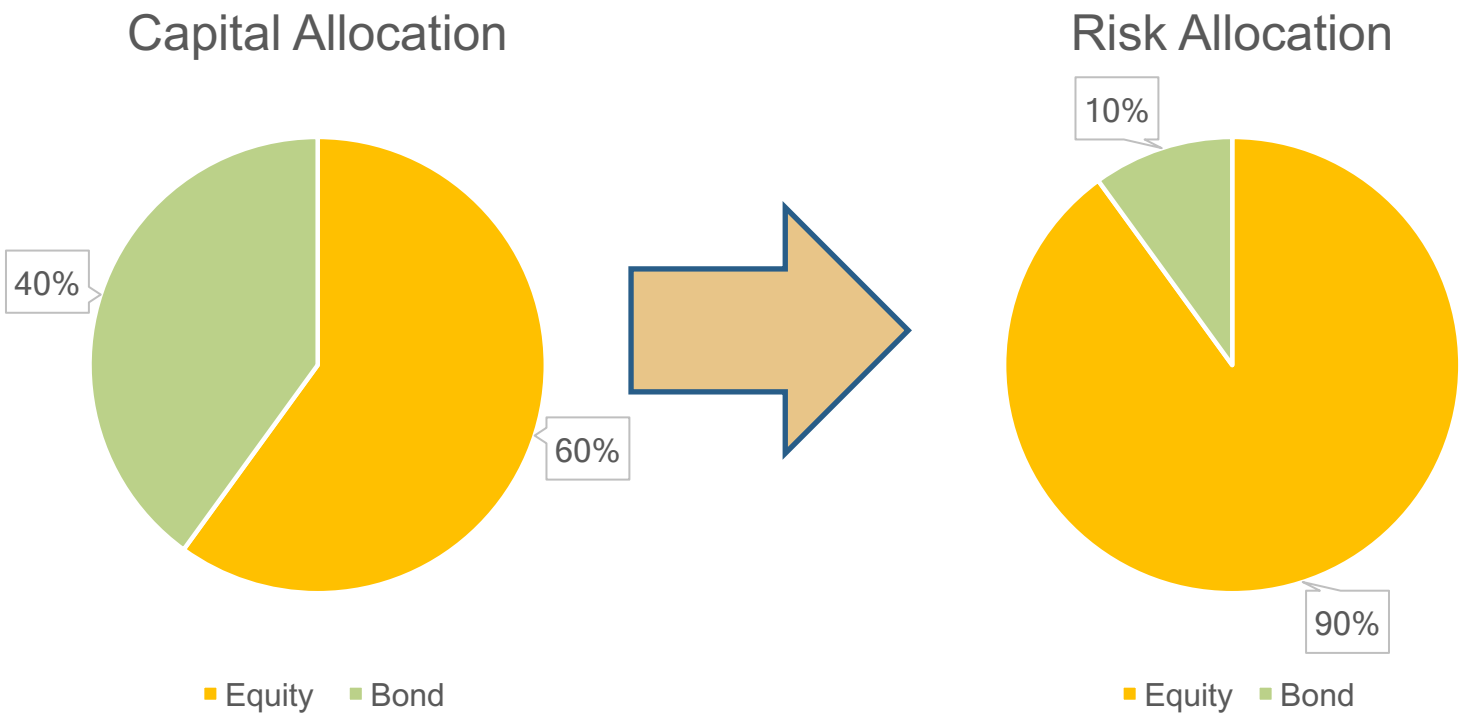
Risk Parity

Cong Cao

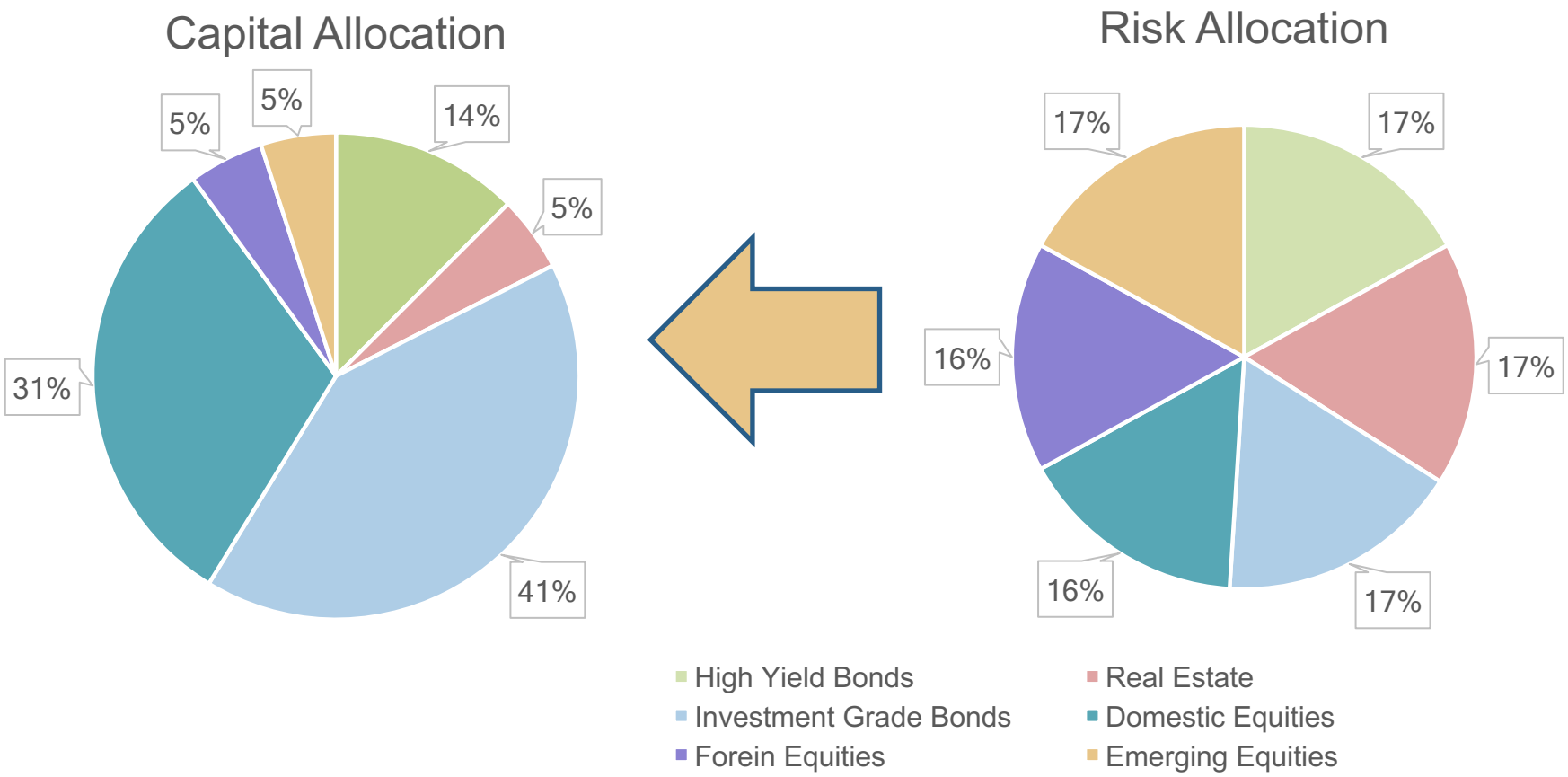
1.
Introduction

The Need for The Diversification

- Traditional portfolios are concentrated in Equity Risk



Allocation of Risk Parity Portfolio



2.
Procedures

2.1 Data Selection

- DFA Global Allocation 60/40 Portfolio Institution Class (DGSIX)

Top 10 Holdings (98.13% of Total Assets)

Name	Symbol
DFA US Core Equity 2 I	DFQTX
DFA Selectively Hedged Global F/I I	DFSHX
DFA International Core Equity I	DFIEX
DFA US Core Equity 1 I	DFEOX
DFA Short-Term Extended Quality I	DFEQX
DFA Five-Year Global Fixed-Income I	DFGBX
DFA Intermediate-Term Extnd Qlty I	DFTEX
DFA Emerging Markets Core Equity I	DFCEX
DFA Inflation-Protected Securities I	DIPSX
DFA World ex US Government Fxd Inc I	DWFIX

Equity	Bond
DFQTX	DFSHX
DFIEX	DFEQX
DFEOX	DFGBX
DFCEX	DFTEX
	DIPSX
	DWFIX

2.2 Methodology

- Risk Parity (Equal weighted Risk Contribution):

1. *Contribution to risk(CR) of the asset*

$$CR_i = \omega_i \partial_{\omega_i} \sigma(\omega) = \omega_i \frac{\omega_i (\Sigma\omega)_i}{\sqrt{\omega^T \Sigma \omega}}$$

