

# Automated Portfolio Construction Through Quantitative Value Strategies

A Sector-Specific Approach Combining Value and Quality

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## **Research Question:**

*Can a sector-specific percentile value investing strategy systematically outperform the market on a risk-adjusted basis over the 2006-2023 period?*

# The Problem & Our Unique Angle

- **Traditional value investing limitations:** Cross-sectoral P/E comparisons ignore business model differences; declining post-2008 effectiveness
- **Market reality:** Factor crowding documented in recent literature (Arnott et al., 2021) reduces traditional value premiums
- **Our differentiation:** First comprehensive sector-specific percentile framework for institutional implementation

## The Challenge

Traditional HML factors suffer from sector concentration bias - i.e.: utilities appear "cheap" vs. technology not due to opportunities, but due to structural business model differences

# Core Hypothesis & Why It Matters

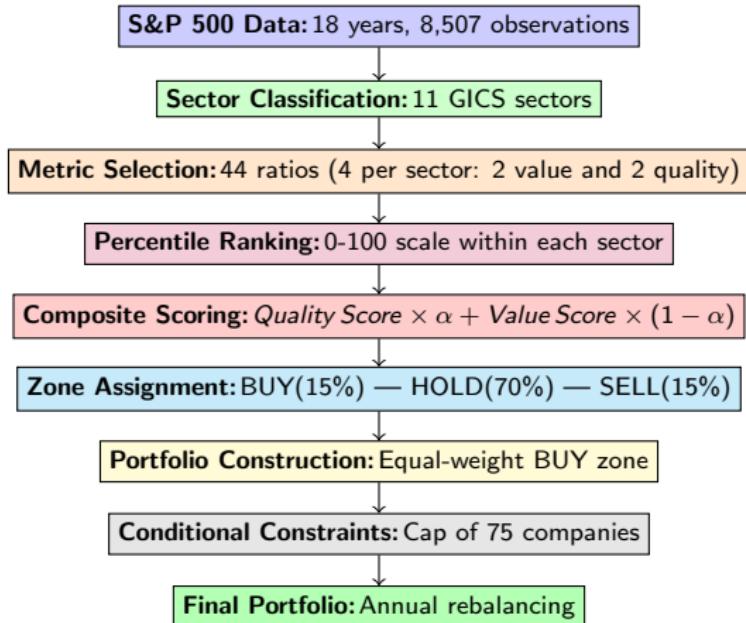
- **H<sub>1</sub>:** Can a sector-specific percentile strategy, which combines quality and valuation metrics, systematically outperform broader market benchmarks on a risk adjusted basis, over the 2006-2023 period?
- **H<sub>2</sub>:** How performance characteristics respond to variations in the quality-valuation weighting parameter (alpha) and in the percentile threshold?
- **Relevance:** Institutional investors need strategies that work across economic cycles with manageable turnover

## Academic & Practical Impact

Bridges gap between factor theory and institutional implementation - addresses \$500B+ factor investing market challenges with academically rigorous methodology

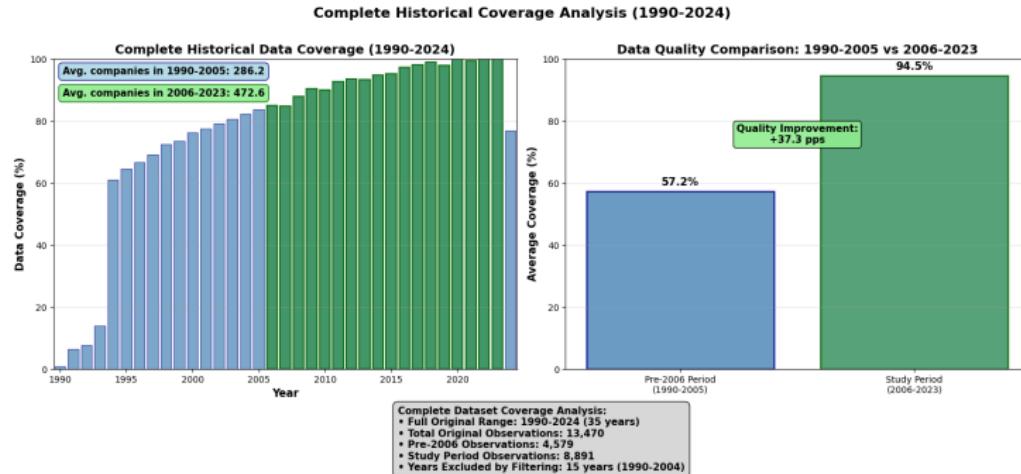
# Methodology Overview - Complete Process

