risk category) are fixed and do not change over time. Which risk category Morningstar assigns to a particular fund also depends on other random factors, such as which funds the company includes in its universe of tracked funds at a given time.
Morningstar also offers a separate Rating system (from 1 through 5 "stars"), which attempts to rate tracked funds' historical risk-adjusted return.[10] Morningstar does not disclose the formula it uses to compile its star ratings. Of the ratings, Morningstar states: "Risk-adjusted return is calculated by subtracting a risk penalty

from each fund total return, after accounting for all loads, sales charges, and redemption fees. The risk penalty is determined by the amount of variation in the fund's monthly return, with emphasis on downward variation. The greater the variation, the larger the penalty." [11] One study has concluded that Morningstar's star ratings are of limited utility for predicting future performance.[12]

Neither Morningstar's Risk nor Rating measurement systems are quantitative in the manner they are presented to consumers, except in the most rudimentary fashion in the case of its star-rating system (*i.e.*, one-two-three-four-five). This is a limitation on Morningstar's measures compared to volatility, standard deviation, and the Sharpe and Sortino Ratios, and compared to the ODRR.

3. An Optimized Measurement of Directional Volatility

Given a choice, most investors would prefer for their investments to grow steadily rather than gyrate spectacularly. Many would prefer such trajectory even if presented with the alternative of investing in a highly volatile portfolio holding the promise to produce outsize long-run returns. This is not an irrational preference. Month-to-month losses are of particular concern to investors with short or medium-term investment horizons in lieu of long-term investment objectives.

Though the S&P 500 has produced unquestionably robust returns over long-term time periods, the index is notably more fickle across shorter time horizons, *i.e.*, month-to-month and year-to-year.[13] (Koenig, 2022). The below chart illustrates performance of $10,000 invested in the State Street Global Advisors SPDR S&P 500 exchange-traded fund trust (SPY) from November 1, 2020 to November 1, 2023.

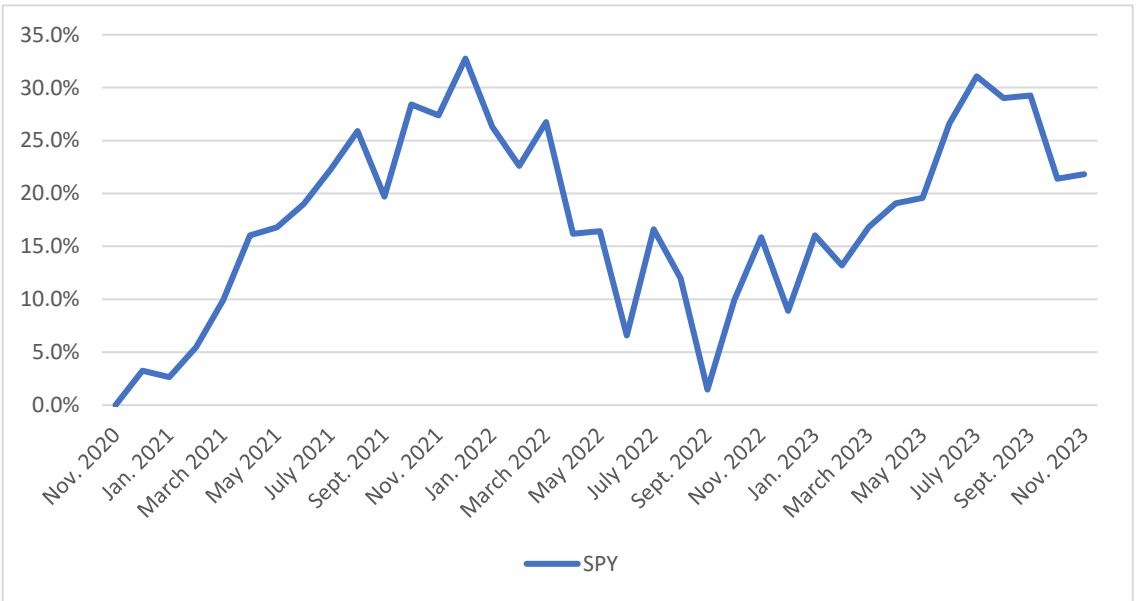

Figure 1: SPY Cumulative Return (Nov. 1, 2020-Nov. 1, 2023)

Returns on ETFs and like instruments tracking the S&P 500 have thus proven highly variable for investors in recent years, even excluding the temporary, dramatic losses induced by the global spread of Covid-19 in March 2020 (preceding the above time period).

