

# DAFI REPORT

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# Overview

- ▶ Introduction
- ▶ Methodology
- ▶ Regression: Linear and Lasso
- ▶ Factor Model Comparison
- ▶ Portfolio Construction
- ▶ Portfolio Evaluation
- ▶ Cross – Portfolio Analysis

# INTRODUCTION

# Introduction

- The Fama-French Five-Factor Model has been highly influential in asset pricing and risk management.
- Recent advancements in financial research have introduced new factors, such as industry-specific factors, momentum (MOM), short-term and long-term reversal factors.
- This project evaluates whether these new factors (check their significance through lasso regression) outperform the traditional Fama-French factors by analyzing their risk metrics both in-sample and out-of-sample. The analysis is based on the variance-covariance matrices, ex-ante and ex-post betas, and key risk metrics such as volatility, Value-at-Risk (VaR), and Expected Shortfall (ES).
- We then create six different portfolio strategies and evaluate the performance with proper metrics.

# METHODOLOGY

# Methodology

In the following slide, we will explain which have been the different steps that we initially took in order to realize our report

01

The first essential step to realize this project has been the collection of the data. We have decided to take in consideration the S&P 500 index.

02

We downloaded all the useful information directly from the Kenneth R. French Data Library website. We were able to find all the csv files for the different factors.

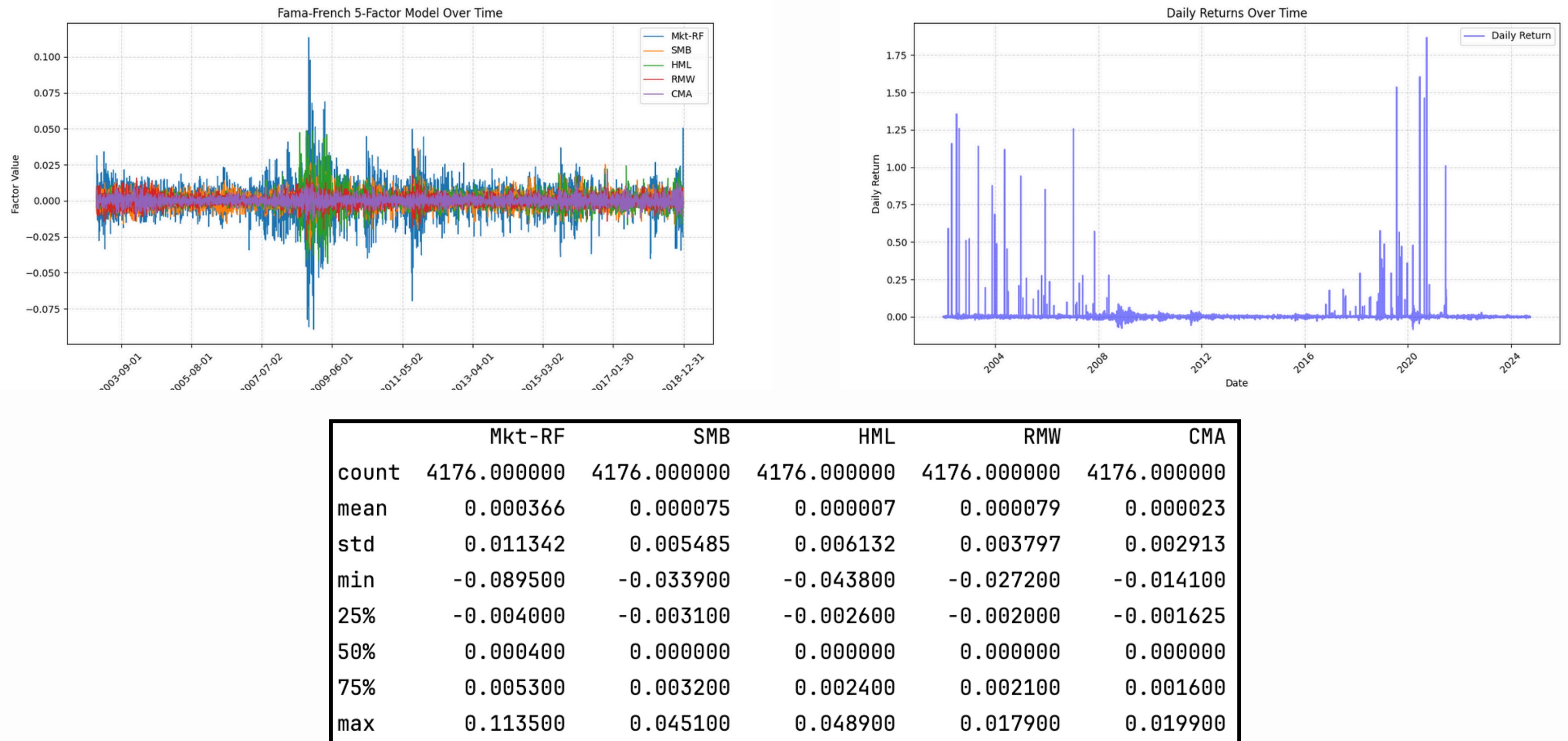
03

We imported the data on pycharm using different functions able to perform different tasks. For the industry factors, since on the website there were only the portfolios, we have created them by doing the pca and preserving the first five components

04

To have a better understanding of the data we were working with, we performed some initial exploratory data analysis.

# Graphs



# **REGRESSION: LINEAR AND LASSO**

### Lasso Regression Results (Selected Features Only, Sorted by Absolute Value):

	Feature	Lasso Coefficient	Selected
8	Industry_Factor_1	0.005598	Yes
0	Mkt-RF	0.003459	Yes
3	RMW	-0.000567	Yes
9	Industry_Factor_2	-0.000472	Yes
5	MOM	-0.000395	Yes

# The Lasso Regression

Lasso regression (Least Absolute Shrinkage and Selection Operator) is a type of linear regression that includes L1 regularization, which helps in feature selection by shrinking some coefficients to zero. The lasso regression has been useful in selecting the most relevant factors among the full set of factors (the five Fama French factors, momentum, industry and short/long term reversal factor).

The factors that we have used after the lasso:

- Mkt - RF (market)
- RMW (profitability)
- Industry Factor 1
- Industry Factor 2
- MOM (momentum)

# Linear Regression

- We performed linear regression on the two different datasets (Dataset1 and Dataset3), and analyzed the mean squared error (MSE) to evaluate how well the factors estimated the daily return of the S&P 500
- The results indicated strong predictive performance, as the MSE for Dataset3 was significantly lower than that of Dataset1 (0.0000018385 vs. 0.0003476591)
- Dataset3 was also able to explain better the training data given the higher R<sup>2</sup>

Sum of Residuals: -0.32923256284704566

Residual Analysis:

	Actual	Predicted	Residual
count	806.000000	806.000000	806.000000
mean	0.000228	0.000637	-0.000408
std	0.009075	0.009055	0.001294
min	-0.048460	-0.041389	-0.013035
25%	-0.003536	-0.003248	-0.001111
50%	0.000554	0.000883	-0.000389
75%	0.004594	0.004906	0.000278
max	0.062105	0.059667	0.007247

Mean Squared Error: 0.0000018385

Mean Squared Error: 0.0003476591

# **FACTOR MODEL COMPARISON**



# Introduction

- Objective: Compare the explanatory power of the Fama-French model vs. factors identified using Lasso regression
- Key Metrics Analyzed:
  - Variance-Covariance Matrices
  - Beta Sensitivity (Ex-Ante vs. Ex-Post)
  - Portfolio Volatility
  - Value at Risk (VaR) & Expected Shortfall (ES)
  - Correlation Analysis

