Portfolio Allocation with Cluster Risk Parity

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Outline

- Cluster Risk Parity Algorithm
- Step by Step
- Portfolio Weights
- Clustering methods
- Back tests
- Advantages

Cluster Risk Parity (CRP)

- Heuristic portfolio allocation method that uses
  - Dynamic Clustering to discover market macro-structure
  - Risk Parity to normalize risk within and across clusters
- Adaptive
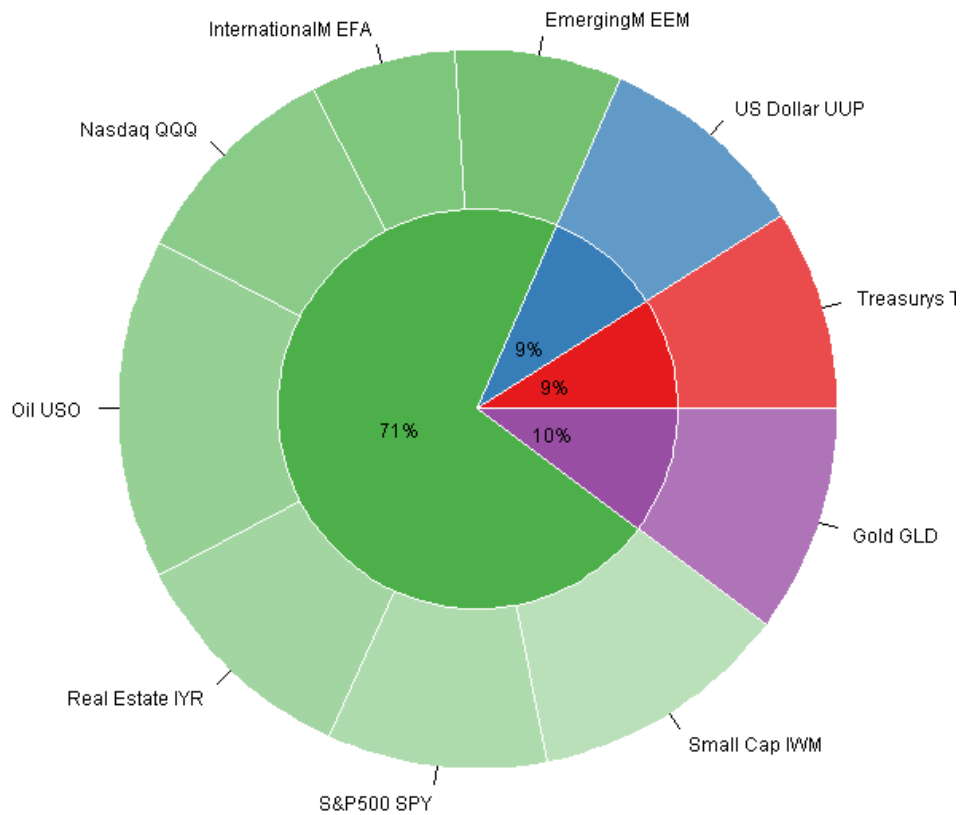- Maximize Portfolio Diversification

Steps to construct CRP portfolio

1. Create groups (clusters) of assets
2. Create risk parity portfolios within each group
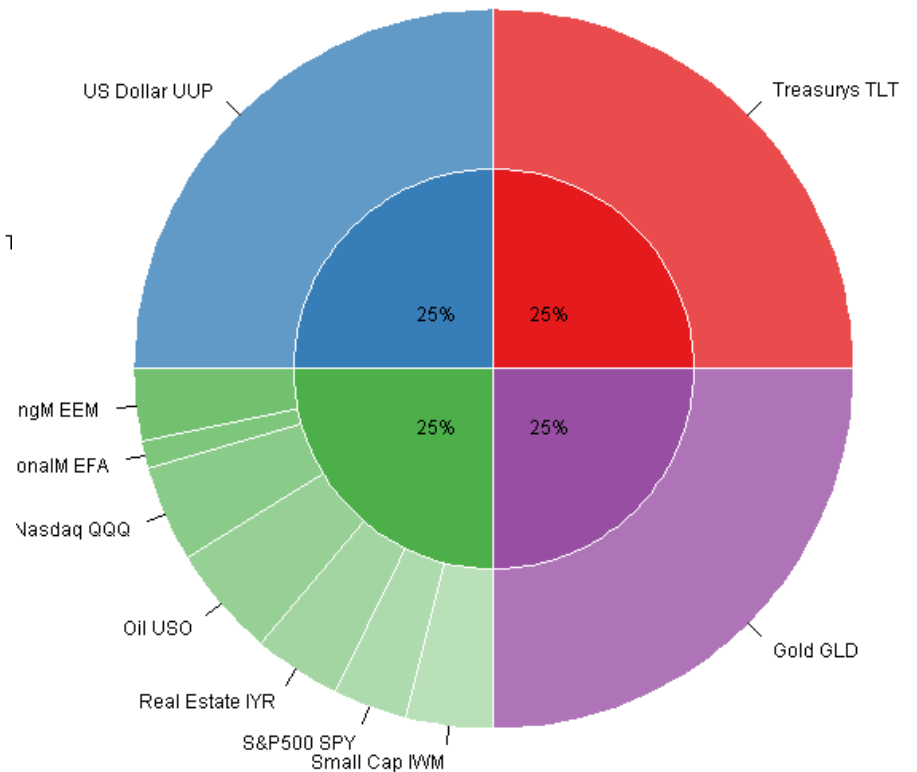3. Distribute weights across clusters using risk parity