**Comprehensive methodology** addressing traditional value investing limitations through systematic sector-neutral framework



# Study Period Selection & Data Quality

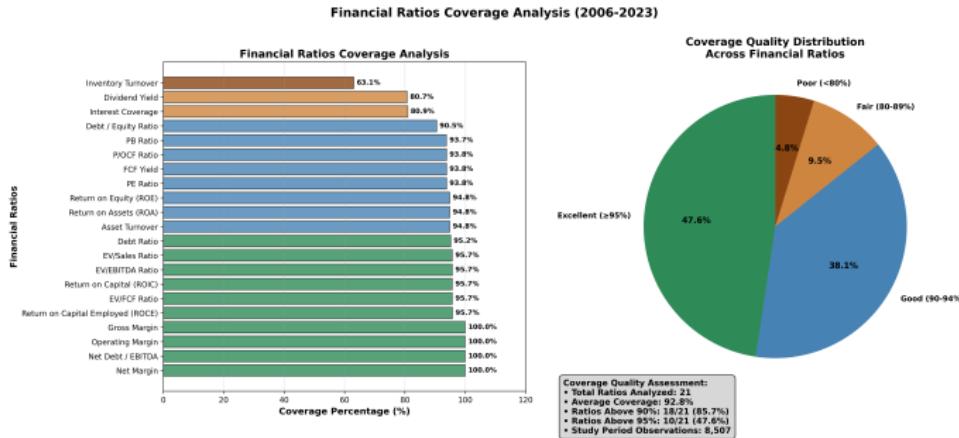
**Empirical justification** for 2006-2023 study period through comprehensive data quality analysis



- **Post-SOX enhancement:** 2006-2023 period benefits from regulatory improvements
- **Coverage improvement:** 94.5% vs 57.2% (**37.3 pps gain**)
- **Sample robustness:** 8,507 observations vs 4,579 pre-2006

# Sector-Specific Framework

**11 GICS sectors with tailored financial metrics** grounded in academic research (Cohen & Polk, 1996; Moskowitz & Grinblatt, 1999) demonstrating that industry-relative valuations outperform cross-sectoral approaches



- **Innovation core:** Within-sector percentile rankings eliminate cross-sectoral bias while maintaining statistical robustness across all 11 GICS classifications

# Sector-Specific Metrics

**Table 2: Sector-Specific Valuation Metrics**

GICS Sector	Valuation Metric 1	Valuation Metric 2
Information Technology	EV/Sales Ratio	PE Ratio
Health Care	PE Ratio	EV/Sales Ratio
Financials	PE Ratio	PB Ratio
Consumer Discretionary	EV/EBITDA Ratio	PE Ratio
Consumer Staples	FCF Yield	PE Ratio
Energy	EV/EBITDA Ratio	PB Ratio
Industrials	EV/FCF Ratio	EV/EBITDA Ratio
Materials	EV/EBITDA Ratio	PB Ratio
Utilities	Dividend Yield	PB Ratio
Real Estate	P/OCF Ratio	PB Ratio
Communication Services	PE Ratio	EV/Sales Ratio

## Sector-Specific Metrics (cont'd)

**Table 3: Sector-Specific Quality Metrics**

GICS Sector	Quality Metric 1	Quality Metric 2
Information Technology	Return on Invested Capital	Gross Margin
Health Care	Net Margin	Return on Assets
Financials	Return on Equity	Debt/Equity Ratio
Consumer Discretionary	Return on Assets	Operating Margin
Consumer Staples	Net Margin	Inventory Turnover
Energy	Net Debt/EBITDA	Return on Capital Employed
Industrials	Asset Turnover	Interest Coverage
Materials	Debt/Equity Ratio	Gross Margin
Utilities	Interest Coverage	Net Debt/EBITDA
Real Estate	Debt Ratio	Interest Coverage
Communication Services	Operating Margin	Gross Margin

# Composite Score Construction - Three-Stage Process

## • Step 1: Within-Sector Percentile Ranking

- Individual metrics transformed to 0-100 percentile scale within each GICS sector-year combination
- Direction-adjusted ranking: Higher percentiles = better performance (P/E inverted, ROE ascending)
- Sector-neutral foundation: Each company ranked only against industry peers

## • Step 2: Category Score Aggregation

- Valuation Score: Arithmetic mean of 2 sector-specific valuation metric percentiles
- Quality Score: Arithmetic mean of 2 sector-specific quality metric percentiles
- **Example:** Tech company with P/E (85th %ile) + EV/Sales (92nd %ile) → Valuation Score = 88.5

