



International Forum of Sovereign Wealth Funds

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**KIC** Korea Investment Corporation

## **Case Study #2: Index Investing: Alternatives to Market Cap Weighting**

**IFSWF Subcommittee II: Investment & Risk Management**

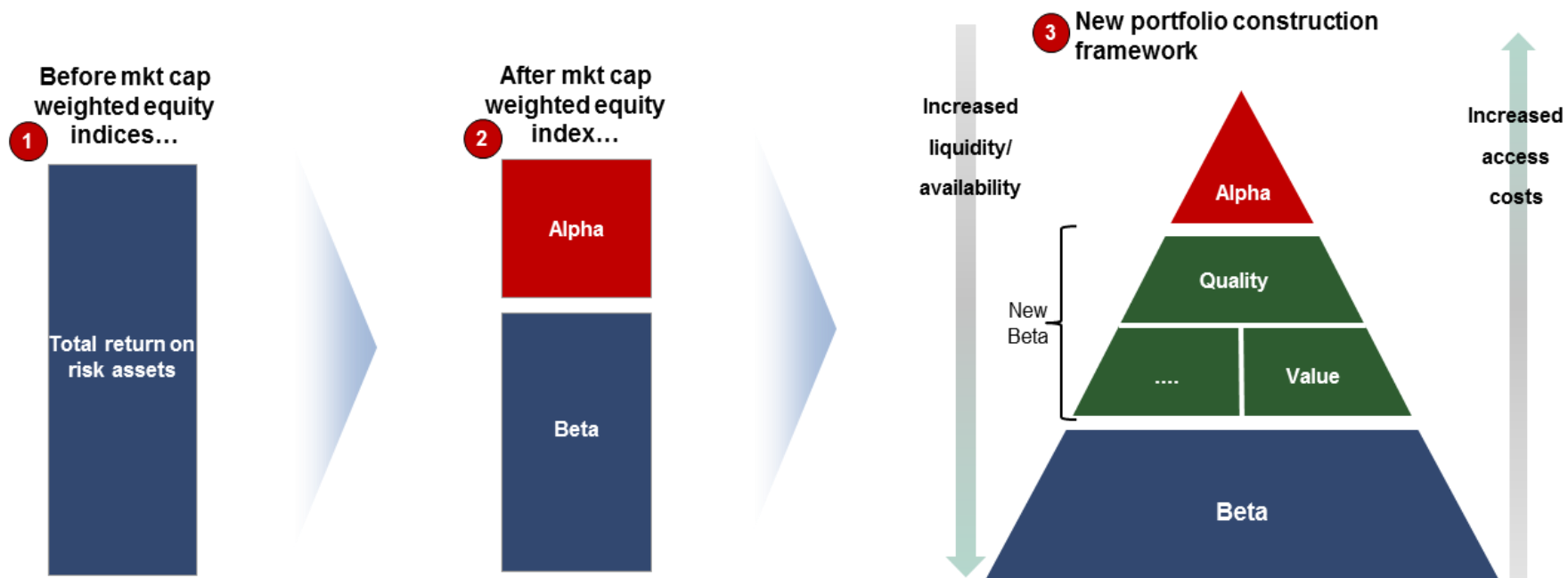
## Objectives

- Provide specific examples of non-market cap weighted indices that have gained traction with investors recently, including low volatility, momentum, size, quality, and valuation factors.
- Articulate the main theoretical arguments in favor of – and against – the use of these non-cap weighted benchmarks. Describe their prospective risks and rewards.
- Identify the investment beliefs and characteristics that an SWF would need to have in order to seek exposure to non-cap weighted benchmarks.
- Describe the “checklist” framework that Korea uses to evaluate prospective non-cap weighted benchmark indices.
- Explain how exposure to these benchmarks should change depending on the prevailing market regime. Describe how Korea uses indicators of co-movement and risk appetite to detect regime shifts.
- Draw conclusions that apply to the broadest possible set of SWFs, while recognizing that all SWFs have unique objectives, circumstances, and constraints, and that no single solution will apply for all SWFs.

## Questions to be addressed

- What is the difference between a non-cap weighted benchmark index and active management?
- What are the most popular non-cap weighted benchmarks?
- How can an SWF combine non-cap weighted benchmarks to form efficient portfolios?

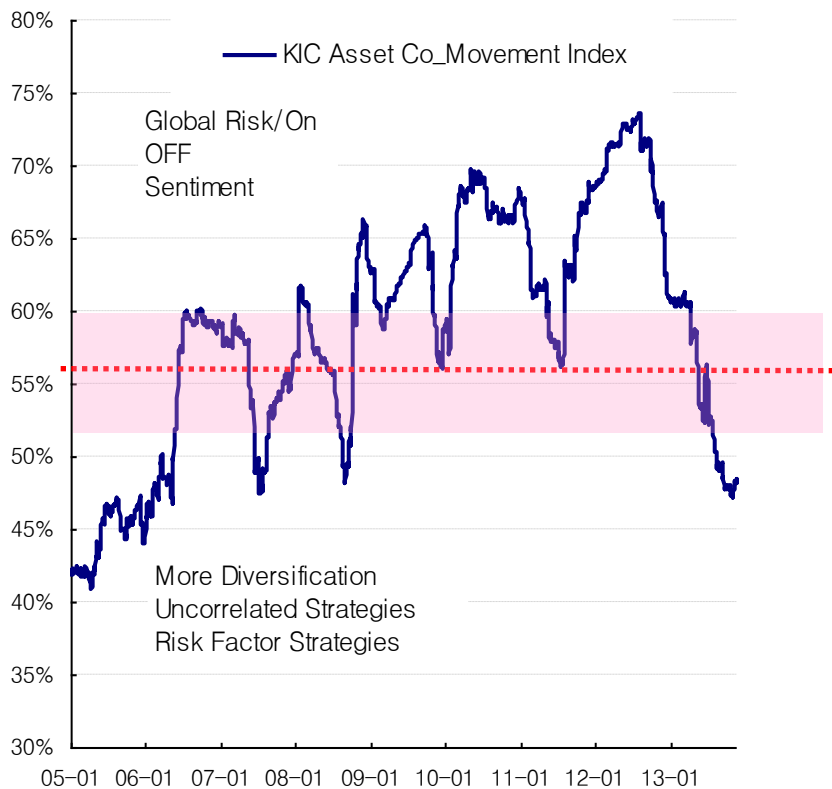
## Portfolio Construction Framework



- 1 In the beginning, before capitalisation weighted equity indices, return attribution was difficult
- 2 Emergence of capitalisation weighted equity indices (e.g. S&P 500) helped in explaining returns. Alpha remains the unexplained component
- 3 Investors start to realise that the alpha provided by their managers could be explained by dynamic systematic strategies