Investors leery of such short-to-medium downside investment risk may find value in a single financial ratio which reflects both an instrument's downside risk as well as its overall return. Such a measurement is described immediately below. The optimal method of quantifying directional risk is:

$$\frac{[\Sigma^{[14]} \textbf{ all positive monthly returns for the financial instrument for a given time period}]^{[15]}}{-\ [\Sigma \textbf{ all negative monthly returns for the instrument for the same time period}]}$$

This is the Optimized Directional Risk Ratio. The ODRR captures the leverage of a financial instrument's overall positive returns compared to its negative returns.

4. Maximizing Returns While Minimizing Risk Using the ODRR

Investments with positive overall returns for a given time period will have an ODRR exceeding 1.0, while the ODRR of an investment with a negative overall return will be less than 1.0. Significantly, financial instruments with higher ODRRs (in excess of 1.0) will tend to be characterized by less downside instability than instruments with lower ODRRs. Investments with higher ODRRs may succinctly be characterized as manifesting a preferable reward/risk ratio - given the rational preference of rational investors - on a month-to-month basis. The instrument characterized by six months of 2.0% positive returns and six months of 1.0% negative returns will have a higher ODRR than one which has six months of 10.0% positive returns and six months of 9.0% negative returns.

ODRR's capacity to succinctly capture such risk-reward considerations can be illustrated by comparing the ODRR of the SPY with that of a test portfolio ("Test Portfolio"), side by side. For purposes of this comparison, the Test Portfolio will be comprised of:

Table 2: Composition of Test Portfolio

Instrument	% of Portfolio
Innovator U.S. Equity Power Buffer ETF - November (PNOV) (ETF)	39.4%
Invesco RAFI Strategic US ETF (IUS) (ETF)	21.3%
Travelers Companies Inc. (TRV) (Stock)	15.5%
Amazon.com, Inc. (AMZN) (Stock)	8.3%
S&P 500 trading index (SPY) (ETF)	6.7%
Vanguard High Dividend Yield Index Fund (VYM) (ETF)	6.4%
Procter & Gamble Co. (PG) (Stock)	1.7%

An investor who invested equal sums in the Test Portfolio and in the SPY on November 1, 2020 would have seen cumulative returns as follows for the succeeding three years:

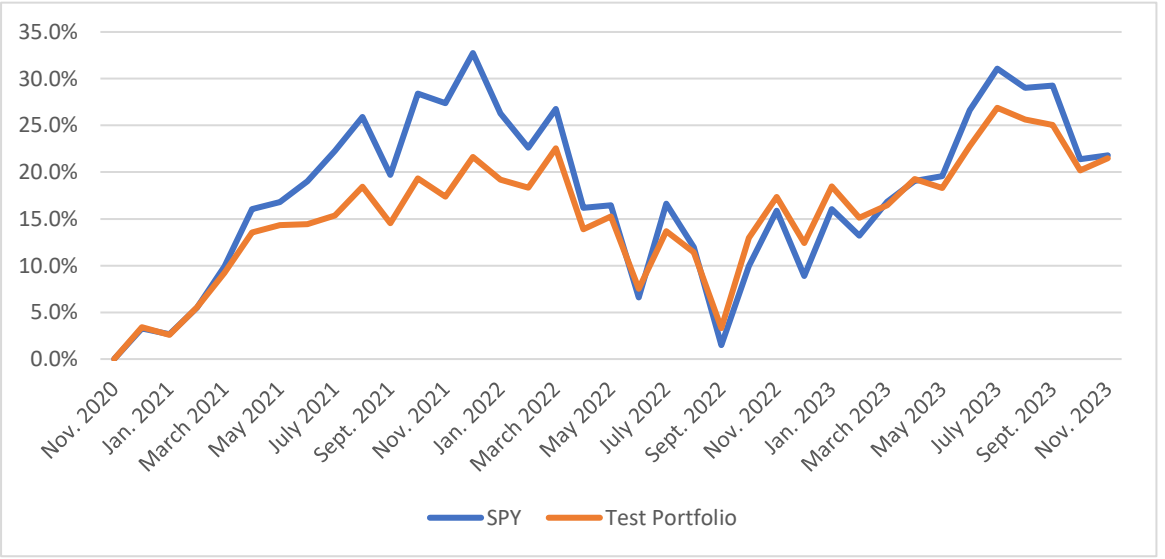

Figure 2: Comparison of SPY and Test Portfolio Cumulative Returns (Nov. 1, 2020-Nov. 1, 2023)

Based on the ETF and portfolio's monthly returns, respectively, of:

Table 2: Monthly Returns of the Test Portfolio and the SPY Nov. 1, 2020-Nov. 1, 2023