# Variance - Covariance Matrix

## CORRELATION ANALYSIS

### Fama-French:

- Highest variance in Market Factor (0.000129)
- Lower covariance among factors

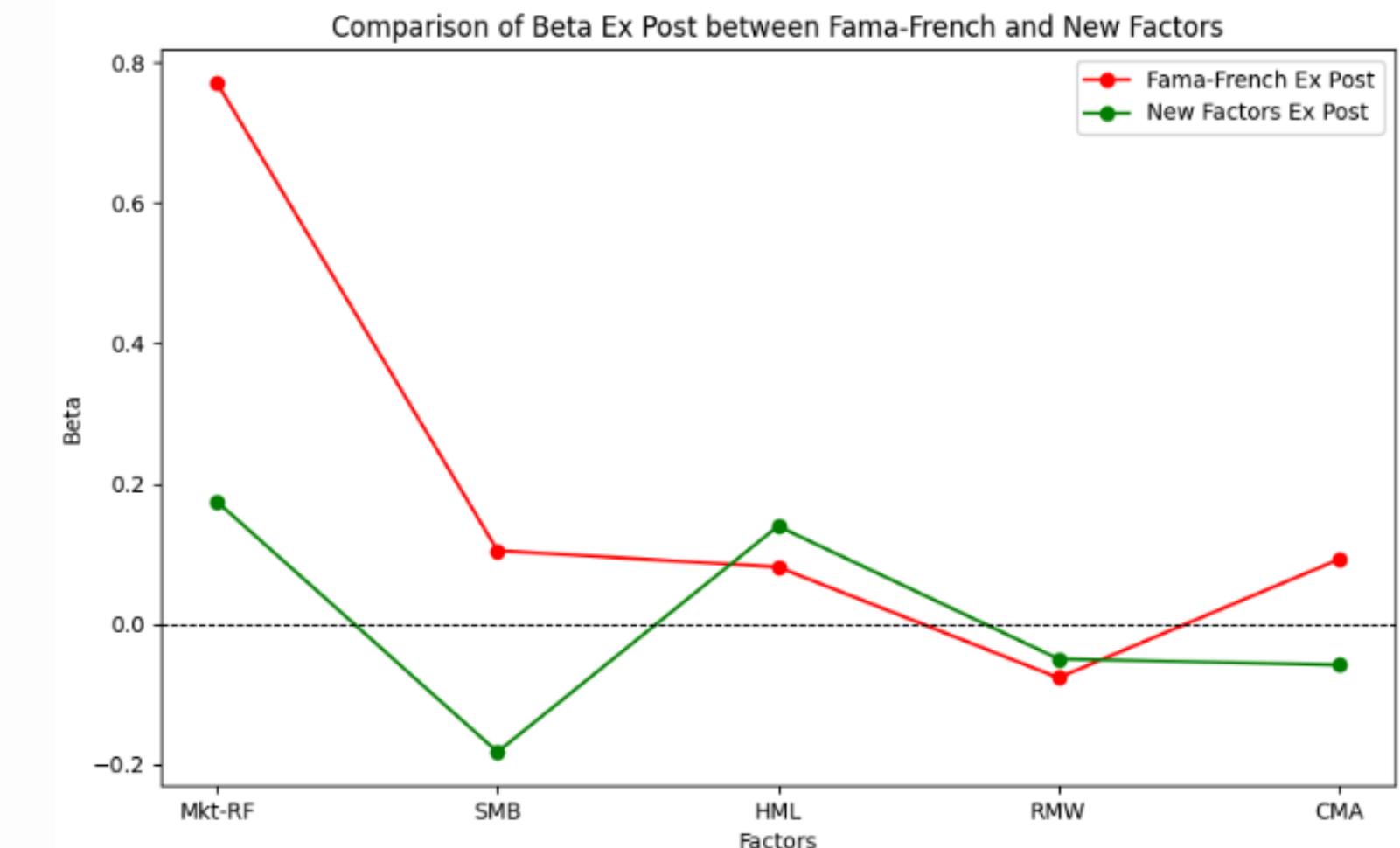
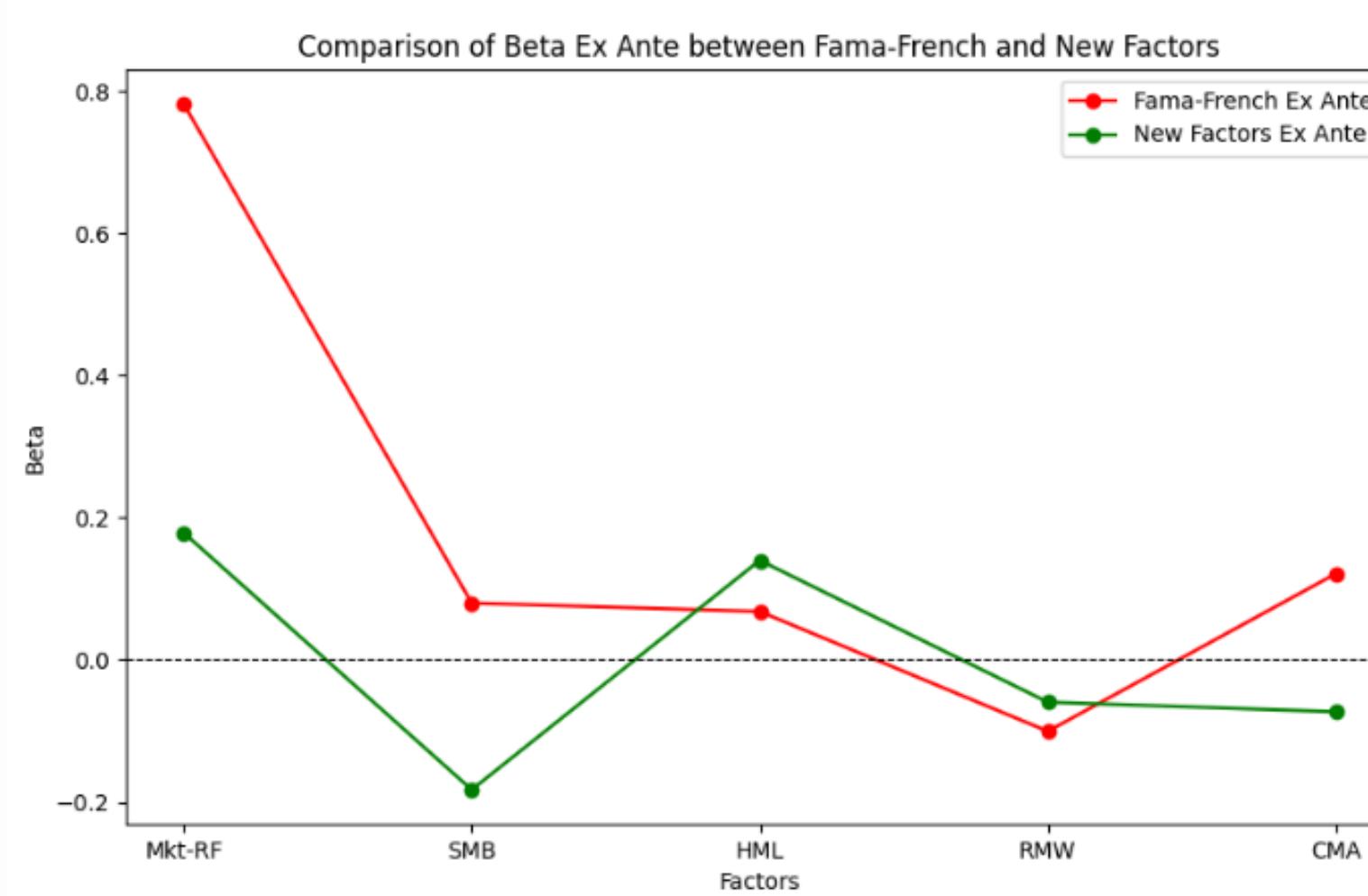
### Var-Covar Matrix Fama-French:

	Mkt-RF	SMB	HML	RMW	CMA
Mkt-RF	0.000129	1.551181e-05	0.000022	-0.000017	-2.765129e-06
SMB	0.000016	3.008155e-05	0.000003	-0.000006	9.052417e-07
HML	0.000022	3.014770e-06	0.000038	-0.000008	4.644790e-06
RMW	-0.000017	-6.308389e-06	-0.000008	0.000014	-1.820044e-06
CMA	-0.000003	9.052417e-07	0.000005	-0.000002	8.487828e-06

### Var-Covar Matrix New Factors:

	Mkt-RF	RMW	Industry_Factor_1	Industry_Factor_2	MOM
Mkt-RF	0.000133	-0.000017	0.000589	0.000055	-0.000032
RMW	-0.000017	0.000015	-0.000071	-0.000002	0.000008
Industry_Factor_1	0.000589	-0.000071	0.002714	0.000360	-0.000150
Industry_Factor_2	0.000055	-0.000002	0.000360	0.000330	-0.000008
MOM	-0.000032	0.000008	-0.000150	-0.000008	0.000082