# Asset co\_Movement index

## KIC Asset Co\_movement index



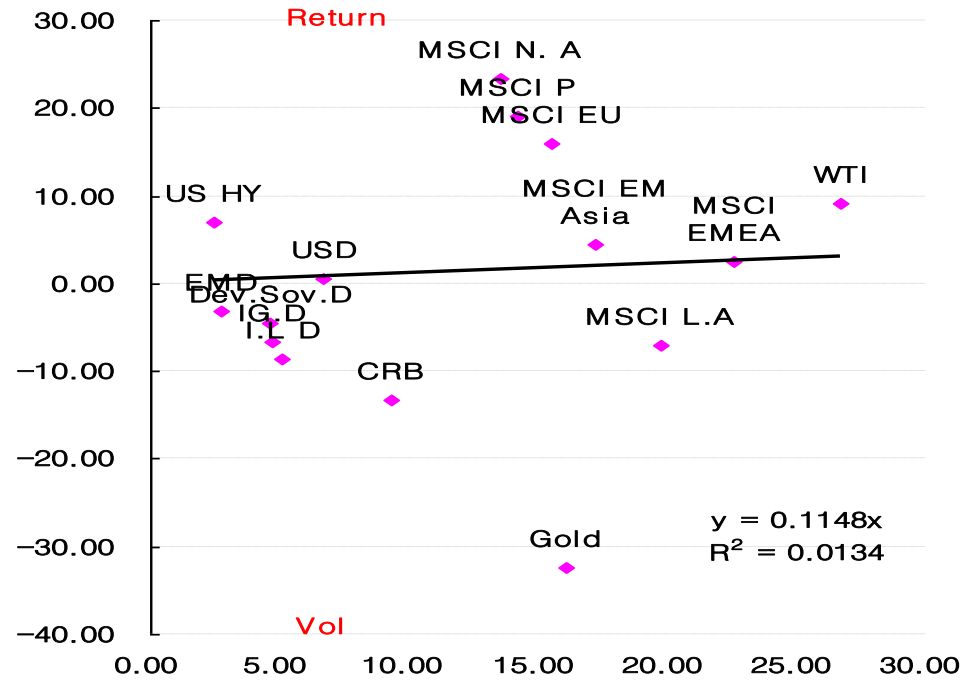
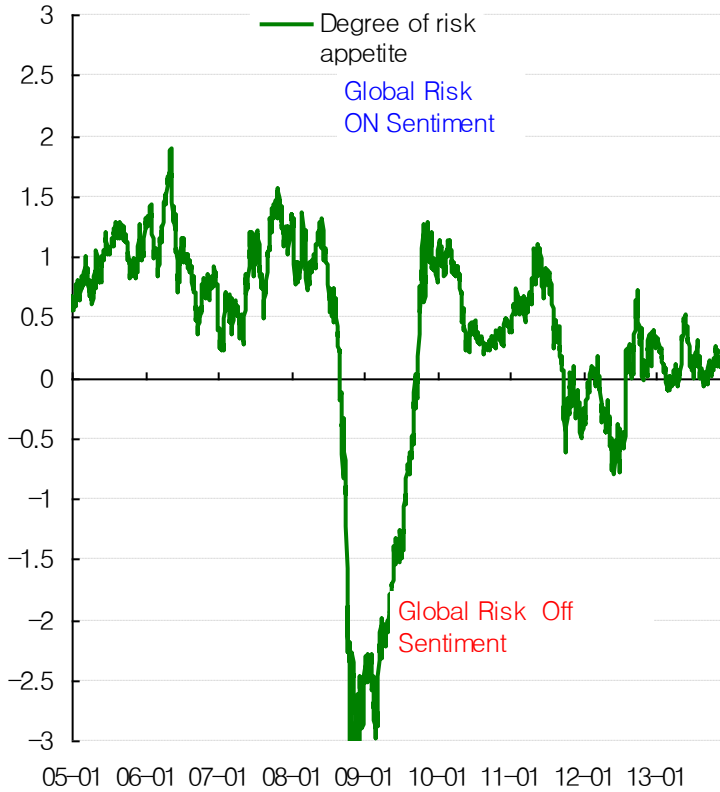
	USD	I.L D	Dev.S ov.D	IG.D	EMD	US HY	MSCI N. A	MSCI P	MSCI EU	MSCI EM Asia	MSCI EMEA	MSCI L.A	CRB	WTI	Gold
USD	1.00	-0.08	-0.73	-0.06	-0.11	0.23	0.20	0.33	0.05	-0.35	-0.55	-0.21	-0.20	0.11	-0.34
I.L D	-0.08	1.00	0.66	0.99	0.95	-0.31	-0.79	-0.49	-0.61	0.53	0.60	0.90	0.62	-0.79	0.85
Dev.Sov.D	-0.73	0.66	1.00	0.65	0.62	-0.38	-0.64	-0.59	-0.43	0.48	0.66	0.60	0.55	-0.65	0.73
IG.D	-0.06	0.99	0.65	1.00	0.95	-0.26	-0.75	-0.46	-0.59	0.53	0.57	0.87	0.61	-0.80	0.81
EMD	-0.11	0.95	0.62	0.95	1.00	-0.05	-0.60	-0.29	-0.39	0.71	0.71	0.94	0.46	-0.76	0.74
US HY	0.23	-0.31	-0.38	-0.26	-0.05	1.00	0.81	0.91	0.86	0.28	0.03	-0.12	-0.76	0.24	-0.59
MSCI N. A	0.20	-0.79	-0.64	-0.75	-0.60	0.81	1.00	0.88	0.92	-0.15	-0.34	-0.61	-0.87	0.64	-0.88
MSCI P	0.33	-0.49	-0.59	-0.46	-0.29	0.91	0.88	1.00	0.86	0.06	-0.16	-0.31	-0.79	0.48	-0.74
MSCI EU	0.05	-0.61	-0.43	-0.59	-0.39	0.86	0.92	0.86	1.00	0.17	-0.02	-0.36	-0.82	0.50	-0.68
MSCI EM Asia	-0.35	0.53	0.48	0.53	0.71	0.28	-0.15	0.06	0.17	1.00	0.91	0.79	0.05	-0.41	0.44
MSCI EMEA	-0.55	0.60	0.66	0.57	0.71	0.03	-0.34	-0.16	-0.02	0.91	1.00	0.83	0.21	-0.42	0.62
MSCI L.A	-0.21	0.90	0.60	0.87	0.94	-0.12	-0.61	-0.31	-0.36	0.79	0.83	1.00	0.43	-0.66	0.80
CRB	-0.20	0.62	0.55	0.61	0.46	-0.76	-0.87	-0.79	-0.82	0.05	0.21	0.43	1.00	-0.42	0.73
WTI	0.11	-0.79	-0.65	-0.80	-0.76	0.24	0.64	0.48	0.50	-0.41	-0.42	-0.66	-0.42	1.00	-0.61
Gold	-0.34	0.85	0.73	0.81	0.74	-0.59	-0.88	-0.74	-0.68	0.44	0.62	0.80	0.73	-0.61	1.00