2. Optimization Problem

$$\underset{\omega}{\operatorname{argmin}} \left[\omega_i - \frac{\sigma^2(\omega)}{(\Sigma\omega)_i N} \right]^2 \; s.t. \, \omega^T i = 1, \omega_i \geq 0 \; \forall \; i$$

2.3 Strategies for Comparison

Inverse Volatility Weighting

$$\omega_i = \frac{\frac{1}{\sigma_i}}{\sum_{j=1}^{N} \frac{1}{\sigma_j}} \forall\, i$$

- Minimize the marginal risk concentration
- Only consider asset volatility

Mean-Variance Optimization

$$\omega_T = \frac{V^{-1}(\mu - R_f i)}{i' V^{-1}(\mu - R_f i)}$$

- No diversification
- Exist estimation errors
- Lack of robustness

2.4 Performance

Net Value

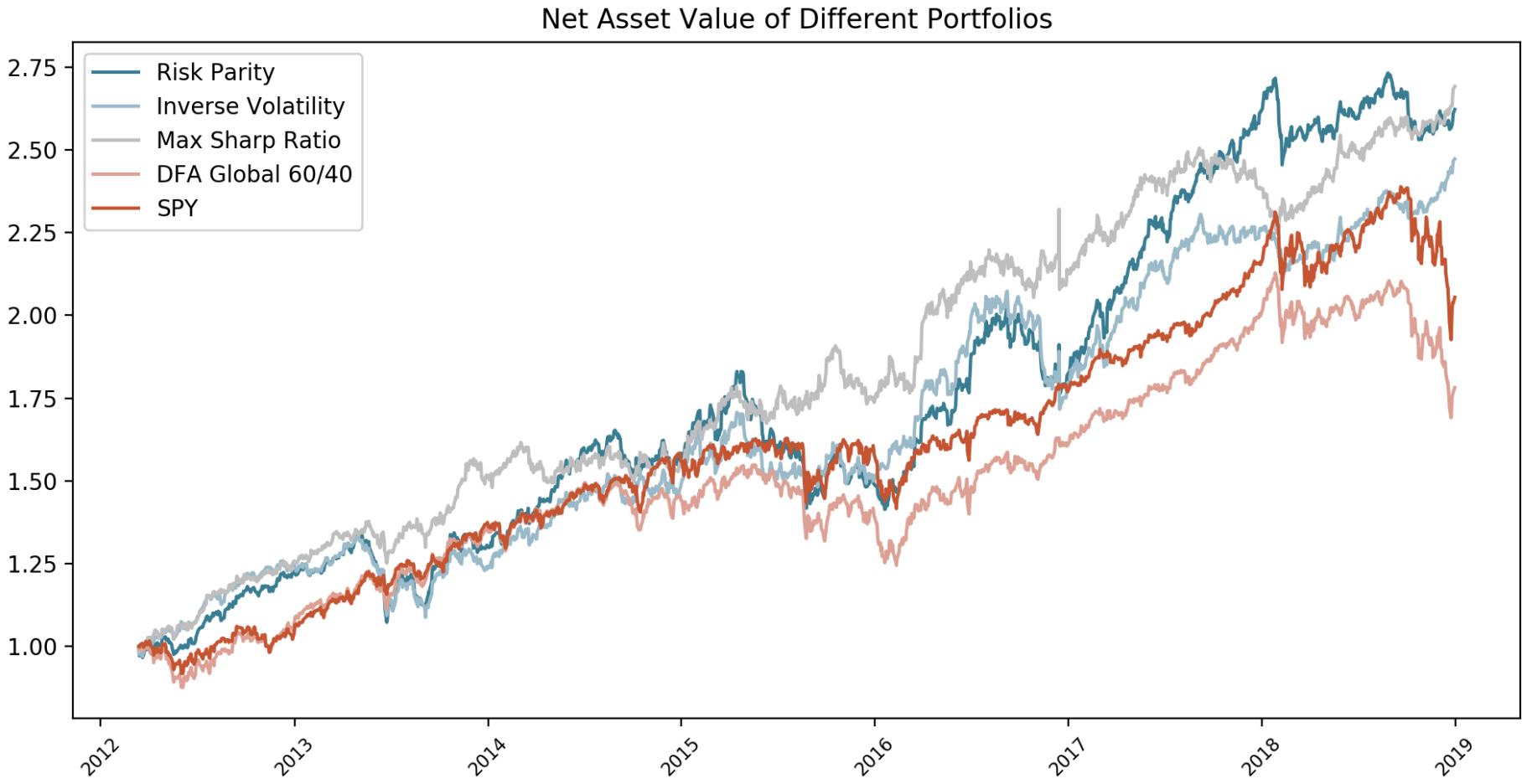
Maximum Drawdown

Financial Indicator Comparison

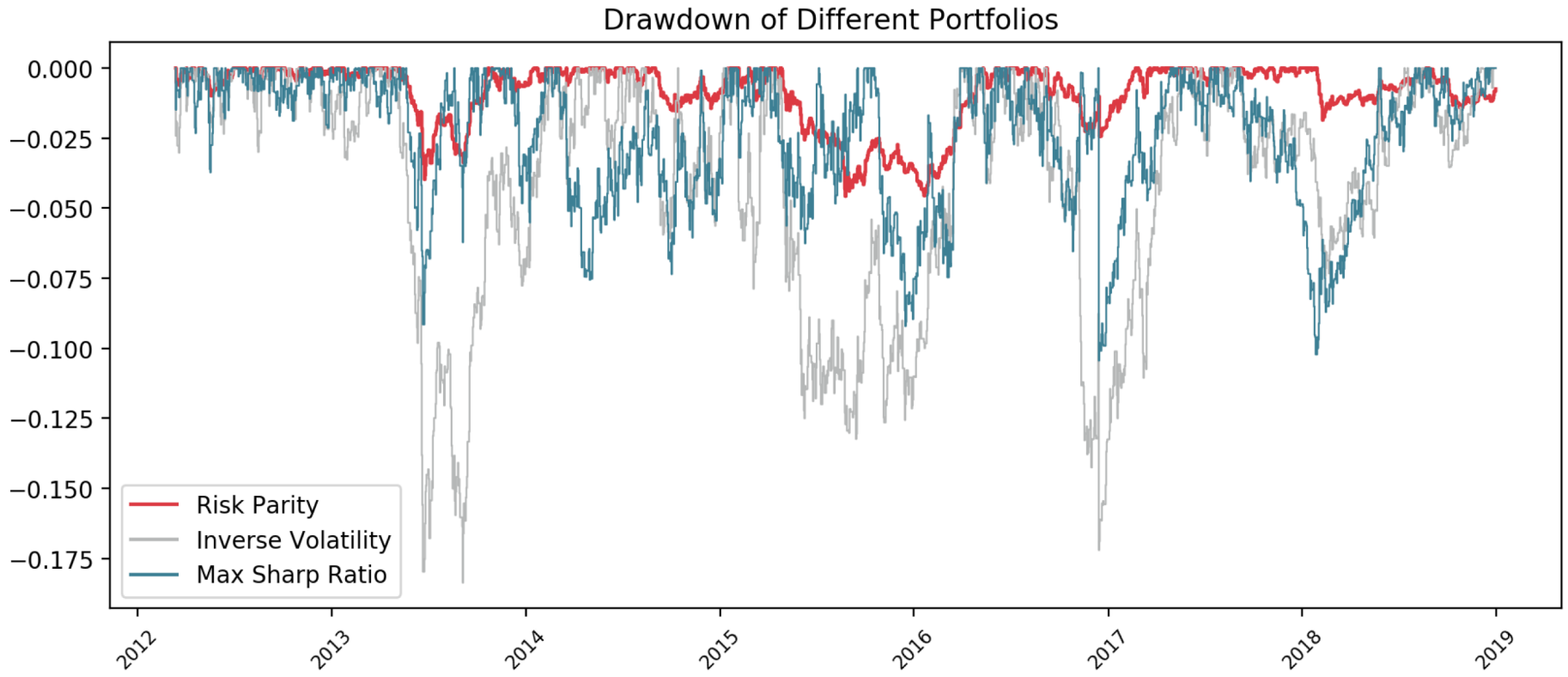
