Risk-Adjusted Performance of Diversification Strategies Across Macroeconomic Regimes

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Abstract

This paper investigates the risk-adjusted performance of traditional diversification strategies across contrasting macroeconomic regimes. I compare a concentrated S&P 500 portfolio against a diversified portfolio comprising equities, short-term Treasury bills, and gold. The analysis focuses on three market downturns: the Global Financial Crisis (2007), the COVID-19 Pandemic (2020), and the Inflationary Bear Market (2022). Using daily price data, I compute period returns, maximum drawdowns, and annualized Sharpe and Sortino ratios (annualized from daily values using $\sqrt{252}$). Results indicate that diversification improves recovery-window performance in deflationary crises, while inflationary shocks still produce weak risk-adjusted outcomes despite reduced drawdowns.

Introduction

Since Markowitz (1952) established Modern Portfolio Theory (MPT), asset allocation has been regarded as the cornerstone of risk management. The traditional "60/40 portfolio" has served as a benchmark for balanced investors, relying on a negative correlation between risky assets and safe-haven assets. However, the macroeconomic conditions of 2022 challenged this paradigm: high inflation and rapid rate hikes produced simultaneous declines in equities and bonds, weakening the standard hedging mechanism.

To examine this vulnerability, this study compares two allocation strategies. Portfolio A is 100% invested in the S&P 500 (SPY), while Portfolio B is a diversified mix: 40% SPY, 35% short-term T-bills (BIL), and 25% gold (GLD). The analysis covers three periods of market stress (2007, 2020, and 2022) to test how diversification performs under deflationary versus inflationary regimes.

Research Questions and Hypotheses

This paper addresses three questions. First, does a simple multi-asset allocation reduce drawdowns relative to an equity-only benchmark during crisis regimes? Second, are the benefits of diversification regime-dependent (deflationary vs. inflationary shocks)? Third, how do risk-adjusted metrics (Sharpe and Sortino ratios) compare across regimes?

Based on MPT, I expect Portfolio B to exhibit lower maximum drawdowns and stronger risk-adjusted performance during deflationary downturns. For inflationary shocks, I expect weaker risk-adjusted performance for both portfolios and a narrower performance gap.

Brief Literature Context

MPT emphasizes the role of diversification in reducing portfolio variance through imperfect correlations (Markowitz, 1952). The Sharpe ratio is a standard risk-adjusted measure that treats volatility symmetrically (Sharpe, 1966), while the Sortino ratio isolates downside risk to reflect investor loss aversion (Sortino & van der Meer, 1991). This study situates those metrics within three recent crisis regimes to evaluate whether diversification behaves as expected when correlations shift.

Methodology

Data

Historical daily closing prices for SPY, BIL, and GLD were compiled from the provided CSV files derived from Google Finance. The CSVs provide two distinct window types, which are reported separately in the Results:

1. Global Financial Crisis (Deflationary)
    - Drawdown window (peak-to-trough): 2007-10-09 to 2009-03-09
    - Recovery window (crisis + recovery): 2007-10-09 to 2013-03-28
2. COVID-19 Pandemic (Deflationary)

- Drawdown window (peak-to-trough): 2020-02-19 to 2020-03-23
- Recovery window (crisis + recovery): 2020-02-19 to 2020-08-18

3. Inflationary Bear Market (Inflationary)

- Drawdown window (peak-to-trough): 2022-01-03 to 2022-10-12
- Recovery window (crisis + recovery): 2022-01-03 to 2024-01-19

Portfolio Construction

Portfolio A is an equity-only benchmark (100% SPY). Portfolio B follows a simplified "All-Weather" allocation:

- 40% Equities (SPY)
- 35% Short-term T-bills (BIL)
- 25% Gold (GLD)

Portfolio returns are computed as a weighted sum of daily asset returns, which implies daily rebalancing.

Return Construction and Aggregation

Daily arithmetic returns are computed from closing prices for each asset. Portfolio B's daily return is a weighted sum of component returns. Period returns are calculated by compounding daily returns within each window type. For the 2007 drawdown-window Portfolio B return, the spreadsheet reports a buy-and-hold weighted sum of asset period returns; I retain that convention for consistency. The risk-free proxy is the daily return of BIL.

Performance Metrics

Daily returns were computed from price series. Period return and maximum drawdown are reported for each portfolio. Risk-adjusted performance is evaluated using Sharpe and Sortino ratios:

$$\text{Sharpe} = \frac{R_p - R_f}{\sigma_p}, \quad \text{Sortino} = \frac{R_p - R_f}{\sigma_d},$$

where R_p is portfolio return, R_f is the risk-free return proxy (daily BIL returns), σ_p is total volatility, and σ_d is downside deviation. The Sharpe ratio follows Sharpe (1966), while the Sortino ratio follows Sortino and van der Meer (1991). Ratios are annualized by multiplying daily ratios by $\sqrt{252}$ to match the spreadsheet calculations. Sortino can be negative when excess returns are negative, and undefined when downside deviation is zero.

Maximum Drawdown

Maximum drawdown is computed from the peak-to-trough decline of the cumulative return series within each regime window. This metric directly reflects capital preservation, which is central to diversification's practical value during crises.

Results

Table 1

Recovery-window period returns (compounded from daily returns)

Period	Return A (%)	Return B (%)
2007 GFC	-0.02	28.70
2020 Pandemic	0.50	7.10
2022 Inflation	1.02	4.40

Note. Recovery windows are listed in the Data section. Portfolio A is 100% SPY; Portfolio B is 40% SPY, 35% BIL, and 25% GLD.