## • Step 3: Final Composite Score

- Equal weighting:  $\text{Composite Score} = \text{Quality} \times 0.5 + \text{Valuation} \times 0.5$
- $\alpha = 0.5$  empirically validated through parameter sensitivity analysis
- Range preservation: Final scores maintain 0-100 interpretability

# Portfolio Construction Process

- **BUY Zone Selection:**

- Top 15% composite scores within each sector selected for portfolio construction
- Equal-weight allocation across all BUY zone companies ensures balanced exposure
- Sector-neutral implementation prevents traditional value concentration bias

- **Conditional Hard Cap Mechanism:**

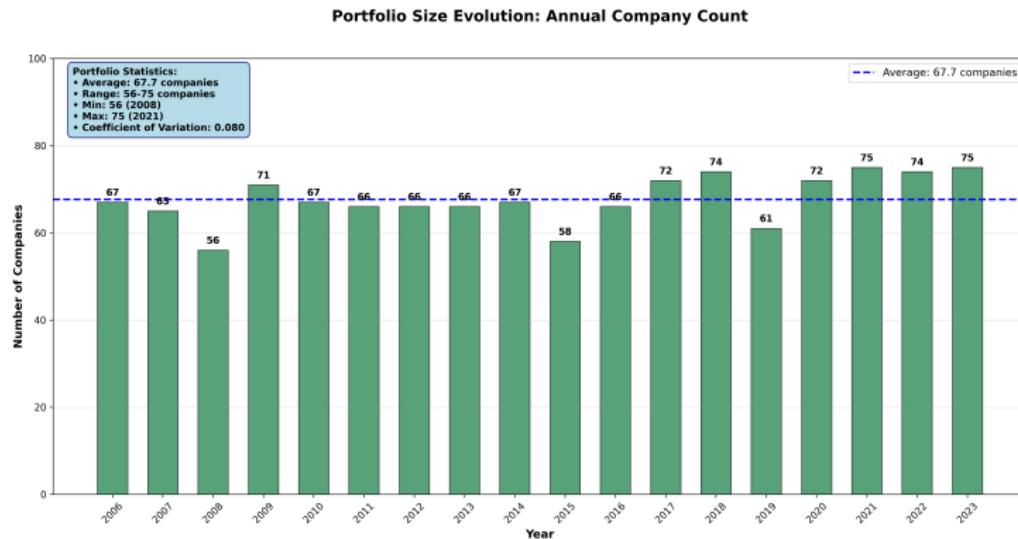
- 75-company maximum constraint (15% of S&P 500 universe)
- Conditional application: Only triggered when BUY candidates exceed 75 companies

- **Annual Rebalancing Protocol:**

- Annual frequency balances factor exposure maintenance with transaction cost control
- 1-year data lag: December 31st financial data → following year portfolio (bias prevention)

# Hard Cap Implementation

**Figure 9: Annual Company Count - Hard cap activation only in 2021 & 2023**



# Comprehensive Bias Prevention Framework

**Systematic bias mitigation protocol:** Five major bias categories systematically identified and addressed through rigorous academic framework

Bias Type	Description	Potential Impact	Mitigation Strategy Implemented
Survivorship Bias	Analysis limited to S&P 500 constituents that survived and achieved sufficient scale	Upward bias in performance metrics; underestimation of downside risk	Explicit acknowledgment; focus on large-cap institutionally investable universe
Look-Ahead Bias	Using information not available at portfolio construction time	Unrealistic performance expectations; non-implementable results	Mandatory 1-year financial data lag; point-in-time dataset construction
Concentration Bias	Excessive concentration in high-scoring sectors or companies	Increased portfolio risk; reduced diversification benefits	75-company hard cap; sector-neutral methodology
Data Snooping	Over-optimization to specific dataset characteristics	Strategy overfitting; poor out-of-sample performance	Fixed parameter selection ( $\alpha=0.5$ ); comprehensive robustness testing
Selection Bias	Cherry-picking favorable periods or market conditions	Non-generalizable results; regime-dependent findings	Complete economic cycle coverage (2006-2023); transparent period justification

# Comprehensive Robustness Testing Framework

**Five-dimensional validation framework** ensuring strategy effectiveness across multiple uncertainty dimensions:

- **1. Parameter Sensitivity Analysis:**

- Alpha parameter sweep:  $\alpha = 0.1$  to  $1.0$  (optimal at  $\alpha = 0.5$ )
- Threshold optimization: BUY zones 5% to 30% (optimal at 15%)

- **2. Monte Carlo Simulation:**

- 1,000 iterations with random company selection, alternative weightings, bootstrap resampling