Annual Return vs. Volatility

High Vol vs. Recession

2.4.1 Net Value



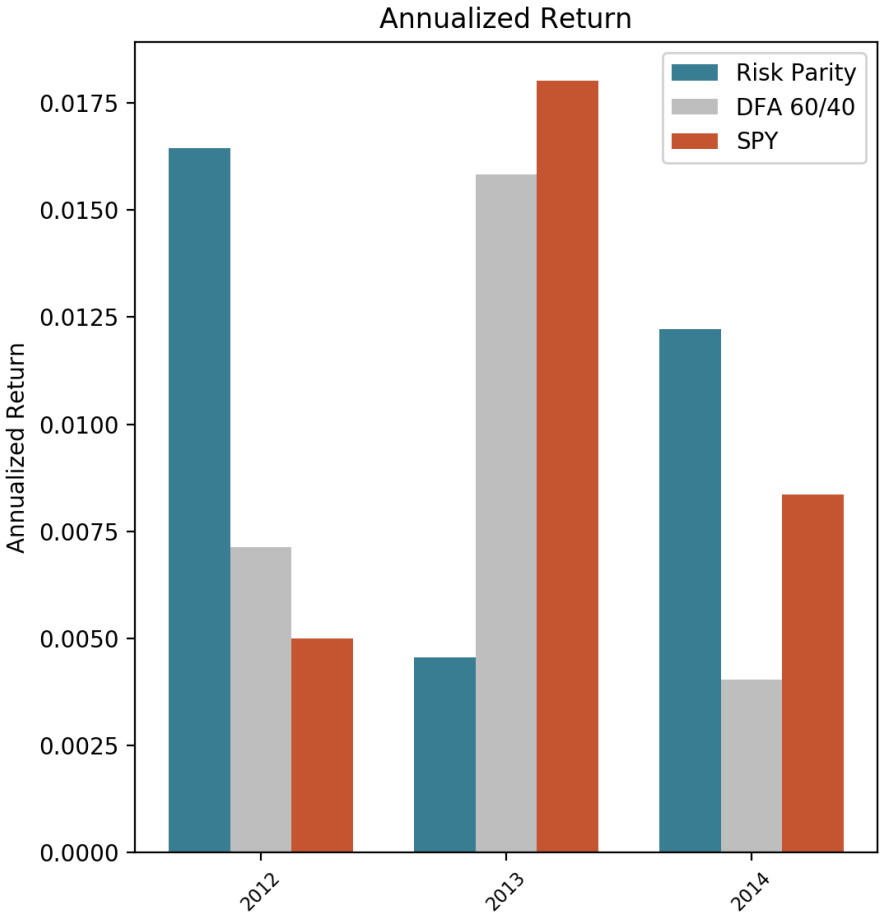
2.4.2 Drawdown

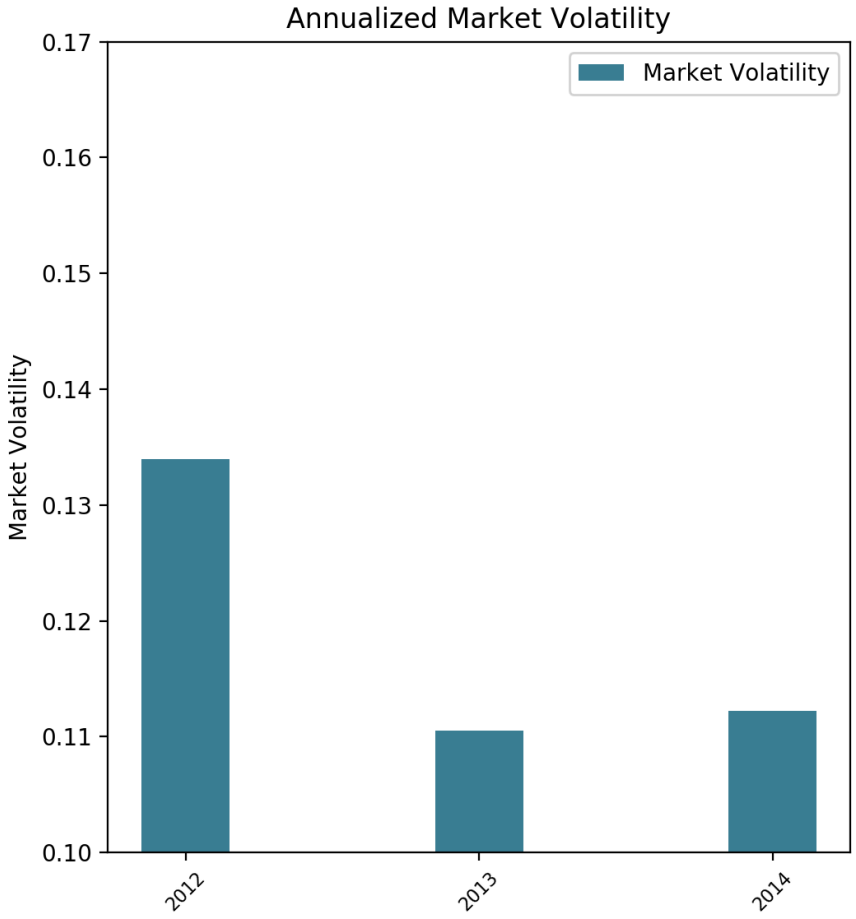


2.4.3 Financial Indicator Comparison

	SPY	Risk Parity	Inverse Volatility	Mean Variance	60/40
Sharpe Ratio	0.905	1.156	1.089	1.011	0.741
Max Drawdown%	19.40	4.50	17.70	11.30	12.70
VaR %	-1.30	-0.20	-0.20	-0.10	-0.80