# Beta Sensitivity



## BETA SENSITIVITY

- Fama-French Model: Ex-Ante Beta (Mkt-RF): 0.7818 → Ex-Post: 0.7711
- New Factors Model: Ex-Ante Beta (Mkt-RF): 0.1787 → Ex-Post: 0.1742
- More dynamic factor loadings in New Factors' Dataset

# Risk Metrics

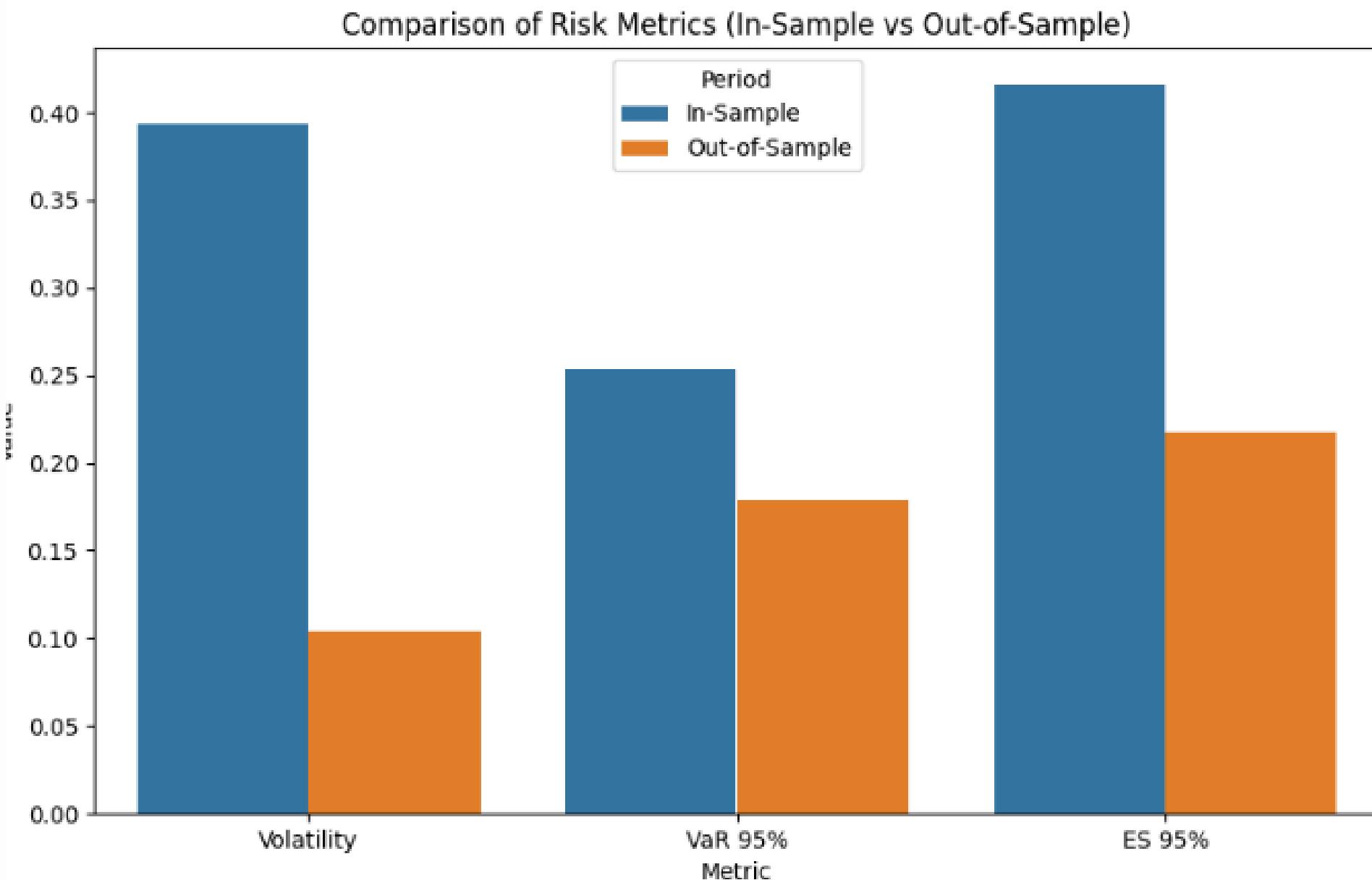
## RISK METRICS

### In-Sample:

- Volatility: 0.3933
- VaR 95%: 0.2539
- Expected Shortfall (ES): 0.4162

### Out-of-Sample:

- Volatility: 0.1393
- VaR 95%: 0.1785
- Expected Shortfall (ES): 0.2176
- Key Insight: Stability maintained in out-of-sample data



# Conclusions

## COMPARATIVE ANALYSIS

Fama-French vs. New Factors:

- Similar risk profiles
- Industry\_Factor\_1 and MOM provide additional explanatory power
- Lower covariances reduce multicollinearity

In-Sample vs. Out-of-Sample:

- Reduction in volatility → Generalization to new data
- Lower VaR and ES → Predictive power retained

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## CONCLUSIONS

- New factors align with traditional Fama-French risk measures
- No significant increase in risk, but improved explanatory power
- Potential for further research in different market conditions

# PORTFOLIO ANALYSIS

# Portfolio Construction

## Equal-Weight Portfolio

- assigns identical weights
- simple but effective
- avoids concentration risk

## Equal-Weight Dynamic Portfolio

- starts with equal weights
- adjusts weight dynamically
- ensure balanced portfolio

## Minimum Variance Portfolio

- minimizes the volatility
- optimizes weights through covariance matrix estimation