**Method: Run PCA Analysis with 15 securities variables of Weekly Return, standing for Fixed Income, Equities, Commodity and get 1<sup>st</sup> factor explain power**

Source: KIC Co\_movement index

# Degree of Risk Appetite

## KIC Degree of Risk appetite

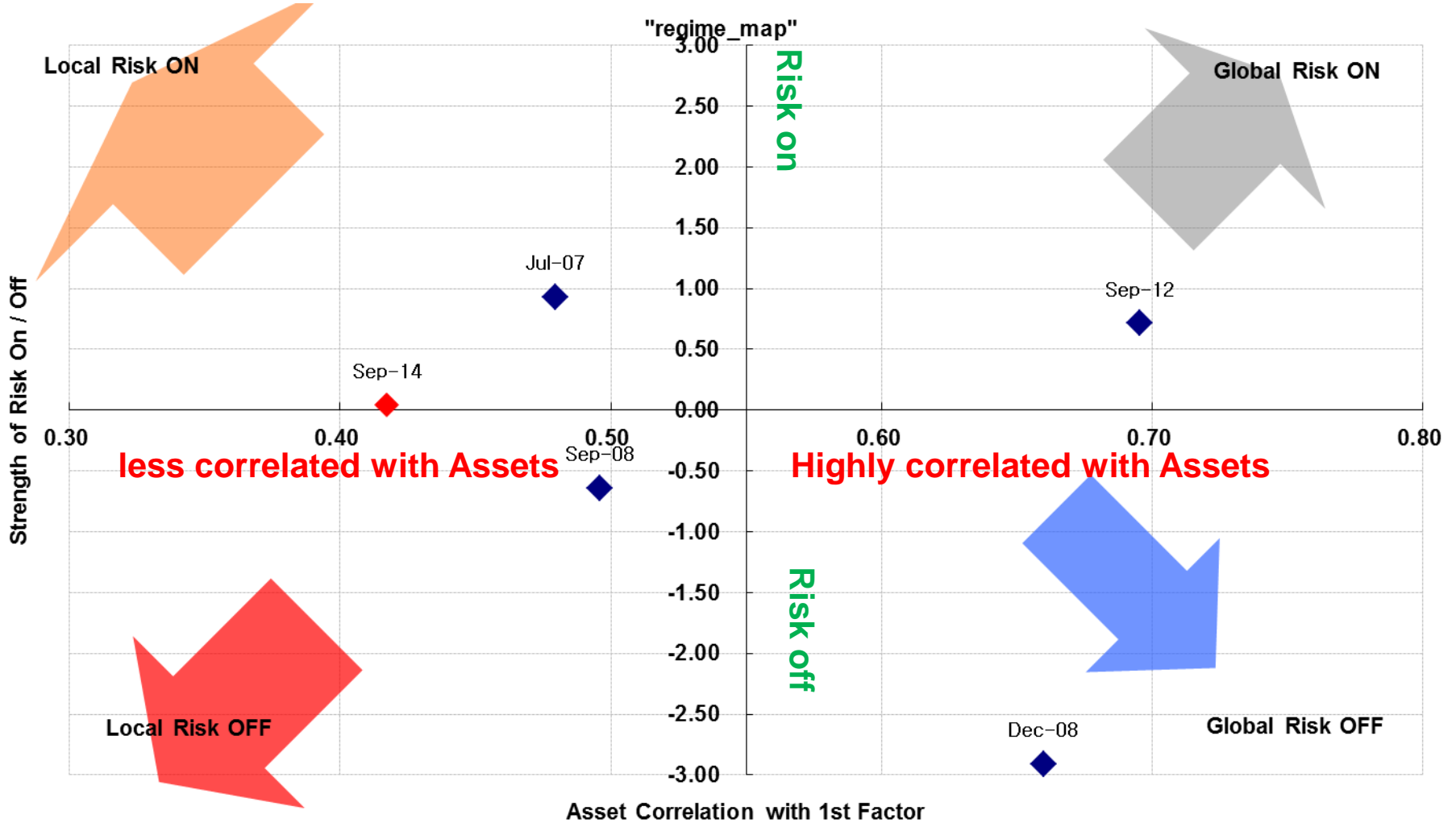


**Method: Run the regression in assets 1year rolling return with each asset volatility and slope is degree of risk appetite index**