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Monthly Returns: Test Portfolio	3.3%	-0.8%	3.1%	3.6%	3.8%	1.0%	-0.4%	0.6%	2.9%	-3.4%	4.1%	-2.2%
Monthly Returns: SPY	3.3%	-0.6%	2.8%	4.4%	6.1%	0.8%	2.2%	3.3%	3.6%	-6.2%	8.7%	-1.0%
	Month 13	**Month 14**	**Month 15**	**Month 16**	**Month 17**	**Month 18**	**Month 19**	**Month 20**	**Month 21**	**Month 22**	**Month 23**	**Month 24**
Monthly Returns: Test Portfolio	4.2%	-1.5%	-0.4%	4.1%	-7.9%	1.6%	-7.3%	5.2%	-1.8%	-7.6%	10.1%	4.3%
Monthly Returns: SPY	5.4%	-6.5%	-3.7%	4.1%	-10.6%	0.3%	-9.9%	10.0%	-4.6%	-10.5%	8.5%	5.9%
	Month 25	**Month 26**	**Month 27**	**Month 28**	**Month 29**	**Month 30**	**Month 31**	**Month 32**	**Month 33**	**Month 34**	**Month 35**	**Month 36**
Monthly Returns: Test Portfolio	-4.5%	5.7%	-3.3%	0.8%	2.9%	-1.4%	4.0%	4.0%	-1.2%	-0.6%	-4.4%	1.2%
Monthly Returns: SPY	-7.0%	7.1%	-2.8%	3.6%	2.2%	0.5%	7.0%	4.5%	-2.1%	0.2%	-7.8%	0.4%

The resulting ODRR for the SPY and the Test Portfolio are:

Table 3: ODRR of SPY and Test Portfolio Nov. 1, 2020-Nov. 1, 2023

Optimized Directional Risk Ratio	
SPY	1.298
Test Portfolio	1.452

Thus, although the cumulative three-year returns are identical for the SPY and the Test Portfolio for the Nov. 1, 2020 to Nov. 1, 2023 period (21.8%), the Test Portfolio has a higher ODRR principally because it produced fewer individual months with markedly poor (<-6.0%) returns:

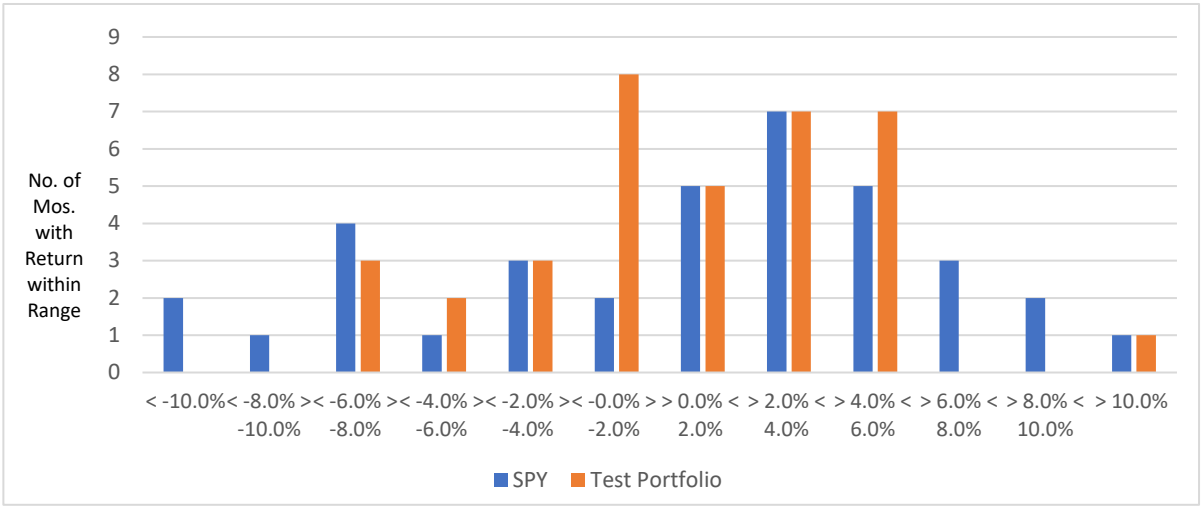

Figure 3: Distribution of Monthly Returns – SPY vs. Test Portfolio (Nov. 1, 2020-Nov. 1, 2023)

The ODRR can be calculated for any given time period of two months or more where there is at least one month with an observed positive return for a financial instrument, and one or more months of negative returns. Two-year, three-year, and five-year timeframes are logical time periods for calculation of the ODRR.
Ten-Year ODRRs and other increments could also be utilized.
The three-year and five-year ODRRs for the SPY, the Invesco QQQ Trust Series 1 (QQQ), and the SPDR Dow Jones Industrial Average Trust (DIA) ETFs for the Nov. 2020-Nov. 2023 time period are as follows:

Table 4: ODRR of SPY, QQQ, and DIA Three and Five-Year Time Periods

Optimized Directional Risk Ratio			
	SPY	QQQ	DIA
3-Year (Nov. 1, 2020-Nov. 1, 2023)	1.298	1.323	1.328
5-Year (Nov. 1, 2018-Nov. 1, 2023)	1.410	1.623	1.320

4.1 Fixed Income Instruments and Portfolios

Certain fixed income instruments will have ODRRs approaching infinity if they have scarcely or never produced negative returns in any given month. For these reasons, the principal application of the ODRR may lie in the field of equity investments. However, the ratio can be used to study the risk and return trade-offs of fixed income instruments which generate non-negligible negative monthly returns over given multi-month time periods.

5. Conclusion

This article has described and considered the merits of an optimized directional risk ratio ('ODRR' or 'Holmes Ratio') calculated as the sum of all positive monthly returns for a financial instrument for a given time period, divided by the negative of the negative monthly returns for that instrument over the same time period. Retail investors may find use of this ratio preferable to prevailing risk measurement methods to assess the attractiveness of competing investment choices. Fund managers may find it valuable to utilize in selecting fund components to maximize a fund's overall returns and stability, while minimizing downside risk.[16]

References

[1] VixFAQ.com. "What is the VIX Index?" (2022) accessed December 13, 2023. https://www.vixfaq.com/cboe-volatility-index-vix/

[2] (VixFAQ.com, 2022).

[3] Macroption.com. "Is Volatility the Same as Risk?" (2023) accessed December 13, 2023. https://www.macroption.com/is-volatility-the-same-as-risk/ ("[v]olatility is [n]on-[d]irectional").

[4] Morningstar. "Sortino Ratio" (2023) accessed December 13, 2023. https://admainnew.morningstar.com/directhelp/Glossary/Custom_Statistics/Sortino_Ratio.htm.

[5] Moller, A., and A. Askeljung, A. "Downside deviation as a measure of identifying underperforming assets" (2020) accessed December 13, 2023. https://www.diva-portal.org/smash/get/diva2:1436772/FULLTEXT01.pdf, p. 4.

[6] (Moller and Askeljung, 2020).

[7] Fernando, J. "Sharpe Ratio: Definition, Formula, and Examples." Investopedia (2023) accessed December 13, 2023. https://www.investopedia.com/terms/s/sharperatio.asp.

[8] There is also the Calmar Ratio, which is calculated as $\frac{r_p - r_f}{\text{Maximum Drawdown}}$ where Maximum Drawdown is calculated and defined as maximum loss from peak to trough over a given investment period. *See* Corporate Finance Institute. "Calmar Ratio" (2023) accessed December 13, 2023. https://corporatefinanceinstitute.com/resources/career-map/sell-side/capital-markets/calmar-ratio/. The Calmar Ratio suffers from the same threshold limitation as the Sharpe and Sortino Ratios, namely, that it is unnecessarily diluted by (and thereby rendered less useful as a medium of information on which investors may rely) incorporation of the exogenous risk-free-rate of return variable.

[9] Morningstar Office. "Fund vs. Fund Report" (2023) accessed December 13, 2023. https://awgmain.morningstar.com/webhelp/Research/Fund_vs_Fund_Report.htm

[10] Morningstar. "Morningstar Rating (Star Rating) – Funds" (2023) accessed December 13, 2023. https://awgmain.morningstar.com/webhelp/glossary_definitions/mutual_fund/mfglossary_MorningstarRating.html.

[11] *Id*.

[12] Vanguard. "Mutual fund ratings and future performance" (2023) accessed December 13, 2023. https://www.stat.berkeley.edu/~aldous/157/Papers/mutual_funds.pdf, p. 9 (concluding that the Morningstar rating system, like others, "offer[s] little insight into future [fund] performance").

[13] David Koenig (Charles Schwab). "Market Corrections are More Common Than You Might Think" (Feb. 22, 2022) accessed December 13, 2023. https://intelligent.schwab.com/article/stock-market-corrections-not-uncommon (noting that "a decline of at least 10% occurred in 10 out of 20 years" between 2002 and 2021, or "50% of the time, with an average pullback of 15%").

[14] Σ = Sum.

[15] The calculations described herein assume receipt, non-reinvestment, and indefinite retention of all dividends received.

[16] The author has no position in any individual financial instrument (ETF or stock) described in this article. The author does not offer investment advice, only his own research-based observations. Past results do not guarantee future returns. Nothing in this article has offered legal advice nor should be construed as such (nor as an invitation to form an attorney-client relationship).