## Mean-Variance Portfolio

- maximizes expected returns for a given risk level
- or minimizes risk

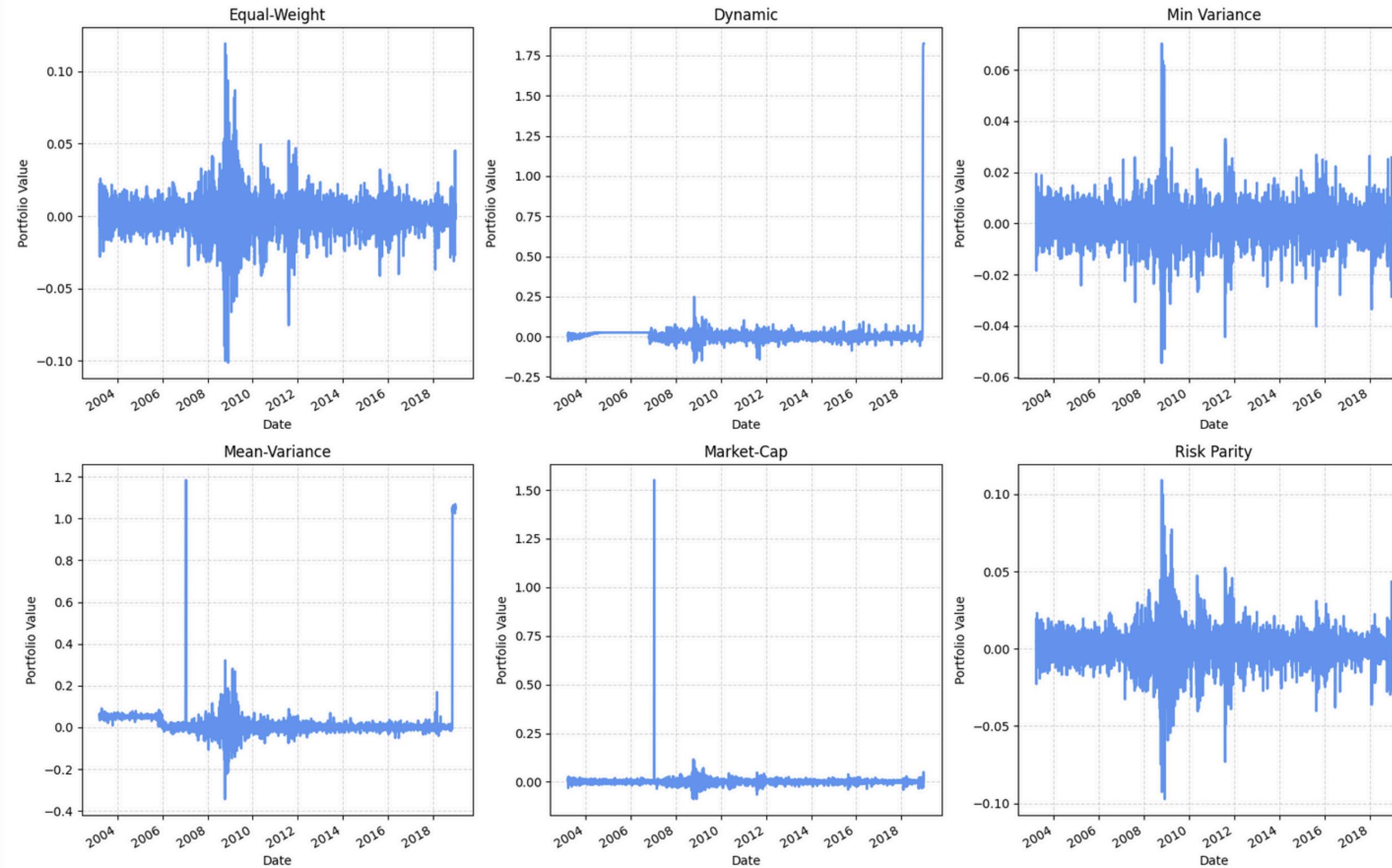
## Market-Cap Weighted Portfolio

- assigns weights based on market capitalization
- larger companies dominate

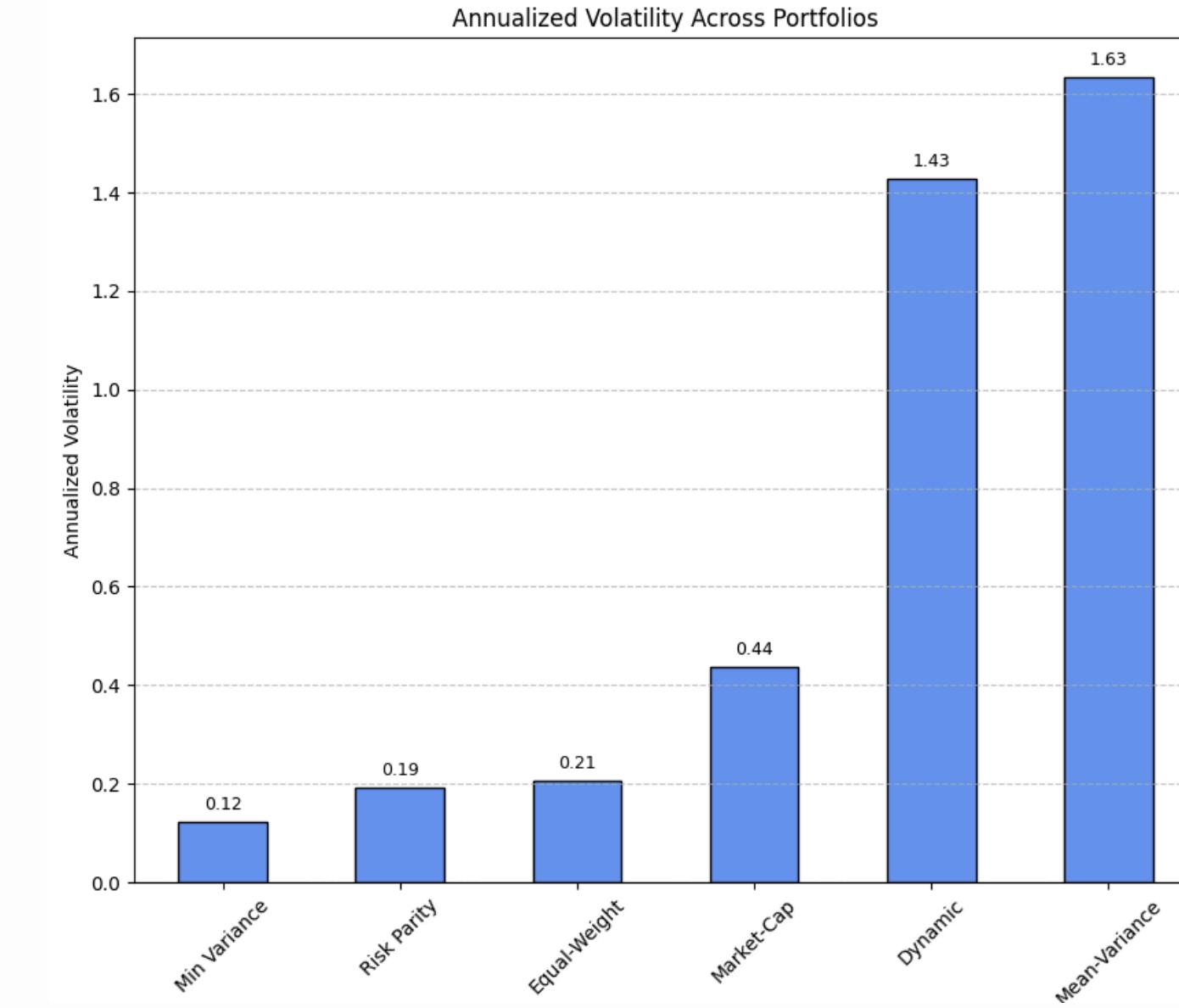
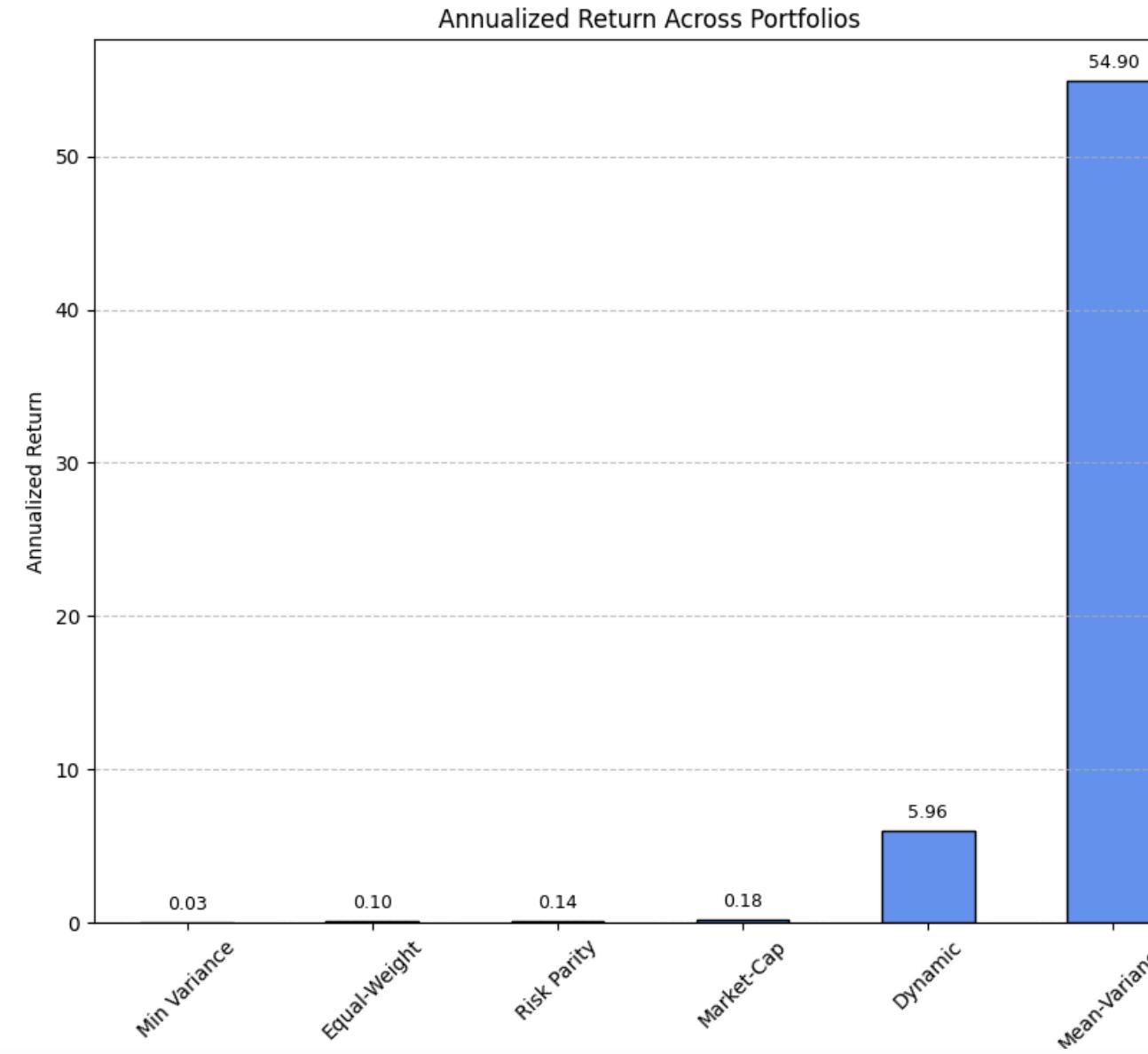
## Risk Parity Portfolio