- **3. Advanced Risk Assessment:**

- Tail risk evaluation and Regime analysis

- **4. Benchmark Comparison Analysis:**

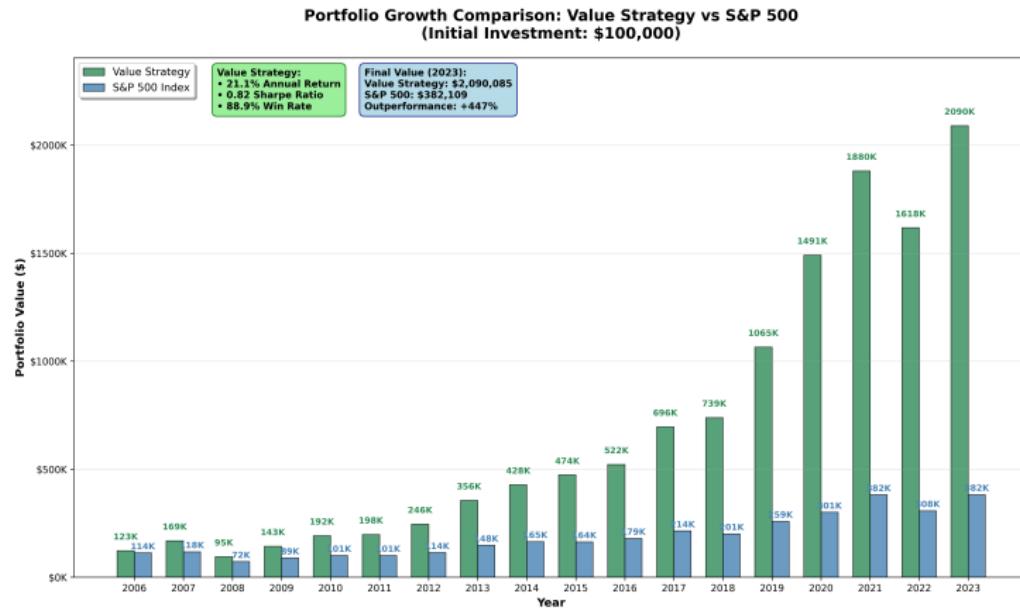
- Factor ETF comparison and Factor loading validation

- **5. Temporal Robustness Analysis:**

- Rolling window testing and Crisis performance

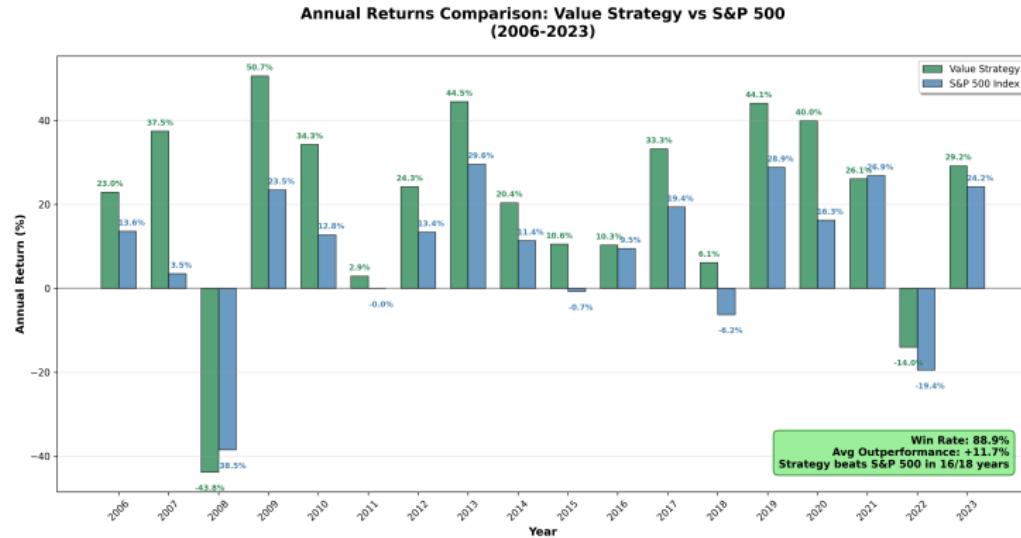
# Core Performance Results

## Figure 4: Portfolio Growth Comparison



# Core Performance Results (cont'd)

## Figure 13: Annual Returns Comparison



# Core Performance Results - Explanation

- **Absolute Performance Metrics:**

- 21.1% annual return vs 9.3% S&P 500 (**+11.8 generated alpha**)
- \$100k → \$2,090k portfolio value vs \$382k S&P 500 (December 2023)
- 88.9% win rate over 18 years (16/18 years outperformed benchmark)
- 95% annual turnover