Table 2

Drawdown-window peak-to-trough returns (buy-and-hold weighted)

Period	Return A (%)	Return B (%)
2007 GFC	-56.47	-17.39
2020 Pandemic	-34.10	-14.41
2022 Inflation	-25.36	-11.95

Note. Drawdown windows are defined as peak-to-trough. Portfolio B drawdown returns are computed as buy-and-hold weighted sums of asset period returns (as in the spreadsheet), not from daily compounding.

Table 3

Sharpe ratios (annualized, recovery windows)

Period	Sharpe A	Sharpe B
2007 GFC	0.1250	0.4519
2020 Pandemic	0.2255	0.7861
2022 Inflation	0.1149	0.2754

Note. Ratios are annualized by multiplying daily ratios by $\sqrt{252}$. The risk-free proxy is daily BIL returns.

Table 4

Sortino ratios (annualized, drawdown windows)

Period	Sortino A	Sortino B
2007 GFC	0.7344	2.8050
2020 Pandemic	-6.3106	-6.1855
2022 Inflation	-1.8878	-1.9780

Note. Sortino can be negative when excess returns are negative, and undefined when downside deviation is zero. For 2007 Portfolio B, SPY and BIL were aligned by calendar date and rows with mismatched dates after 2007-11-23 were removed, eliminating the spurious -100% BIL return from a multi-day gap; the annualized Sortino is 2.8050. For 2020 and 2022, Portfolio B Sortino is computed from drawdown-window daily weighted returns using 40% SPY, 35% BIL, and 25% GLD.

Regime-Level Outcomes

2007 Global Financial Crisis. The recovery-window return for Portfolio A is -0.02%, while Portfolio B returns 28.70%. The drawdown-window peak-to-trough return is -56.47% for Portfolio A and -17.39% for Portfolio B. Recovery-window Sharpe ratios favor Portfolio B (0.4519 vs. 0.1250). The drawdown-window Sortino is 0.7344 for Portfolio A and 2.8050 for Portfolio B after correcting BIL date alignment in the drawdown series.

2020 Pandemic Shock. Recovery-window returns are 0.50% for Portfolio A and 7.10% for Portfolio B. The drawdown-window return for Portfolio A is -34.10%, while Portfolio B is -14.41%. Recovery-window Sharpe ratios again favor Portfolio B (0.7861 vs. 0.2255). Drawdown-window Sortino ratios are negative for both portfolios (A: -6.3106; B: -6.1855), reflecting negative excess returns over a short window.

2022 Inflationary Bear Market. Recovery-window returns are 1.02% for Portfolio A and 4.40% for Portfolio B. The drawdown-window return for Portfolio A is

-25.36%, while Portfolio B is -11.95%. Recovery-window Sharpe ratios remain higher for Portfolio B (0.2754 vs. 0.1149). Drawdown-window Sortino ratios are negative for both portfolios (A: -1.8878; B: -1.9780), indicating negative excess returns during the drawdown period.

Discussion

The empirical results show that diversification improves recovery-window returns and Sharpe ratios in all three regimes. Drawdown-window results highlight severe losses for the equity-only benchmark, while Portfolio B's 2007 drawdown loss is materially smaller. In contrast, the inflationary shock of 2022 produces weak risk-adjusted performance even after diversification, and drawdown-window Sortino ratios are negative for both portfolios in 2020 and 2022.

This pattern indicates a regime-specific vulnerability: inflationary shocks still produce weak risk-adjusted performance even after diversification. These results suggest diversification is necessary but not sufficient during inflation-driven crises, motivating exploration of dynamic allocation or inflation-protected assets.

Practical Implications

From a capital-preservation perspective, the magnitude of drawdown reduction is economically meaningful. A portfolio that avoids deep drawdowns requires a smaller recovery return to reach prior peaks, which supports long-horizon compounding. The results also indicate that a simple three-asset allocation can improve outcomes without complex regime timing, although its effectiveness depends on the macroeconomic driver of the crisis.

Interpretation of Risk-Adjusted Metrics

The Sharpe ratio treats upside and downside volatility symmetrically, whereas the Sortino ratio isolates downside deviation. In drawdown windows, negative excess returns produce negative Sortino values, as seen in 2020 and 2022 for both portfolios. Undefined Sortino values can also occur when downside deviation is zero, which should be reported

explicitly rather than replaced with positive values.

Window Consistency

The regime split between drawdown and recovery windows clarifies why performance comparisons can be misleading if metrics are mixed across windows. Risk-adjusted metrics should be computed on the same window as the corresponding return and drawdown statistics to preserve methodological consistency.

Limitations

This study uses a simplified allocation and a limited set of assets, and depends on the availability and quality of the provided CSV data. The analysis does not include transaction costs, taxes, or alternative weighting schemes that might improve robustness. The 2020 drawdown window is short, so annualized interpretations should be treated cautiously. The 2007 Portfolio B Sortino is sensitive to date alignment between SPY and BIL. Future work could extend the model with additional inflation-hedging assets and regime-switching strategies.

Conclusion

Across three distinct market regimes, diversification improves recovery-window performance and reduces drawdown-window losses relative to an equity-only benchmark. The regime split between drawdown and recovery windows underscores the need for consistent measurement when comparing risk-adjusted outcomes. A resilient long-term strategy likely requires diversification plus dynamic allocation that accounts for macroeconomic regime shifts.

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