- equalizes risk contributions
- assigns lower weights to highly volatile assets

# Portfolio Evaluation



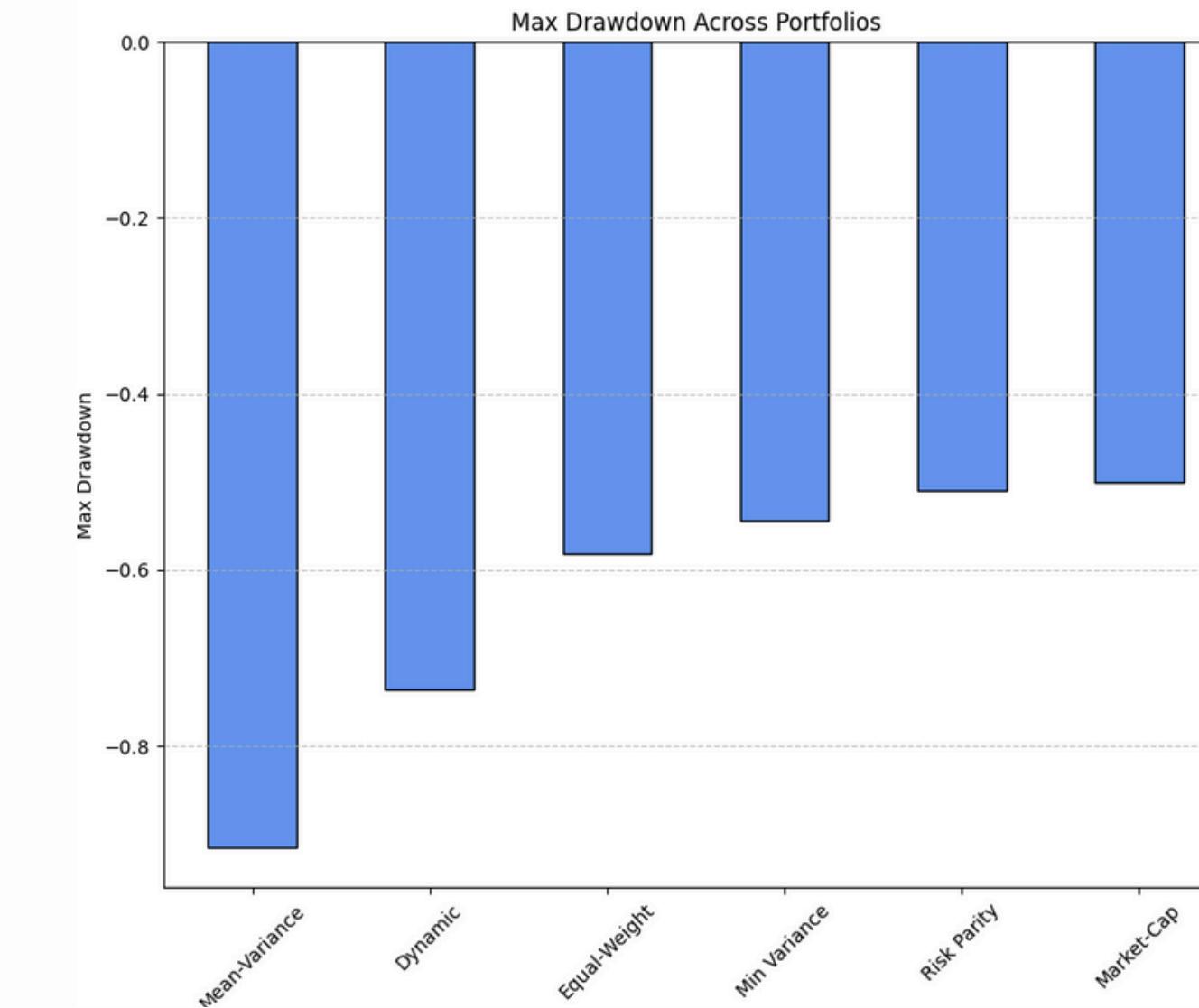
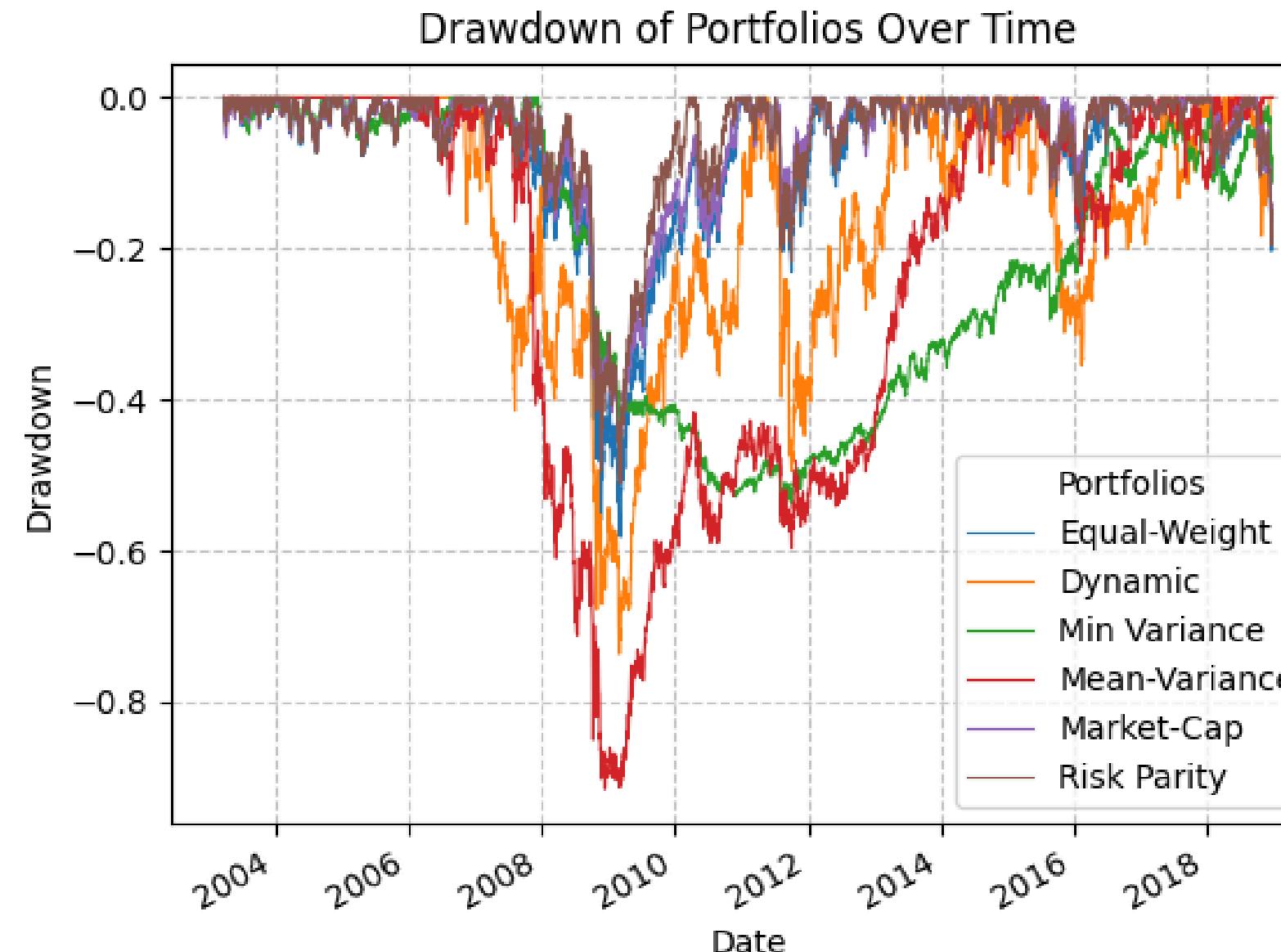
# Annualized Return and Annualized Volatility