Source: KIC Risk On/OFF index

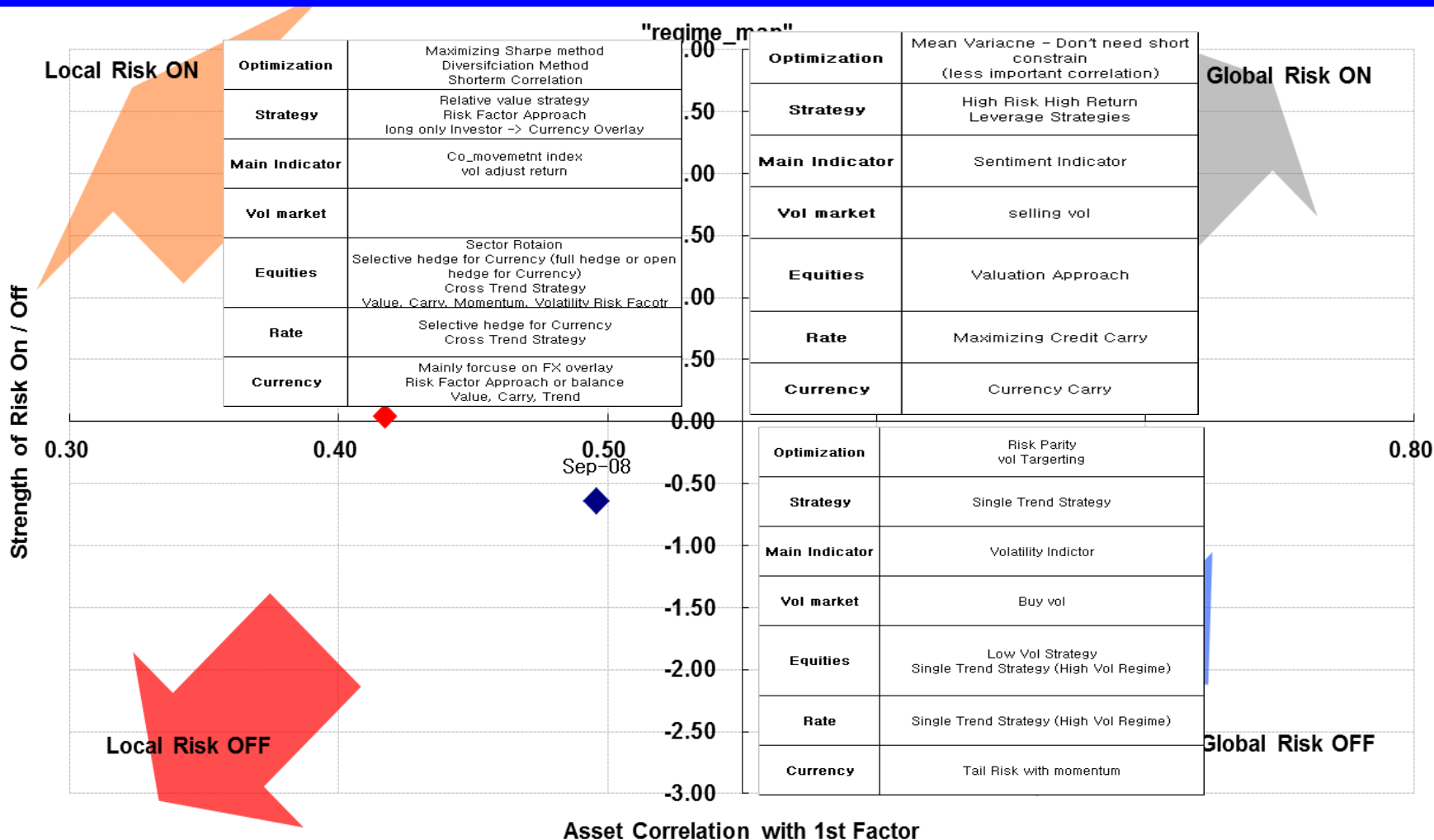
# Market Regime

## KIC Market Regime Map



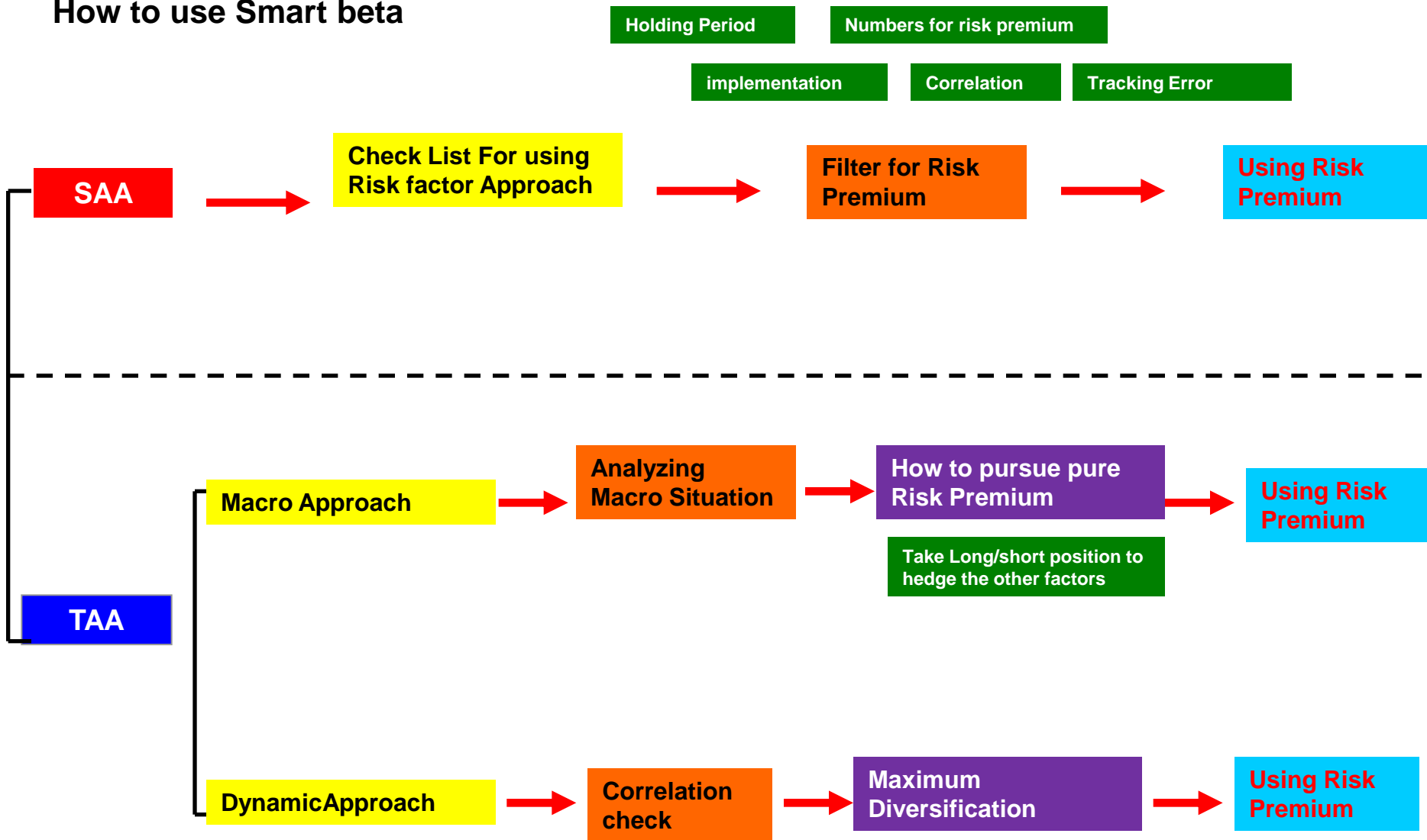
**There is not the only one answer in Financial Market**  
**Not only diversifying Assets but also diversifying Strategies**

**KIC Market Regime Map**





## How to use Smart beta



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## SAA Approach for Smart Beta