Risk Contributions

Weights

Legend: Fixed Income, Currency, Equity, Commodity

ERC Weights

US Dollar UUP, Treasurys TLT, Gold GLD, Small Cap IWM, S&P500 SPY, Real Estate IYR, Oil USO, Nasdaq QQQ, InternationalM EFA, EmergingM EEM

43%, 17%, 7%, 32%

Cluster ERC Weights

US Dollar UUP, Treasurys TLT, Gold GLD, Small Cap IWM, S&P500 SPY, Real Estate IYR, Oil USO, Nasdaq QQQ, InternationalM EFA, EmergingM EEM

47%, 16%, 13%, 24%

Clustering

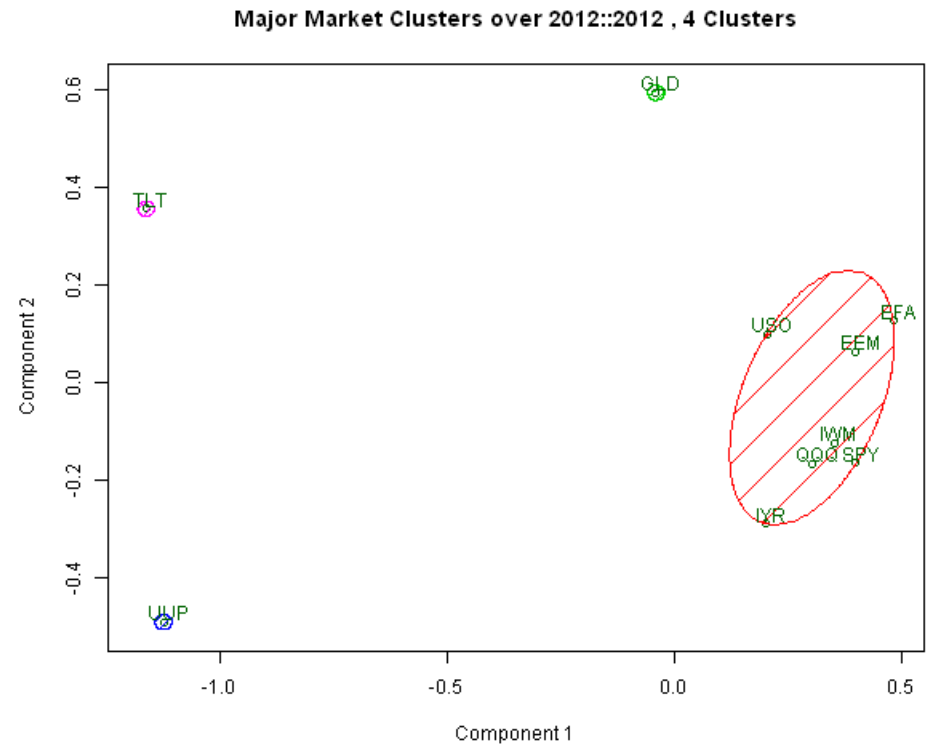Major Market Clusters over 2012::2012 , 4 Clusters
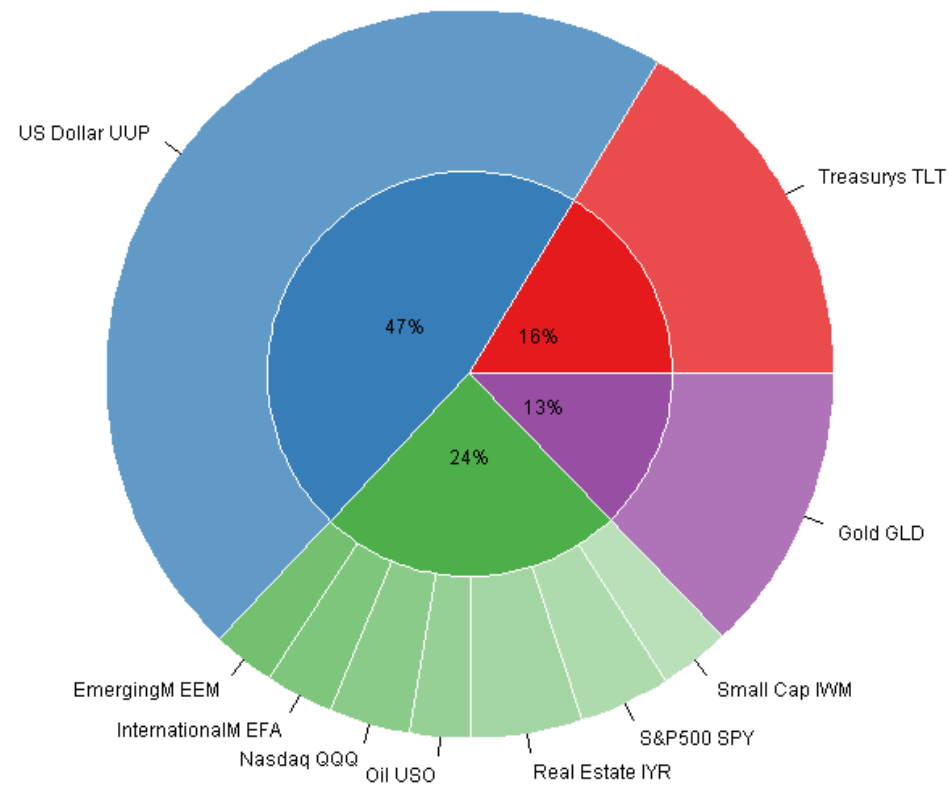
- Method:
  - Hierarchical
  - K-Means
- Optimal Number of clusters:
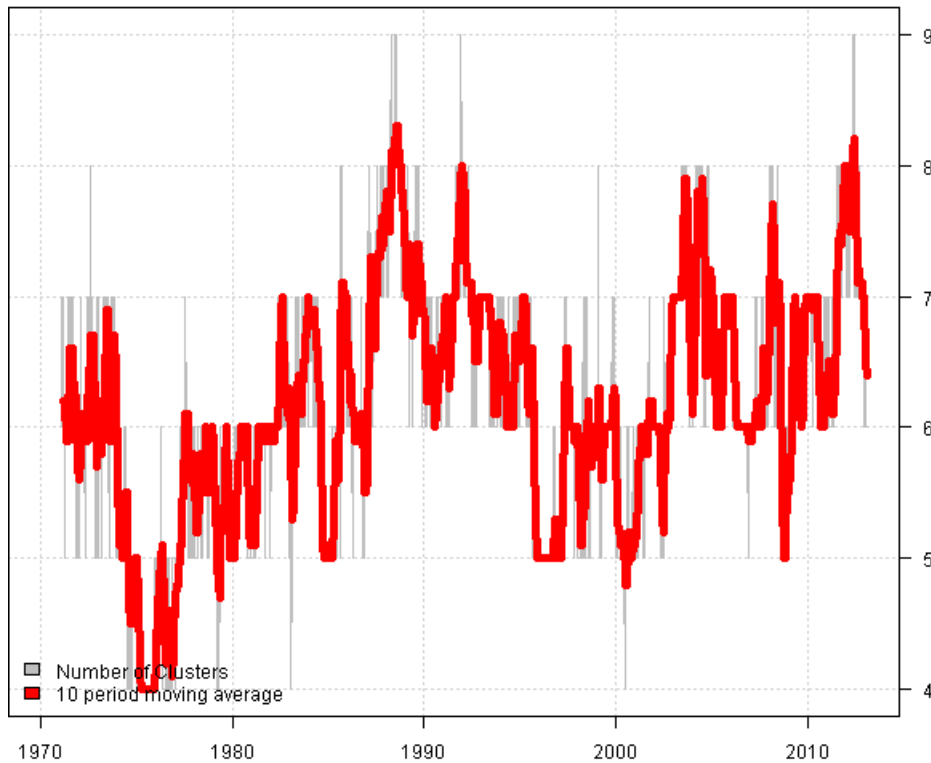 - Percentage of Variance explained
  - Elbow point
- Look back window to construct clusters
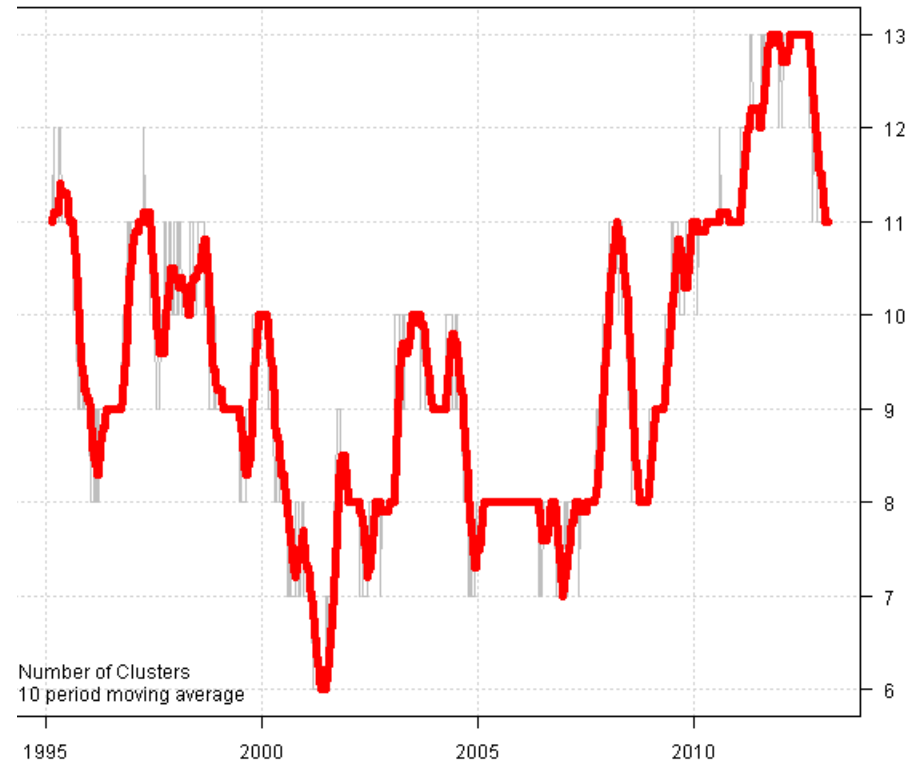
Historical Evolution of Clusters