$$ATR = \left( \frac{\text{cumulative return}_{\text{end}}}{\text{cumulative return}_{\text{start}}} \right)^{\text{ann const}/\text{nr days}} - 1$$

$$AV = \sigma_{\text{returns}} \times \sqrt{\text{ann const}}$$

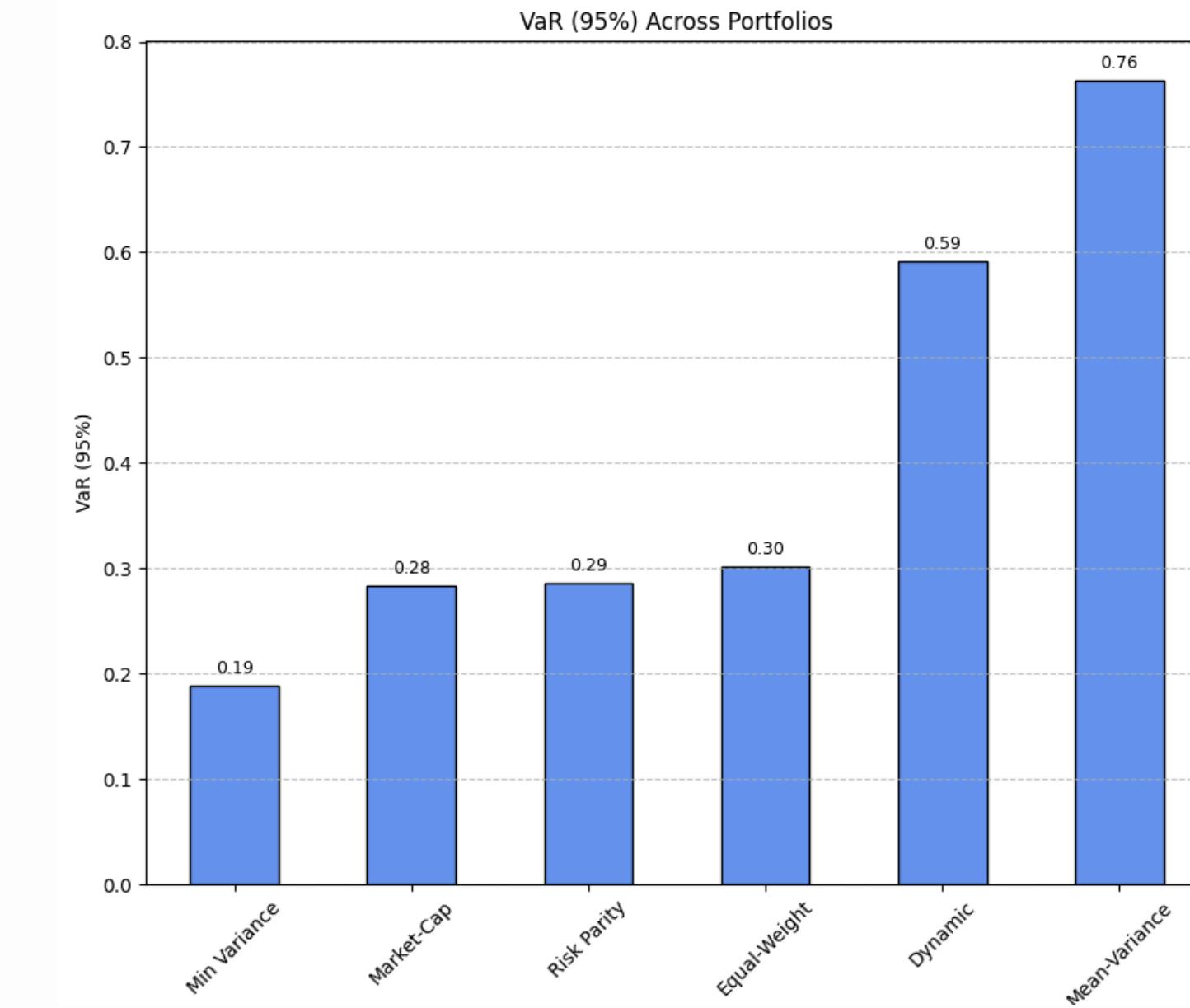
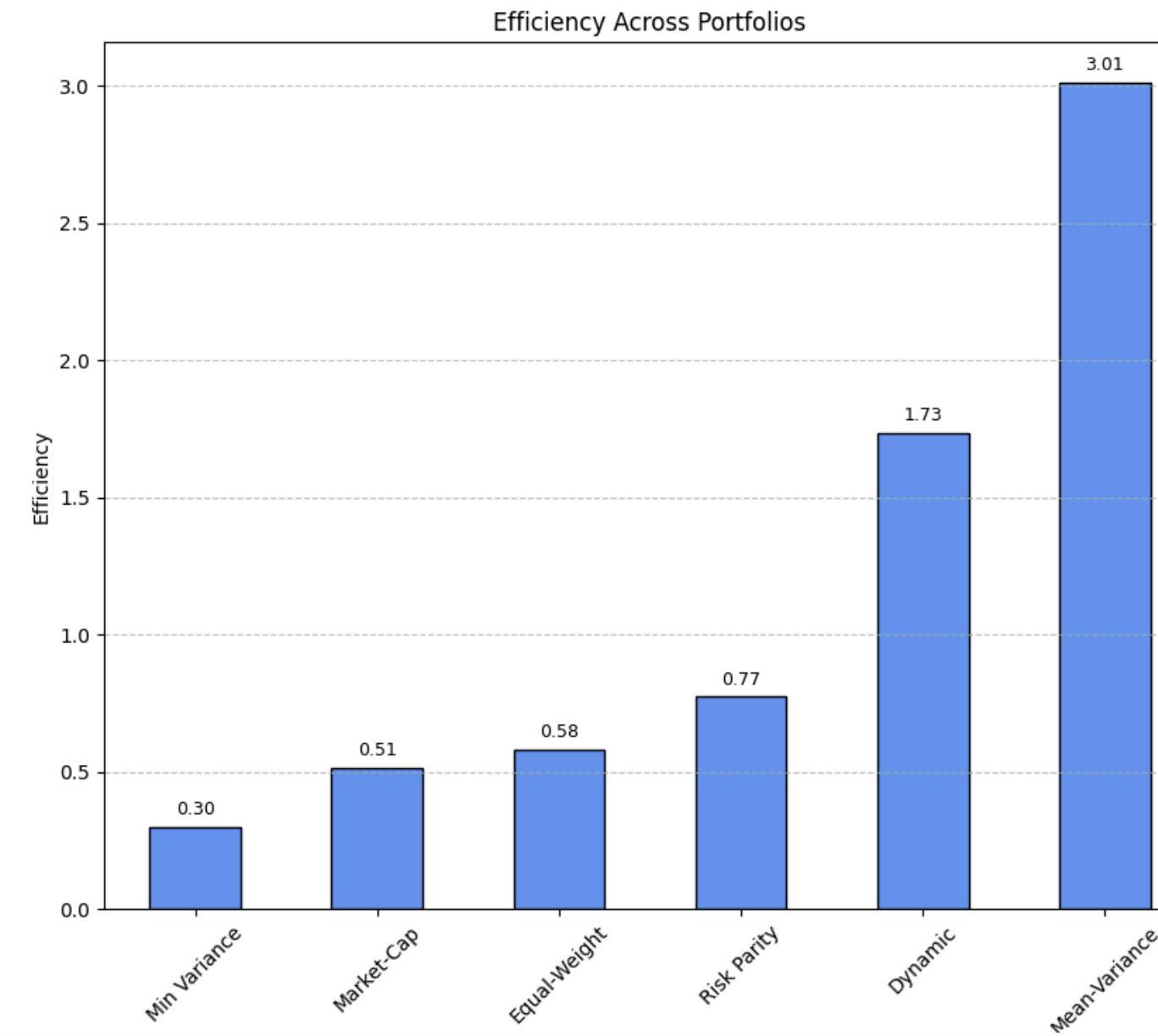
# Drawdown and Max Drawdown