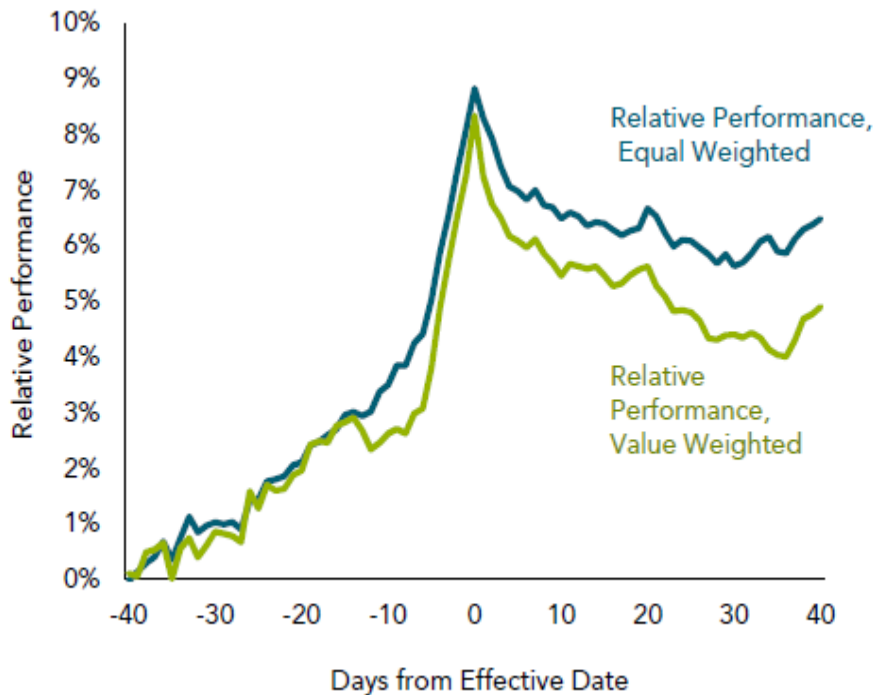
## Check List for using Smart Beta

<b>Self_check</b>	<b>Numbers</b>	At least 3 risk premium to make stable alpha because smart betas have cycle
	<b>Holding Periods</b>	At least 3year for holding Periods to use smart beta
	<b>Tracking Error</b>	Who are response for smart beta profit? (Tradition asset or Alternative Asset)?
<b>Factor_Check</b>	<b>Persistent</b>	statistically significant risk premium over very long history [~50+ years ]
	<b>Continuous</b>	the risk premium observed in proportion to exposure to the dimension, across all securities
	<b>Implementation</b>	exposure to the dimension implemented in a scalable, cost-effective and reliable fashion
	<b>Pervasive</b>	statistically significant risk premium across geopolitical borders
<b>Portfolio_Check</b>	<b>optimization</b>	Equal weight, risk parity, Maximum Diversification.....