- **Risk-Adjusted Performance:**

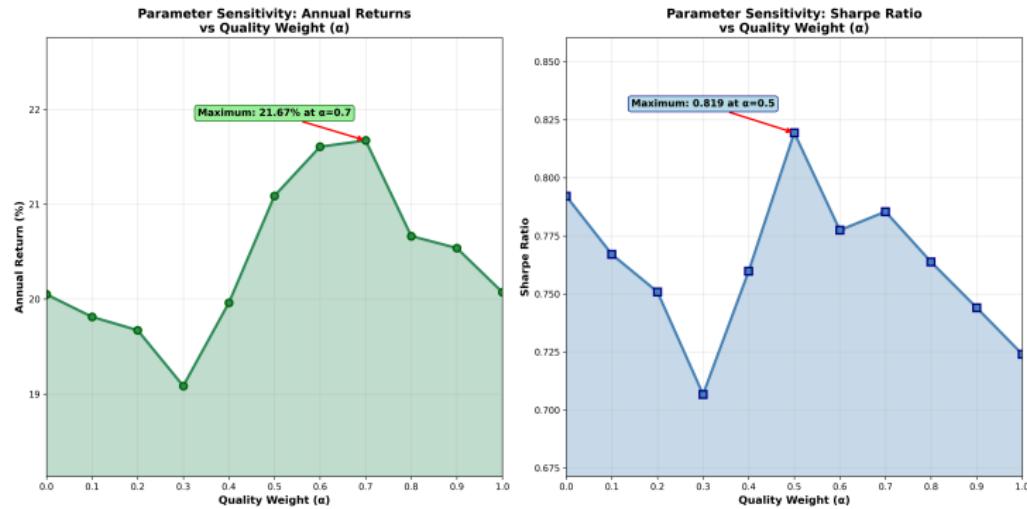
- 0.819 Sharpe ratio vs 0.416 benchmark (**+0.403 improvement**)
- 0.69 Information Ratio demonstrates consistent alpha generation capability
- 5.4% tracking error indicates controlled active risk within institutional parameters

- **Downside Protection & Crisis Resilience:**

- 43.8% maximum drawdown vs 50.9% S&P 500 during 2008-2009 financial crisis
- Superior downside protection through systematic quality screening methodology
- Consistent performance across 5 economic regimes

# Parameter Sensitivity Analysis

Figure 7: Parameter Sensitivity Analysis



# Parameter Sensitivity Analysis - Alpha Optimization

## • Alpha Parameter Optimization Findings:

- $\alpha = 0.5$  (equal weighting) empirically optimal across quality-valuation spectrum
- Academic validation: Confirms DeMiguel et al. (2009) equal weighting superiority in portfolio construction
- Economic interpretation: Quality and valuation factors contribute equally to systematic outperformance

## • Stability Analysis across Parameter Range:

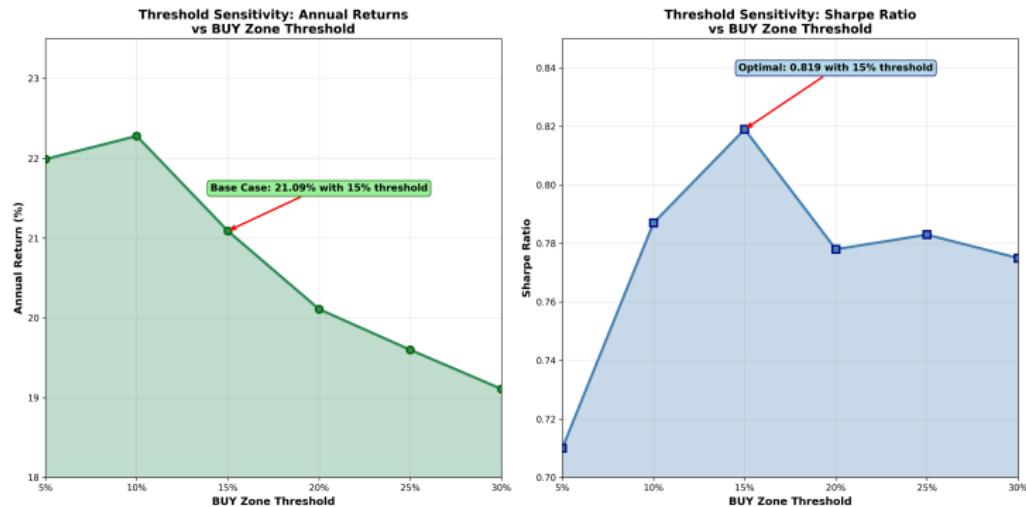
- Robust performance band:  $\alpha = 0.4$  to  $0.8$  maintains Sharpe ratio  $0.75$
- Performance degradation pattern: Linear decline outside optimal range
- Risk-return optimization: Equal weighting maximizes risk-adjusted returns while minimizing implementation complexity