DOW 30

S&P 500

CRP Back-test Performance

10 Major Asset Classes

10 Major Asset Classes (ETFs): Nov 2005-May 2013

	Return	Sharpe
Equal Weight	7.70	0.52
Risk Parity	7.20	0.68
Risk Parity - ERC	7.75	0.98
Dynamic Clustering with Equal Weight	9.15	0.80
Dynamic Clustering with Risk Parity	8.39	1.03
Dynamic Clustering with Risk Parity - ERC	8.18	1.08
Average Risk Parity Variants	**7.48**	**0.83**
Average Dynamic Clustering Variants	**8.29**	**1.06**

DOW 30 Stocks

Dow 30 Stocks: Dec 1995 - May 2013

	Return	Sharpe
Equal Weight	12.67	0.69
Risk Parity	12.46	0.71
Risk Parity - ERC	12.25	0.71
Static Clustering with Equal Weight	12.41	0.68
Static Clustering with Risk Parity	12.27	0.71
Static Clustering with Risk Parity - ERC	12.12	0.71
Dynamic Clustering with Equal Weight	13.52	0.72
Dynamic Clustering with Risk Parity	12.90	0.74
Dynamic Clustering with Risk Parity - ERC	12.92	0.75
Average Risk Parity Variants	**12.36**	**0.71**
Average Static Clustering Variants	**12.20**	**0.71**
Average Dynamic Clustering Variants	**12.91**	**0.75**

Cluster Risk Parity

- Heuristic

- Adaptive

- Maximize Portfolio Diversification

The End

Please visit my blog at

www.systematicinvestor.wordpress.com

for more examples and ideas.

References

Download R Code at www.systematicportfolio/RFinance2013

Systematic Investor blog

- Clustering with selected Principal Components

- Examples of Current Major Market Clusters

- Optimal number of clusters

- Tracking Number of Historical Clusters

- Tracking Number of Historical Clusters in DOW 30 and S&P 500

- Cluster Portfolio Allocation

- Cluster Risk Parity back-test

CSS Analytics blog

- Cluster Risk Parity

- Cluster Risk Parity– A Visual Representation

- Cluster Risk Parity (CRP) versus Risk Parity (RP) and Equal Risk Contribution (ERC)

- A Visual of Current Major Market Clusters

- A Backtest Using Dynamic Clustering versus Conventional Risk Parity Methods

- Dynamic versus Static Clustering: Dow 30 Stocks 1995-Present

- Static versus Dynamic Clustering on Multiple Asset Classes