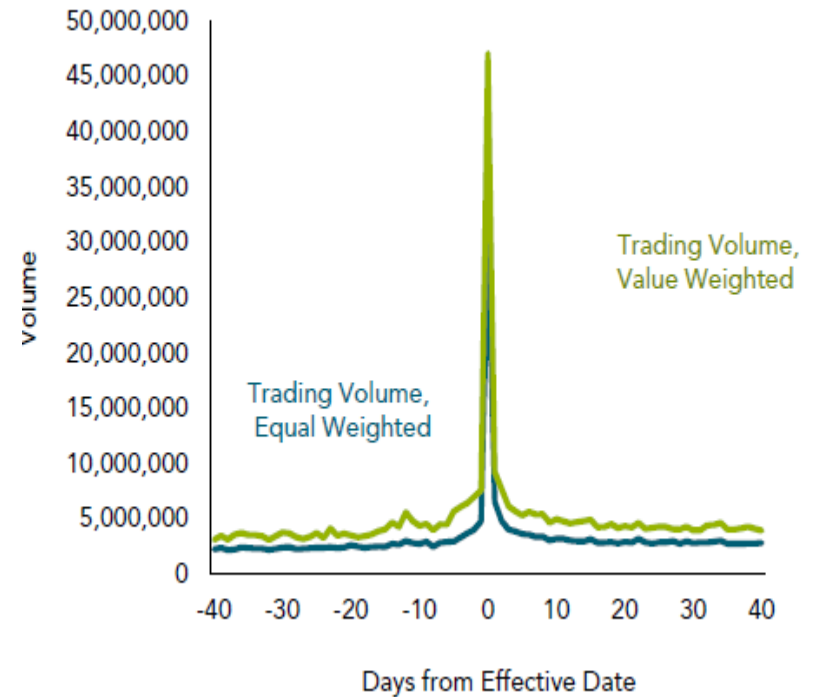
# Considering Trading Cost

## The cost of index implementation is not cheap

**Hidden Cost**



**Trading Volume**



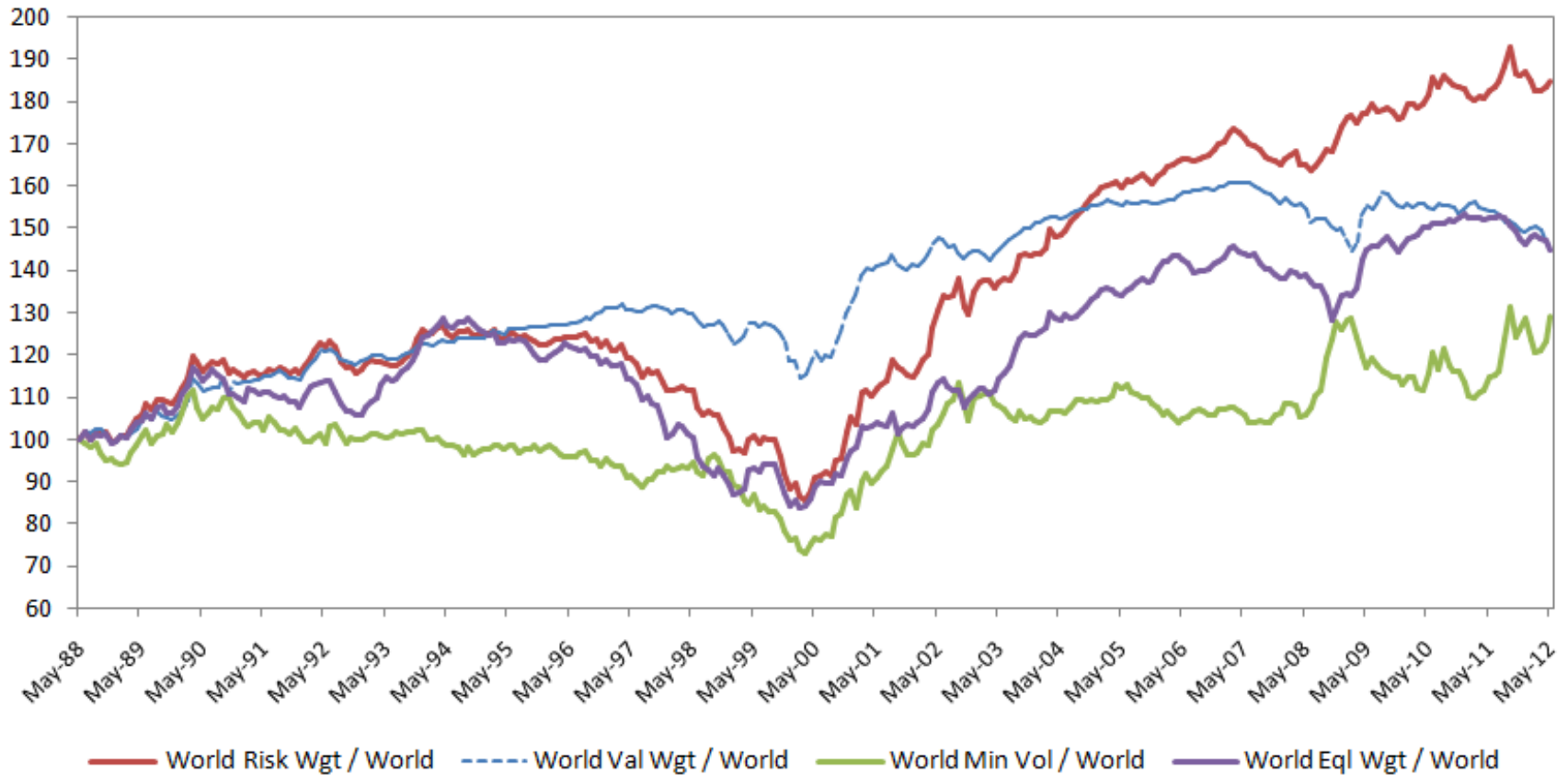
## MSCI Smart Beta Index

MSCI Risk Based Strategy Indices	MSCI Return Based Strategy Indices
<ul style="list-style-type: none"> <li>Reflect the objective of lowering overall risk (i.e., shifting to left along the efficient frontier) by reweighting the portfolio to emphasize lower-volatility constituents (Strongin, Ang, Blitz, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Recognize that certain well-documented factors – value, size, momentum, GDP – are associated with persistent performance (Fama-French, Carhart, BARRA, etc.) in a mean-variance framework</li> </ul>
<p><b><u>MSCI Minimum Volatility Indices</u></b>  <b>Constructed using minimum variance optimization</b></p> <ul style="list-style-type: none"> <li>Semiannual rebalancing, constrained turnover 20%</li> <li>Launched in 2008, index history from 31 May 1988</li> </ul>	<p><b><u>MSCI Value Weighted Indices</u></b>  <b>Weighted according to four fundamental variables</b></p> <ul style="list-style-type: none"> <li>Semiannual rebalancing, approximate turnover 18%</li> <li>Launched in 2010, index history from 31 Dec 1976</li> </ul>
<p><b><u>MSCI Risk Weighted Indices</u></b>  <b>Weights based on the inverse of historical variance</b></p> <ul style="list-style-type: none"> <li>Semiannual rebalancing, approximate turnover 24%</li> <li>Launched in 2011, index history from 31 Dec 1979</li> </ul>	<p><b><u>MSCI GDP Weighted Indices</u></b>  <b>Index country weights based on nominal GDP</b></p> <ul style="list-style-type: none"> <li>Annual rebalancing, approximate turnover 7%</li> <li>Launched in 1988, index history from 31 Dec 1969</li> </ul>
<p><b><u>MSCI Equal Weighted Indices</u></b>  <b>Equal allocation across parent index constituents</b></p> <ul style="list-style-type: none"> <li>Quarterly rebalancing, approximate turnover 23%</li> <li>Launched in 2008, index history from 31 May 1988</li> </ul>	<p><b><u>MSCI Factor Indices</u></b>  <b>Constructed using long short portfolio optimization</b></p> <ul style="list-style-type: none"> <li>Monthly rebalancing, approximate turnover 60%</li> <li>Launched in 2009, index history from 31 May 2002</li> </ul>

## Individual smart Beta has own Cycle

***Need to aggregate at least 3 risk premium beta which are uncorrelated for SAA Because Individual smart Beta has own Cycle***

Relative Performance of Risk Premia Indices



**Suggesting to investors who want to invest Smart Beta in early stage  
Integrated Strategy with Cap weight and Tilted by risk premium is low  
Tracking Error against Traditional BM**

*One integrated basket*

**Market Cap Weight (MSCI market Cap) ± Tilting (Value, Size, Quality, Momentum, Quality)**

## Example (Fama 3 factor): How to use Smart beta with Traditional Weight

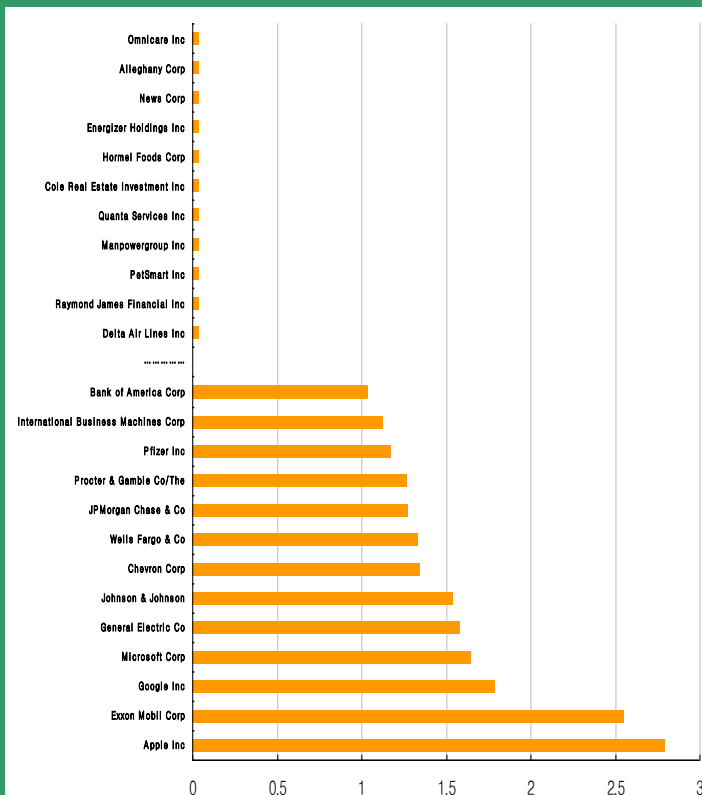
Cap\_Weight

Smart Beta

HF\_Strategy

$$Return(Portfolio) = Market_{beta} + SMB_{Size} + HML_{Value} + alpha$$

C  
A  
P  
W  
E  
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S  
A  
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R  
  
