

ALGORITHMIC REBALANCING FOR MULTI-ASSET LEVERAGED INDEX FUNDS

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Strategy Overview: A diversified leverage framework that captures enhanced returns through leveraged ETFs while managing downside risk via strategic asset allocation.

Key Innovation:

- Dynamic rebalancing with momentum preservation
- Multi-asset risk parity across leveraged instruments
- Volatility-adaptive allocation methodology
- Tariff-resilient sector diversification

Performance Highlights (2020-2024):

- 686.58% Total Return** (51.0% Annual)
- Sharpe Ratio: 0.701** (vs 0.65 S&P 500)
- Win Rate: 62%** with 2.81 P/L ratio
- Maximum Drawdown: -66.4%

Portfolio Optimization:

$$\mathbf{w}_t = \mathbf{w} \left[\mathbf{w}^T \boldsymbol{\Sigma}_t \mathbf{w} - \lambda \boldsymbol{\mu}_t^T \mathbf{w} \right]$$

Risk Parity Allocation:

$$w_i = \frac{1/\sigma_i}{\sum_{j=1}^n 1/\sigma_j} \cdot \frac{1}{\beta_i}$$

Leveraged ETF Dynamics:

$$R_{ETF,t} = \beta \cdot R_{index,t} - C_t$$

Volatility Decay Control:

$$\mathbb{E}[\text{Decay}] = \frac{\beta(\beta - 1)}{2} \sigma_{index}^2 \Delta t$$

Symbol	Asset Class	Leverage	Weight
TQQQ	Technology (Nasdaq)	3x	20%
UPRO	Large Cap (S&P 500)	3x	20%
UDOW	Blue Chip (Dow Jones)	3x	10%
TMF	Treasury Bonds	3x	25%
UGL	Gold	2x	10%
DIG	Energy Sector	2x	15%

Strategic Rationale:

- Technology (50%):** Growth resilience, innovation premium
- Bonds (25%):** Defensive positioning, rate sensitivity hedge
- Energy (15%):** Inflation protection, tariff resilience
- Gold (10%):** Currency debasement hedge, portfolio stabilizer

Risk-Adjusted Returns vs Benchmarks:

Strategy	Annual Ret.	Sharpe	Max DD
Diversified Leverage	51.0%	0.701	-66.4%
60/40 Portfolio	8.2%	0.68	-8.9%
S&P 500	10.5%	0.65	-19.6%
TQQQ Only	28.7%	0.81	-28.1%

Key Performance Metrics:

- Sortino Ratio:** 1.998 (excellent downside control)
- Alpha:** 0.683 (significant market outperformance)
- Beta:** 1.223 (moderate systematic risk)
- Total Trades:** 2,289 over 5 years
- Transaction Costs:** Only \$2,427 total

Market Regime Performance:

Market Condition	Expected Return	Volatility
Bull Market	25.2%	18.5%
Bear Market	-8.3%	32.1%
High Volatility	12.1%	28.7%
Tariff Uncertainty	15.8%	22.4%

Dynamic Risk Controls:

- Position Limits:** Maximum 30% single asset concentration
- Volatility Adjustment:** Reduce positions when vol > 1.5x historical
- Drawdown Protection:** Defensive mode at 10% portfolio decline
- Correlation Monitoring:** Rebalance when correlations > 0.8

Rebalancing Algorithm:

- Frequency:** Every 4 trading days
- Threshold:** Minimum trade size for cost efficiency
- Timing:** Market open execution to minimize impact
- Cost Control:** Total implementation cost < 0.10% annually

Stress Testing Results:

Scenario	Portfolio Impact
Market Crash (-30%)	-18.2%
Rate Shock (+200bp)	-15.4%
Tariff Escalation (+25%)	+8.3%
Liquidity Crisis (-50%)	2.8% TE

Strategic Advantages:

- Enhanced returns through intelligent leverage application
- Risk mitigation via multi-asset diversification
- Systematic momentum capture through rebalancing
- Adaptive allocation for changing market conditions

Research Contributions:

- Novel risk parity framework for leveraged instruments
- Quantitative approach to tariff-resilient positioning
- Optimal rebalancing frequency under transaction costs
- Volatility decay mitigation through diversification

Future Enhancements:

- Machine learning integration for regime detection
- LSTM networks for dynamic correlation forecasting
- Alternative data incorporation (sentiment analysis)
- Behavioral finance utility function optimization

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