2.4.4 Annual Return vs. Volatility





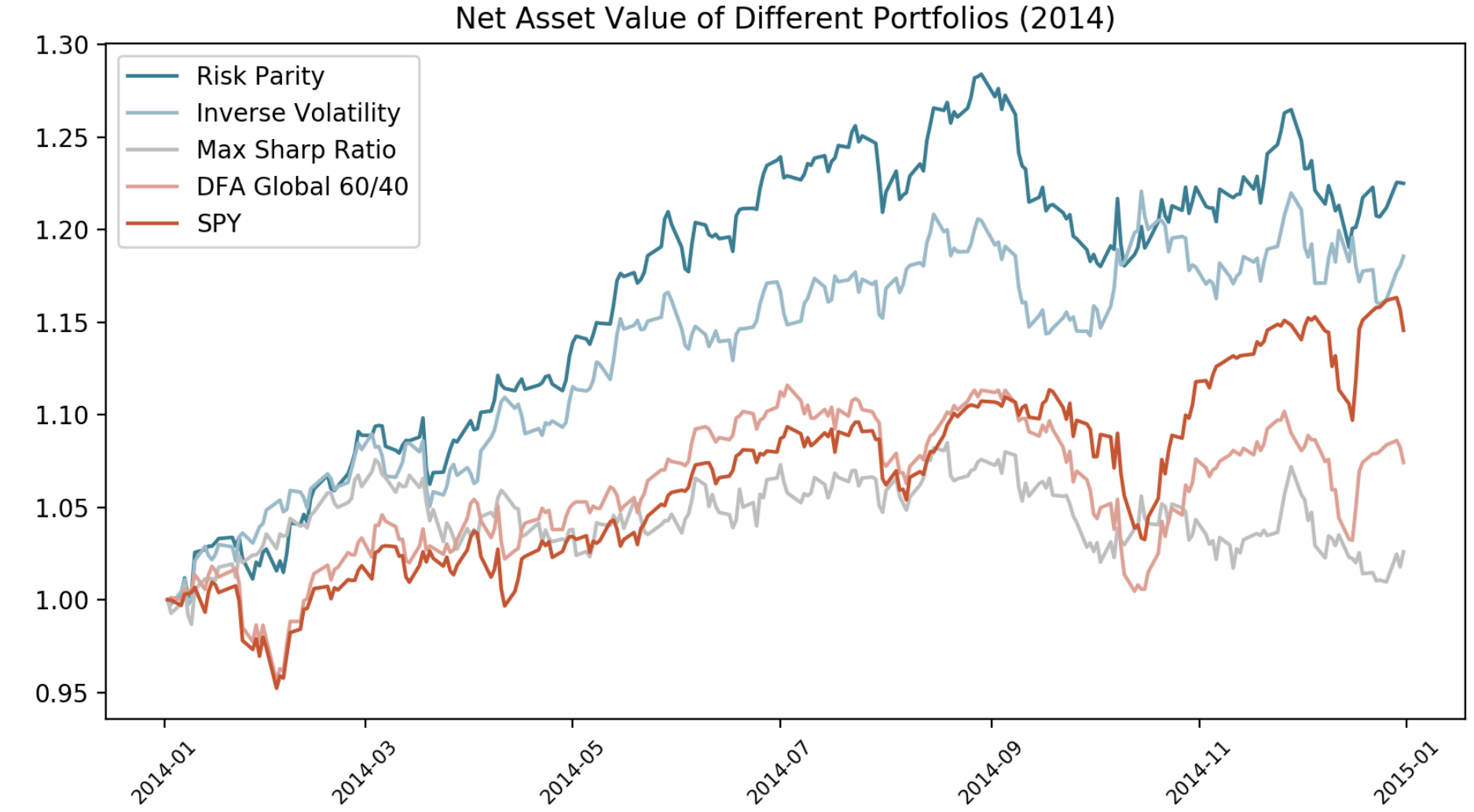
2.4.5 High Vol vs. Recession Period

2012 (High Volatility):