## • Factor Integration Insights:

- Pure quality ( $\alpha = 1$ ): 20.0% annual return, 0.723 SR
- Pure valuation ( $\alpha = 0$ ): 20.0% annual return, 0.794 SR
- Optimal combination ( $\alpha = 0.5$ ): 21.1% annual return, 0.819 SR
- Synergistic effect: Combined factors outperform individual components

# Percentile Sensitivity Analysis

**Figure 8: Percentile Threshold Sensitivity Analysis**



- **Percentile Threshold Optimization Findings:**
  - 15% BUY zone empirically optimal across performance metrics
  - Academic validation: Balances portfolio concentration risk with signal strength preservation
  - Economic interpretation: Captures top-tier opportunities while maintaining sufficient diversification
- **Stability Analysis across Threshold Range:**
  - Performance degradation pattern: Sharpe ratio declines below 10% (concentration risk) and above 25% (signal dilution)
  - Risk-return optimization: 15% threshold maximizes alpha generation while controlling portfolio risk
- **Implementation & Portfolio Construction Insights:**
  - Concentration management: 15% threshold generates average 67.7 companies per portfolio
  - Signal preservation: Maintains statistical significance while enabling institutional implementation

- **Survivorship Bias Acknowledgement:**

- S&P 500 universe constraint: Excludes delisted and failed companies from analysis
- Potential impact: May overstate returns by 50-150 basis points annually (literature estimates)
- Justification rationale: Institutional focus on liquid, large-cap investable universe (80% US equity market)

- **Pseudo Out-Of-Sample Validation (Level 2):**

- Parameter selection limitation:  $\alpha = 0.5$  optimization used complete 2006-2023 dataset
- Model specification risk: Sector-specific metrics selected with full period visibility
- Academic transparency: Results represent strong evidence of potential, not guarantee of future performance

# Methodological Limitations & Academic Transparency (cont'd)

- **Look-Ahead Bias:**

- Model-level consideration: Strategy parameters optimized using complete dataset may incorporate forward-looking insights
- Data-level prevention: Mandatory 1-year financial data lag ensures following year implementation
- Academic transparency: Conservative implementation prevents individual company look-ahead bias but cannot eliminate model selection advantages

- **Static GICS Classification Constraint:**

- Business model evolution: Companies' core activities change faster than GICS classifications
- Future research: Adaptive classification frameworks represent important methodological extension

# Key Contributions & Future Research Directions

- **Academic Contributions to Factor Investing Literature:**
  - First comprehensive sector-specific percentile framework for systematic value investing with empirical validation
  - Within-sector ranking methodology eliminates cross-sectoral bias documented in traditional HML factors
  - Empirical evidence for equal-weighting superiority ( $\alpha = 0.5$ ) in quality-valuation combinations
- **Practical Contributions to Investment Management:**
  - Institutional-grade methodology
  - Implementation-ready framework
  - Crisis-tested robustness
- **Future Research Extensions:**
  - Enhanced validation: Walk-forward out-of-sample testing with rolling parameter estimation
  - Dynamic classification: Adaptive sector frameworks reflecting evolving business models

*"Sophisticated implementation still matters in systematic investing"*

# Thank you!

Questions?