B  
E  
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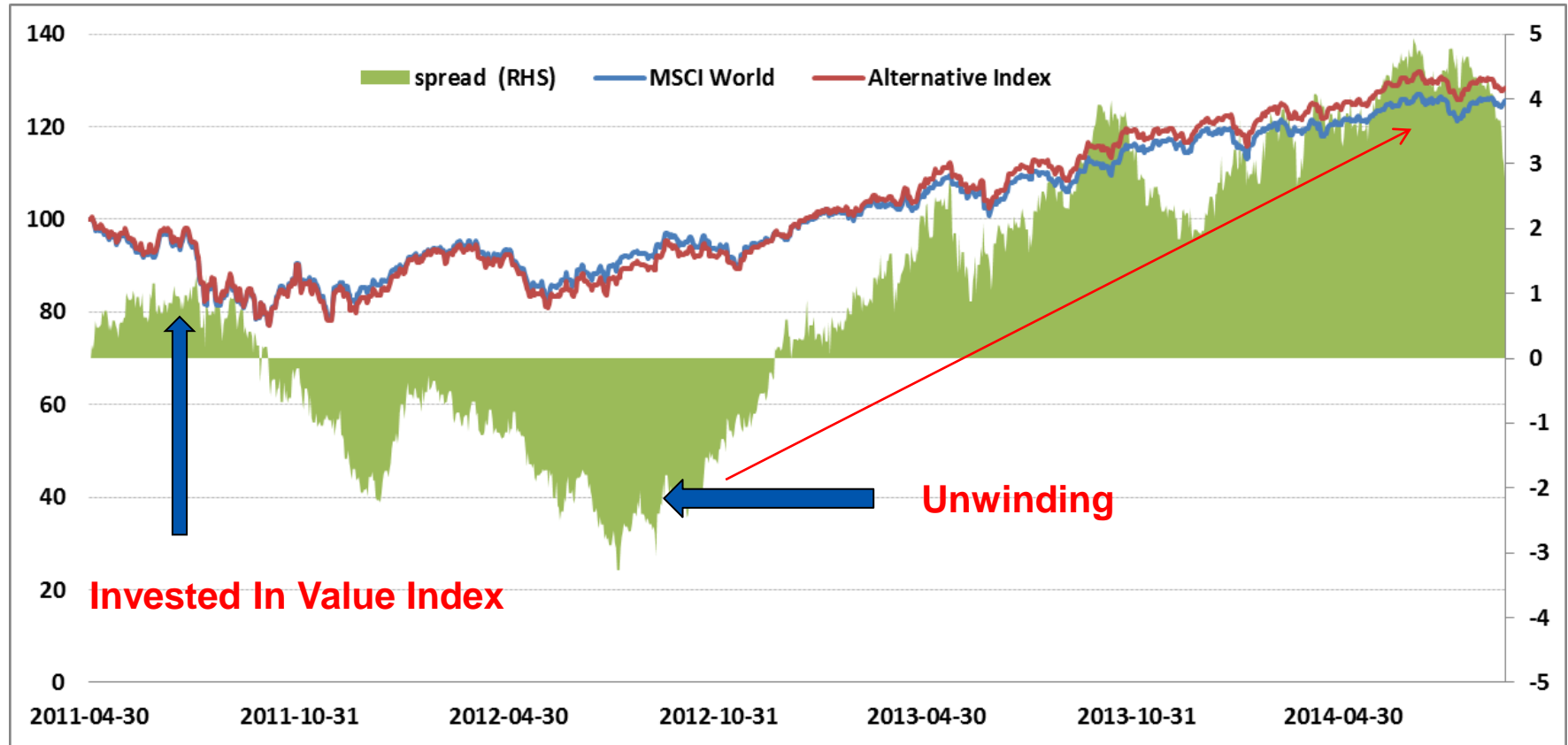
Name	Size & Value Premium	Tilting
Apple Inc	Rank 5	-0.007
Exxon Mobil Corp	Rank 5	-0.007
Google Inc	Rank 5	-0.007
Microsoft Corp	Rank 5	-0.007
General Electric Co	Rank 5	-0.007
Johnson & Johnson	Rank 5	-0.007
Chevron Corp	Rank 5	-0.007
Wells Fargo & Co	Rank 5	-0.007
JPMorgan Chase & Co	Rank 5	-0.007
Procter & Gamble Co/The	Rank 5	-0.007
Pfizer Inc	Rank 5	-0.007
International Business Machines Corp	Rank 5	-0.007
Bank of America Corp	Rank 5	-0.007
.....	.....	.....
Delta Air Lines Inc	Rank 1	0.013
Raymond James Financial Inc	Rank 1	0.013
PetSmart Inc	Rank 1	0.013
Manpowergroup Inc	Rank 1	0.013
Quanta Services Inc	Rank 1	0.013
Cole Real Estate Investment Inc	Rank 1	0.013
Hormel Foods Corp	Rank 1	0.013
Energizer Holdings Inc	Rank 1	0.013
News Corp	Rank 1	0.013
Alleghany Corp	Rank 1	0.013
Omnicare Inc	Rank 1	0.013



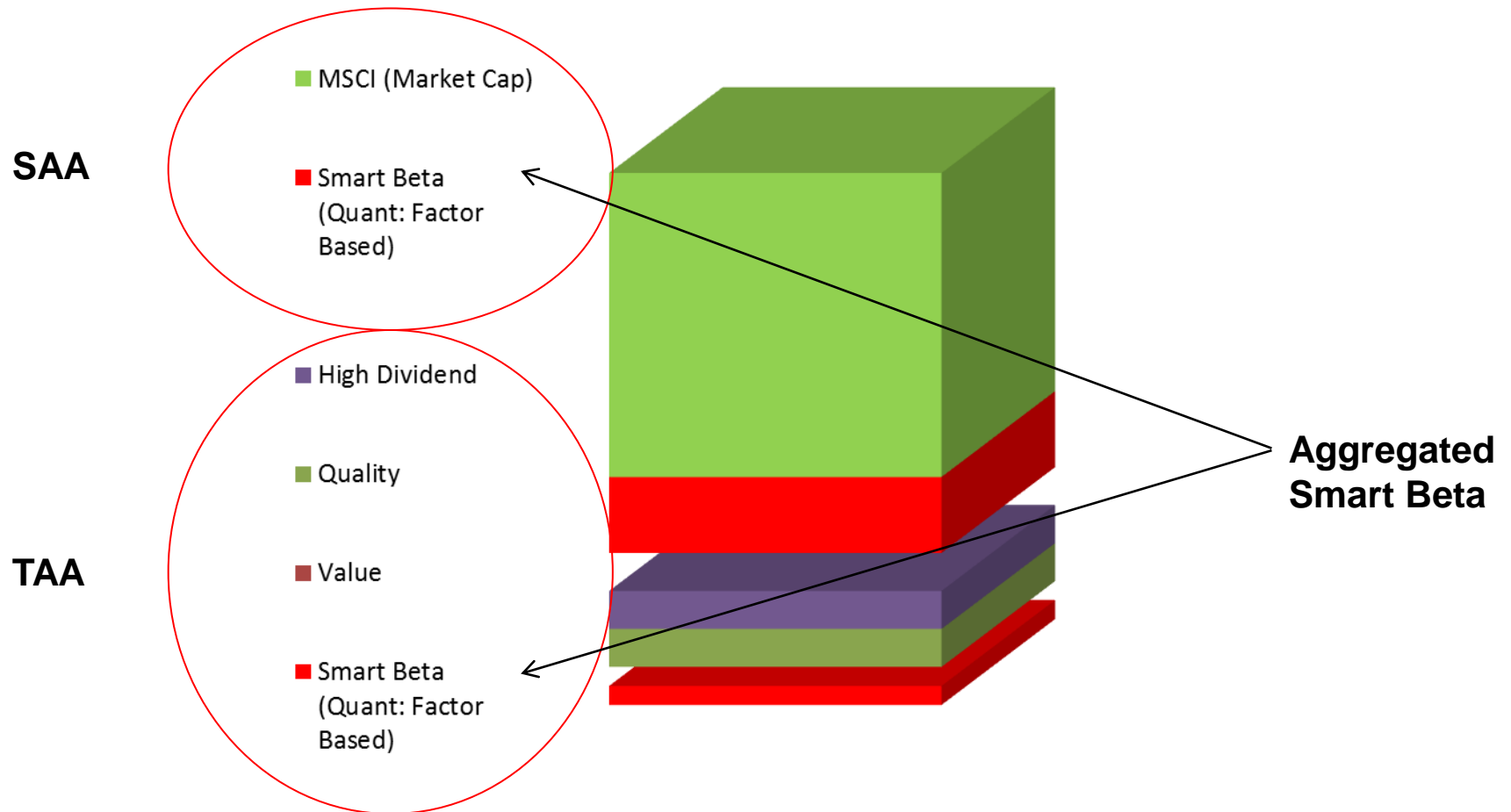
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## Case Study of failure and succession