	SPY	Risk Parity	Inverse Volatility	Mean Variance	60/40
Sharpe Ratio	0.59	2.65	2.90	2.66	0.749
Max Drawdown %	10.00	1.00	4.4	4.9	7.9
VaR %	-1.40	-0.17	-0.12	-0.10	-0.90

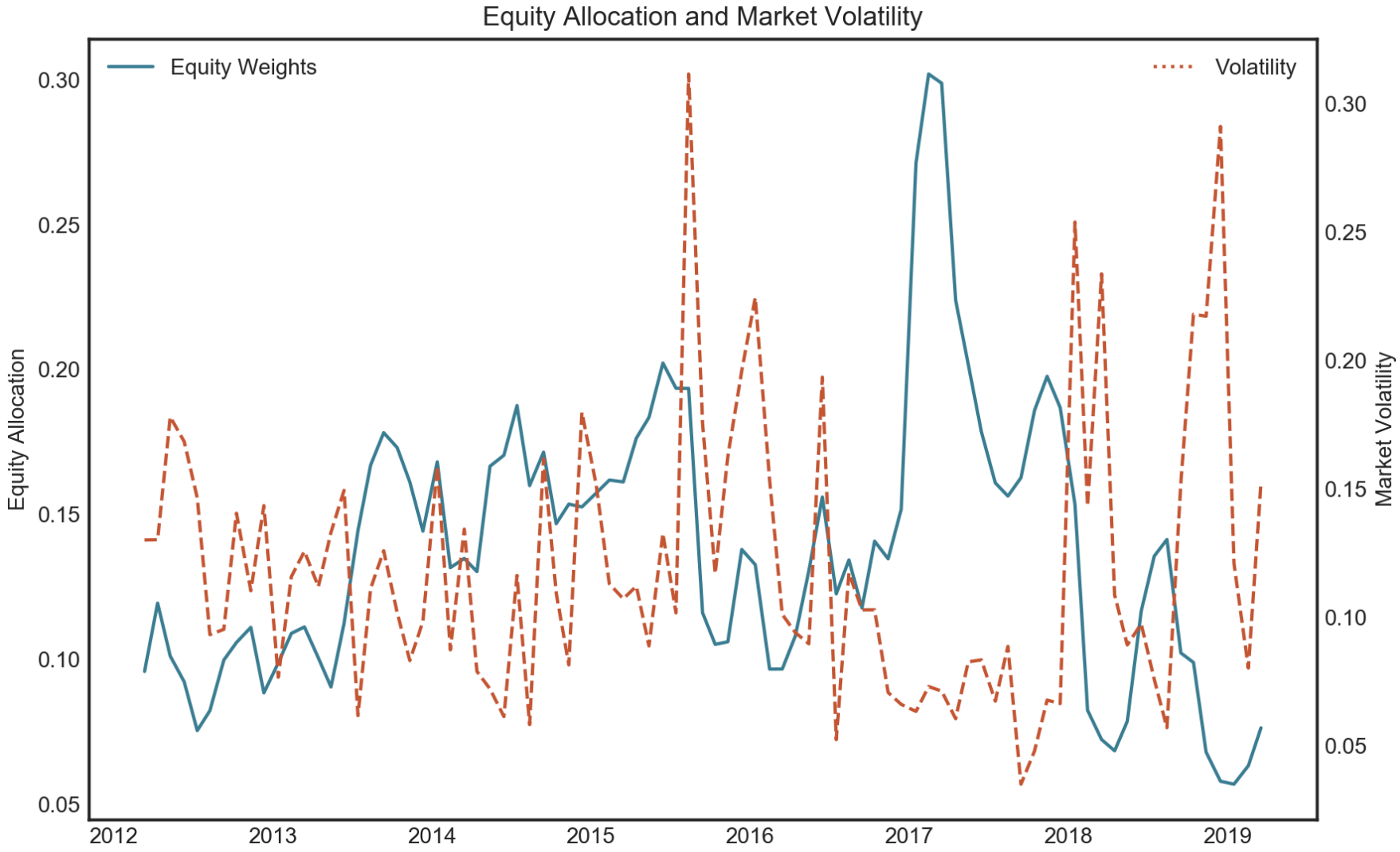
2014 (During Recession):

	SPY	Risk Parity	Inverse Volatility	Mean Variance	60/40
Sharpe Ratio	1.18	1.84	1.62	0.31	0.59
Max Drawdown %	7.30	1.50	5.40	6.90	5.90
VaR %	-1.10	-0.10	-0.20	-0.10	-0.70