**GitHub Repository:**

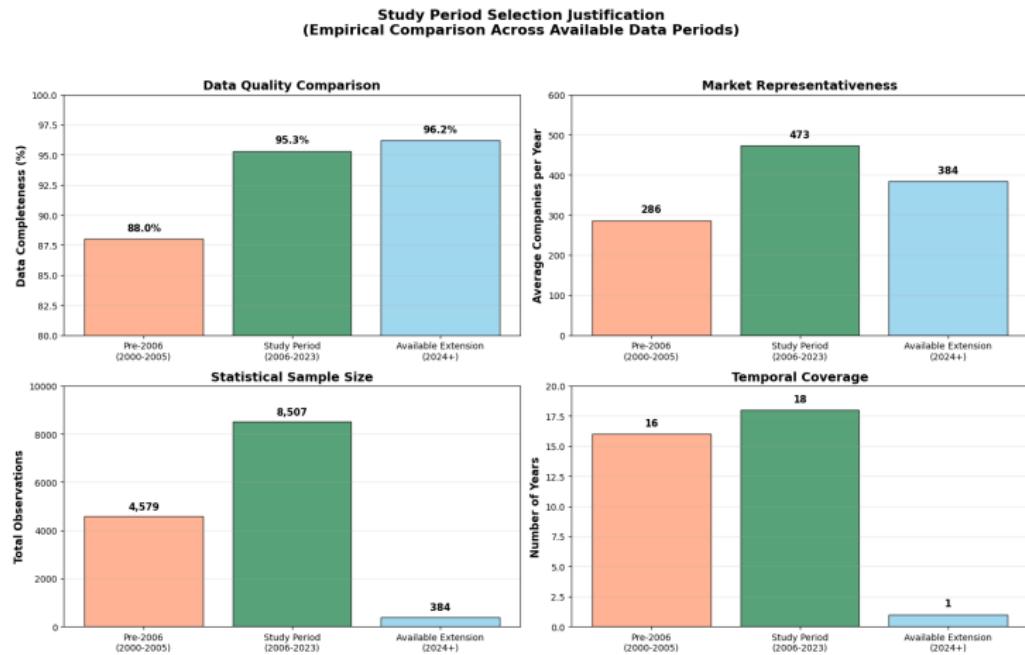
[github.com/nicoolopez/Master-Thesis-Value-Quant-Investing](https://github.com/nicoolopez/Master-Thesis-Value-Quant-Investing)