$$\text{Drawdown} = \frac{\text{cumulative return}}{\text{cumulative return}_{\max}} - 1$$

$$\text{Maximum drawdown} = \min(\text{drawdown})$$

# Efficiency and Value at Risk

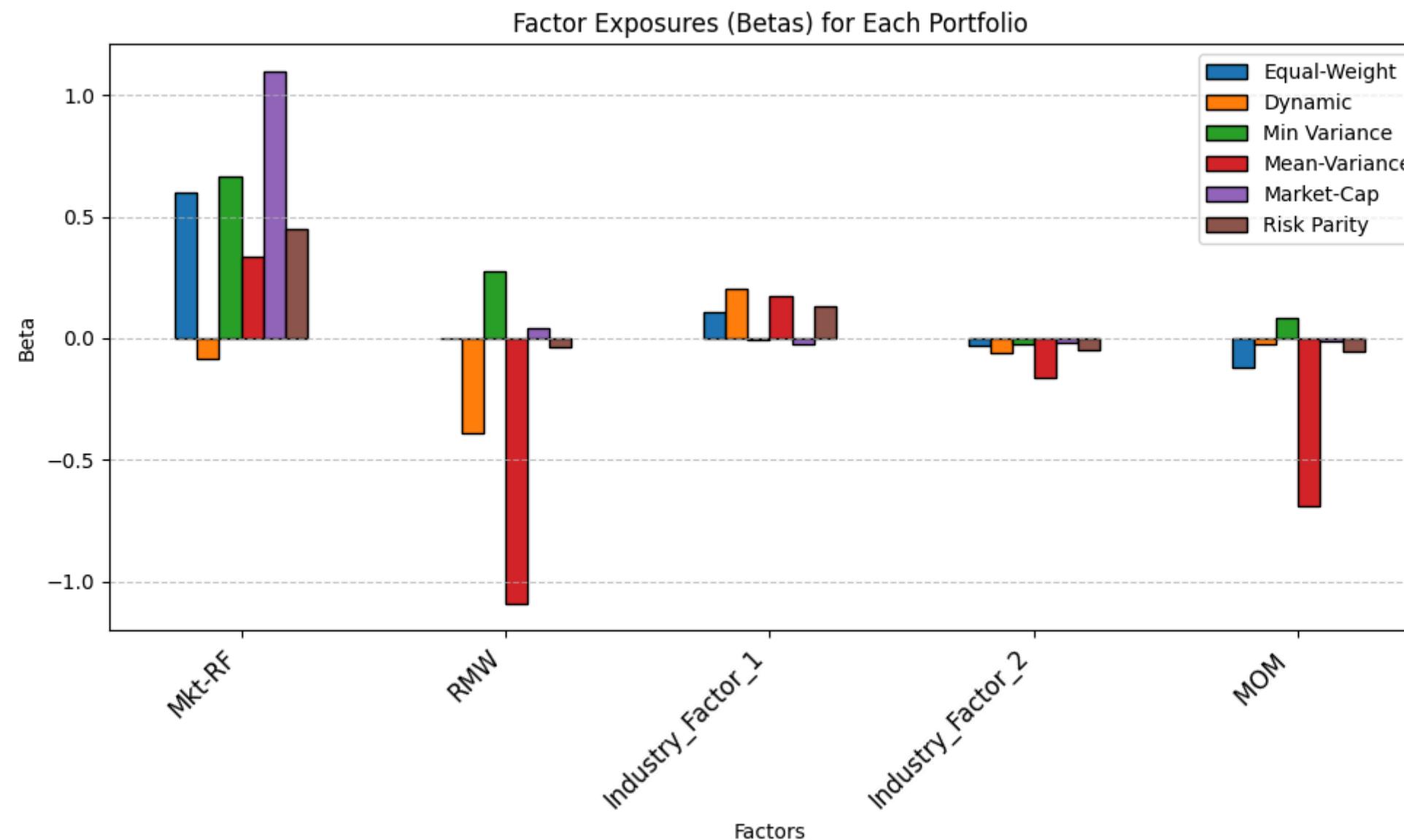


$$Efficiency = \frac{\mu_{returns} \times ann\ const}{AV}$$

$$VAR (95\%) = -\text{Percentile}(returns, 5\%) \times \sqrt{ann\ const}$$

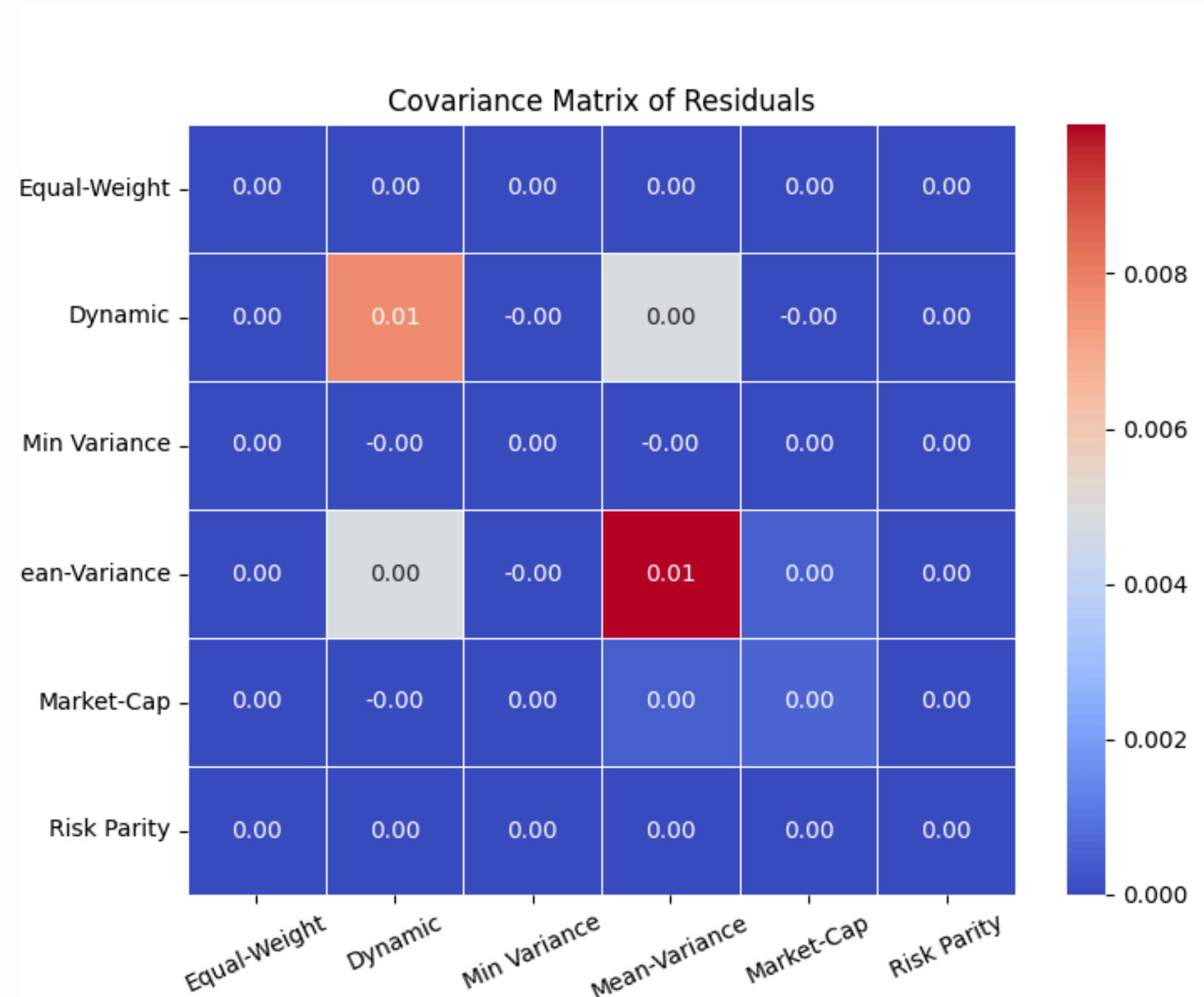
# CROSS-PORTFOLIO ANALYSIS

# Factor Regression and Sensitivity



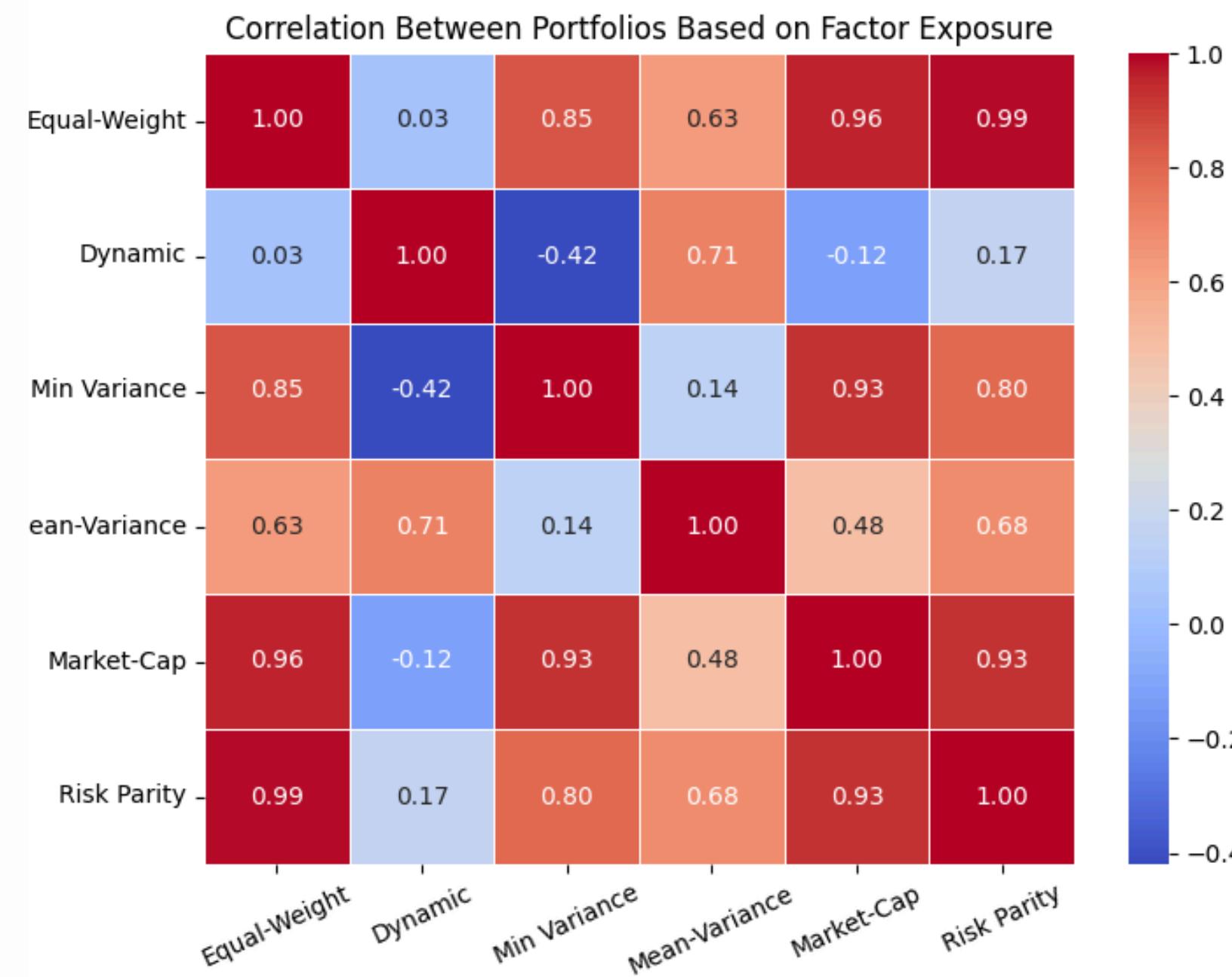
- the **factors** capture the systematic risk exposure or portfolios
- the **betas** represent the sensitivity of portfolios to the factors