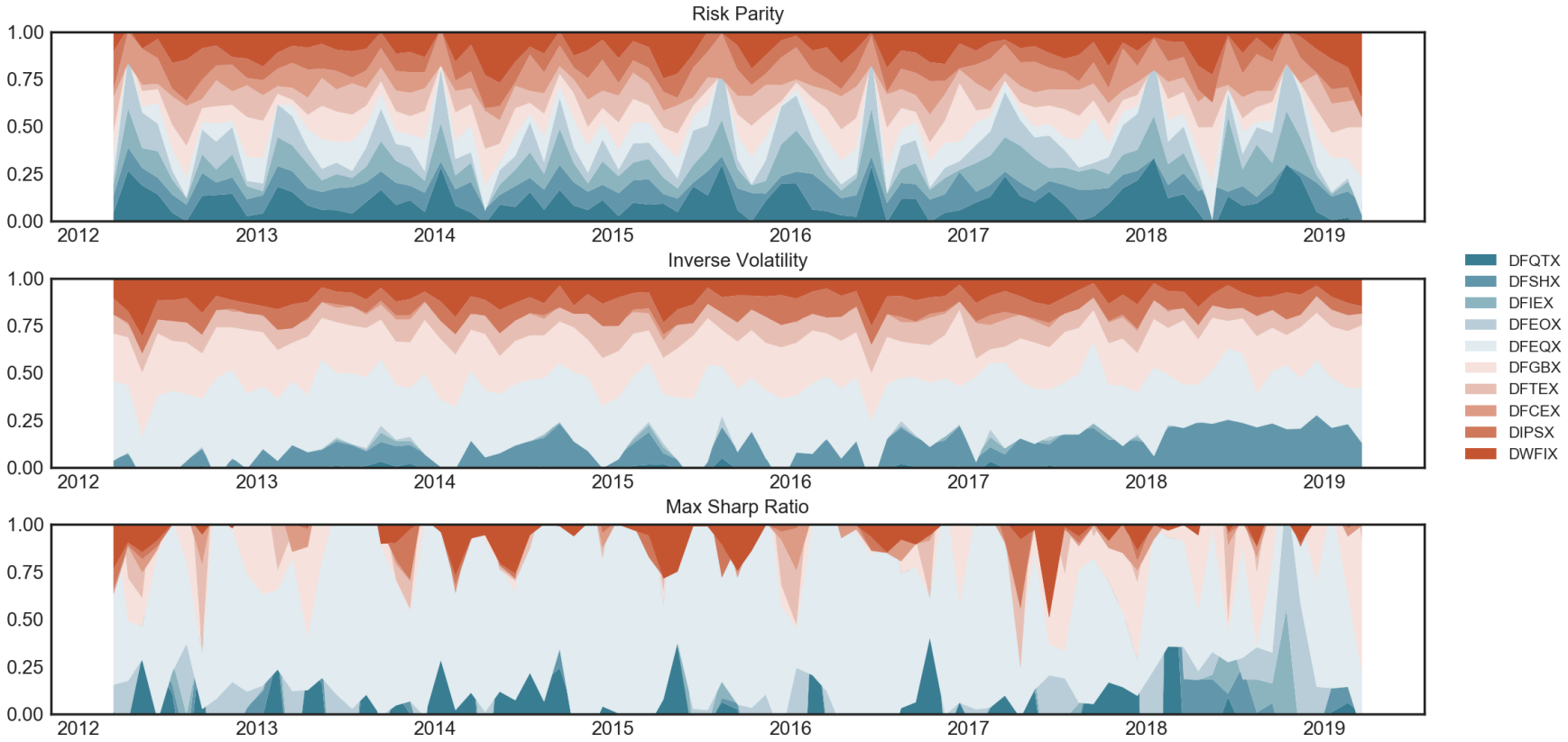

Net Asset Value of Different Portfolios (2014)
Risk Parity
Inverse Volatility
Max Sharp Ratio
DFA Global 60/40
SPY
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
2014-01
2014-03
2014-05
2014-07
2014-09
2014-11
2015-01

3.
Conclusion

Equity Allocation vs. Volatility Risk Parity



Risk Contributions



Summary

1. Outperform during the high market volatility and recession periods.

2. Reduce equity concentration and tail risk.

3. Robust in different economic environment.

Concern

- Leverage limitation

- Correlation of bonds and equities

Thanks!

Any questions?