*Complete methodology documentation and reproducible code available online*



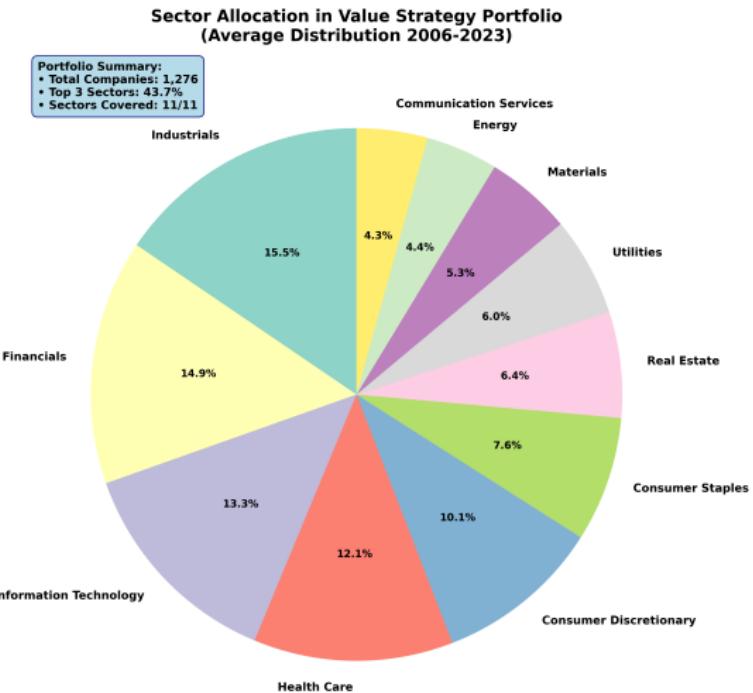
# Appendix 1

## Figure 1: Study Period Selection



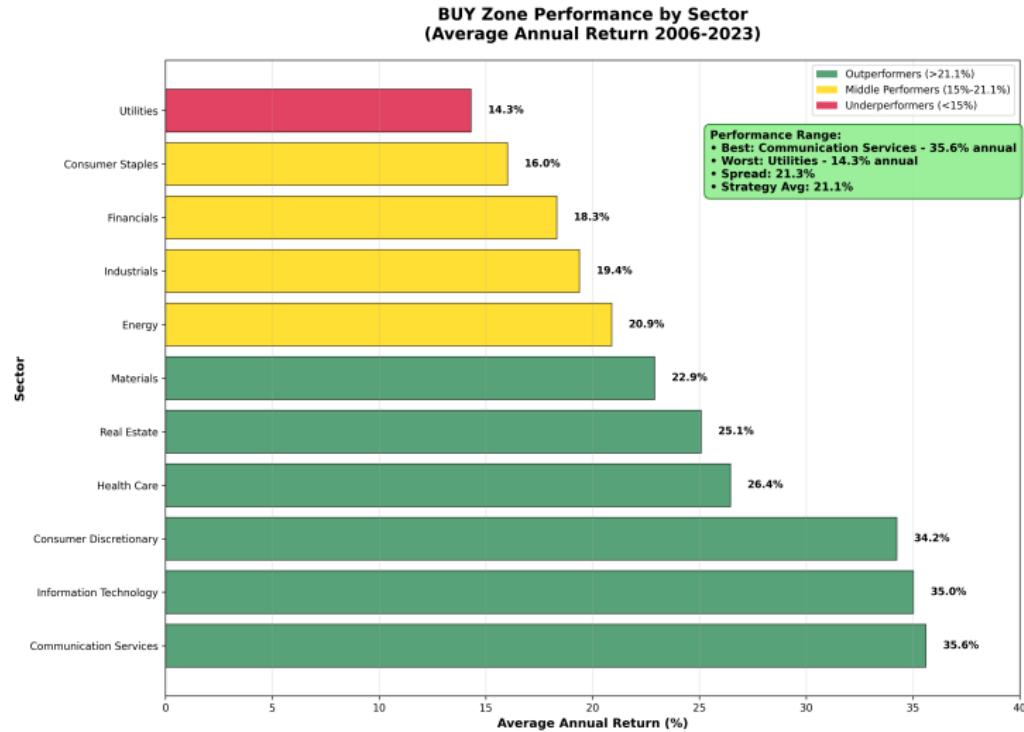
# Appendix 2

## Figure 5: Sector Allocation



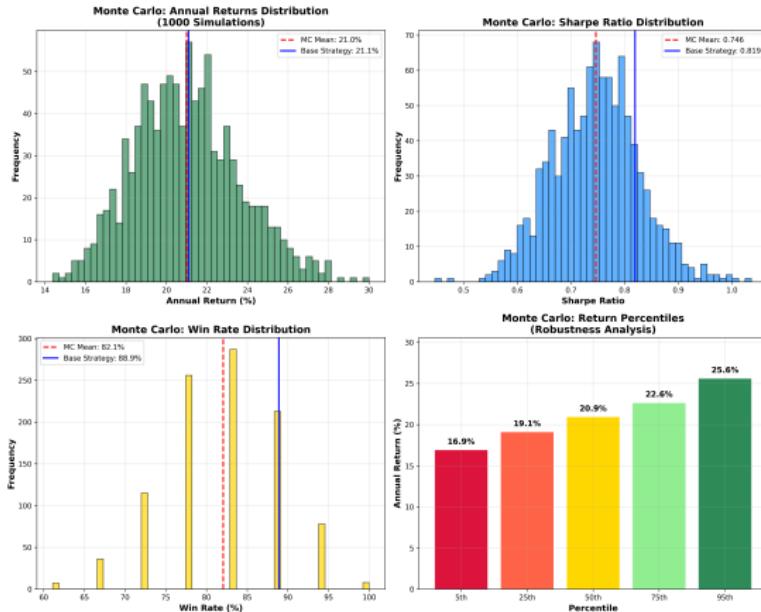
# Appendix 3

## Figure 6: Buy Zone Performance by Sector



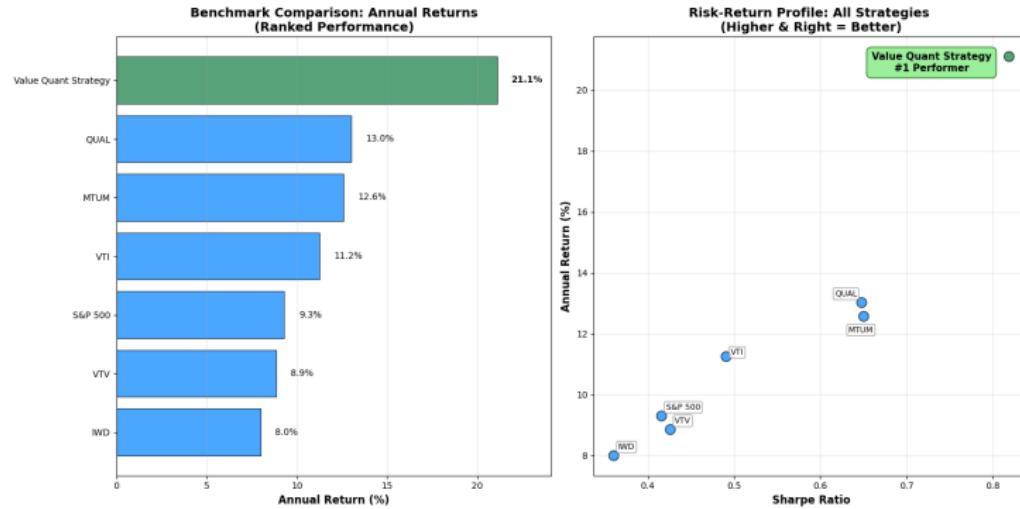
# Appendix 4

## Figure 10: Monte Carlo Results



# Appendix 5

## Figure 11: Benchmark Comparison



# Appendix 6

## Figure 12: Portfolio Turnover

