

EQUAL DRAWDOWN CONTRIBUTION PORTFOLIO

A Risk-Based Asset Allocation Strategy

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Abstract

Risk-based allocation principles have attracted considerable attention in portfolio management, with the Equal Risk Contribution (ERC) approach being one of the most prominent examples. ERC portfolios equalise contributions to volatility and can be efficiently computed by cyclical coordinate descent algorithms. However, volatility is a local risk measure and does not directly capture path-dependent tail events such as portfolio drawdowns.

In this paper, we introduce the **Equal Drawdown Contribution** (EDC) portfolio, which equalises contributions to a path-dependent risk measure, namely the conditional maximum drawdown at level α . The resulting optimisation problem is intrinsically non-linear and requires Monte Carlo simulation. We propose a practical implementation based on (i) a Monte Carlo estimator of conditional maximum drawdown, (ii) Gaussian importance sampling with a calibrated drift shift, and (iii) a robust cyclic coordinate descent procedure inspired by the ERC literature. We also employ an ERC portfolio as a natural initial guess in order to accelerate convergence for large universes.

Numerical experiments on simulated data and equity universes illustrate the behaviour of EDC portfolios and provide comparisons with cap-weighted, equal-weighted and ERC allocations, both in terms of ex-ante drawdown risk and out-of-sample performance.

Key words: Portfolio Management, Equal Risk Contribution, Maximum Drawdown

8 Conclusion

This paper introduces the Equal Drawdown Contribution (EDC) portfolio, a new member of the risk-parity family that replaces volatility with maximum drawdown as the underlying risk measure. By constructing portfolios in which each asset contributes equally to conditional maximum drawdown, the EDC framework aligns portfolio construction with the concerns of investors who place disproportionate weight on large cumulative losses rather than on symmetric fluctuations in returns. In doing so, it extends the classical ERC methodology of [Maillard et al. \(2010\)](#) into a richer, more behaviourally relevant setting that explicitly accounts for the asymmetric and path-dependent nature of severe losses.

A central contribution of the paper is the demonstration that drawdown-based risk measures, despite their path dependence and non-linearity, retain key structural properties¹ that make risk attribution and risk budgeting possible. These properties enable the derivation of marginal and percentage drawdown contributions, which in turn yield a clear and intuitive definition of the EDC portfolio. The resulting fixed-point characterization closely parallels that of classical risk-parity portfolios, but it incorporates richer information about the joint evolution of portfolio value and running maxima.

From a computational perspective, the paper shows that EDC portfolios are tractable to implement. Although the evaluation of conditional maximum drawdown requires simulation, both finite-difference approximations and pathwise derivative methods permit efficient estimation of marginal drawdown contributions. Building on these gradient estimates, we propose a practical optimization algorithm based on iterative weight updates and normalization, which converges reliably in both simulated and empirical settings. The framework is flexible enough to incorporate constraints, factor structures and dynamic extensions.

The empirical implications of EDC are conceptually appealing. Because the allocation is anchored to drawdown risk, portfolios tend to favour assets with stable and resilient return trajectories. Aggressively down-weighting assets contribute disproportionately to severe losses. This induces a form of tail-risk diversification that is not captured by volatility-based risk parity, and often leads to more robust performance during episodes of market stress. At the same time, EDC portfolios can exhibit lower turnover and more stable weights than mean-variance allocations, reflecting the persistence of drawdown profiles relative to higher-moment estimation noise.

The results of this study open several avenues for future research. A natural next step is an extensive empirical evaluation across asset classes and market regimes, comparing EDC not only to ERC but also to alternative drawdown-aware allocation frameworks, such as conditional drawdown-at-risk and expected shortfall-based optimization. The integration of factor models offers another promising direction, enabling the decomposition of drawdown risk into systematic drivers and facilitating the design of factor-based EDC portfolios. Finally, the development of dynamic and multi-period variants of EDC, together with the incorporation of return forecasts and transaction costs, would extend the framework toward a fully-fledged dynamic portfolio management tool.

Overall, the EDC paradigm provides a conceptually coherent, theoretically grounded and practically implementable approach to portfolio construction for investors who seek to manage drawdown risk explicitly. By bringing maximum drawdown into the risk-parity framework, this paper contributes to a broader shift in asset allocation toward risk measures that more faithfully capture investors' true economic concerns and regulatory constraints. The EDC portfolio thus represents a valuable addition to the toolkit of risk-aware asset allocation methodologies.

¹Such as positive homogeneity, convexity and the existence of a well-defined Euler decomposition