  - strong positive exposure to market factor
  - weak exposure to the other factors

# Residual Analysis



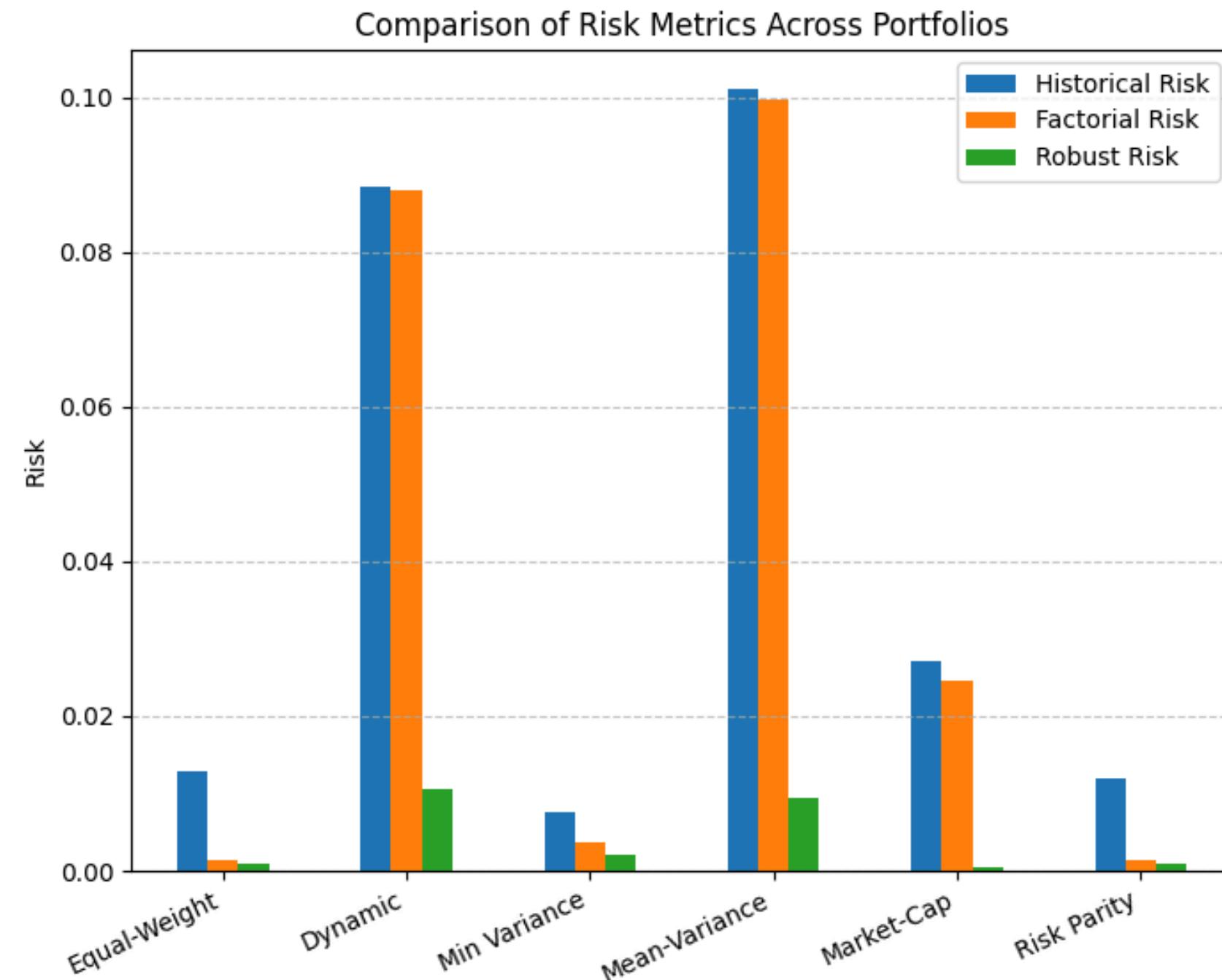
- uncorrelated residuals
- factors explain perfectly the returns
- overfitting?

# Correlation between portfolios



→ high correlation  
→ Dynamic Portfolio has a lower correlation

# Risk Metrics



- **Historical risk** = the standard deviation of the portfolio returns
- **Factorial risk** = the standard deviation of the residuals
- **Robust risk** = the Median Absolute Deviation of residuals

# **THANK YOU!**

**For your attention**