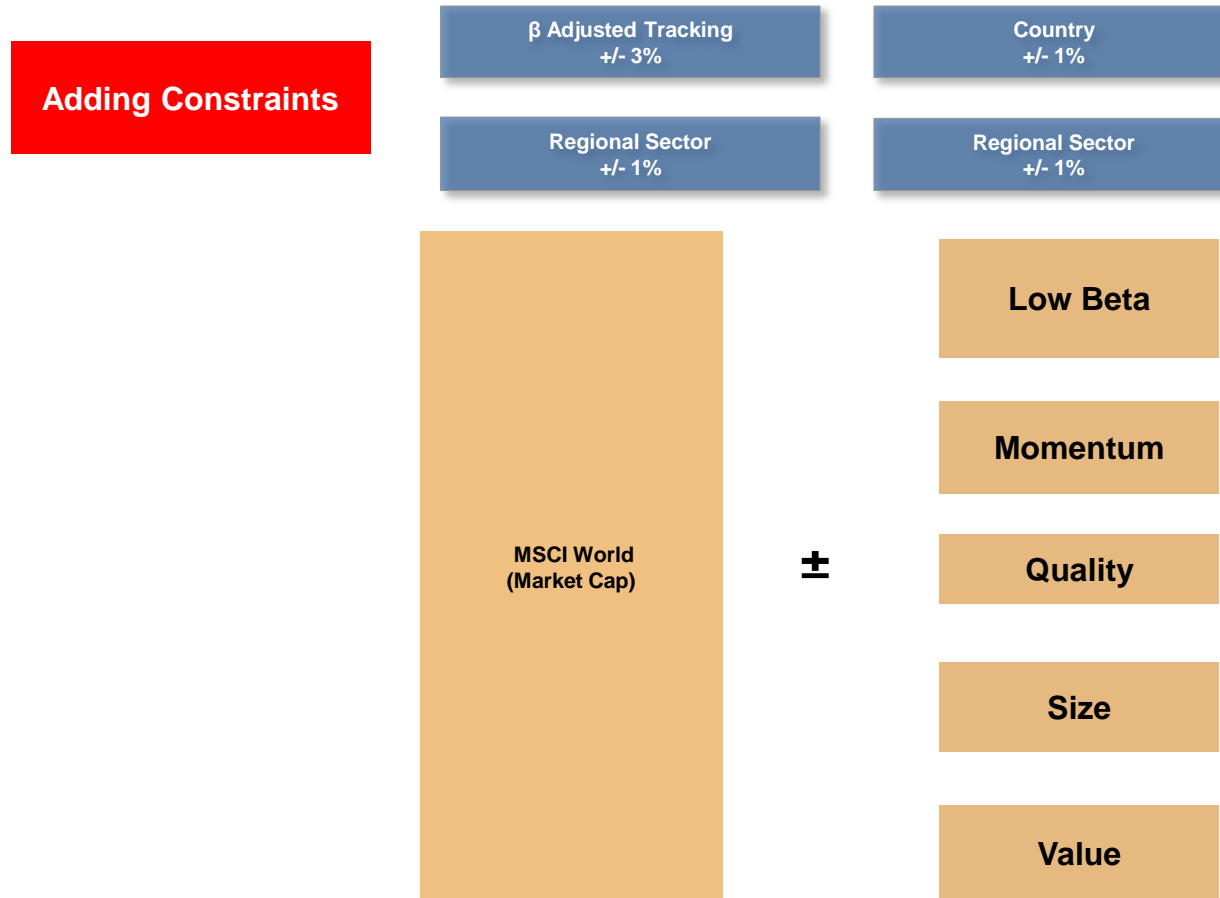
## Case of Failure: Too Short period time to evaluate Value Premium



## 2014Y Equity Portfolio



## Market Cap + Smart Beta



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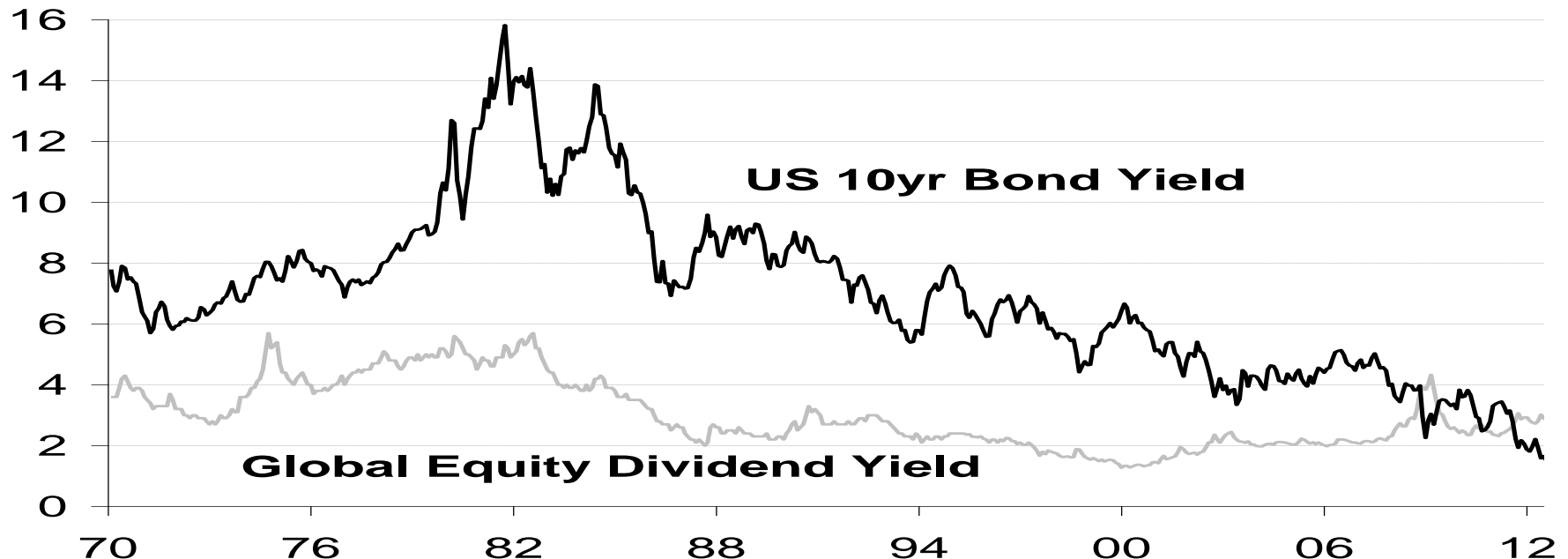
## TAA Macro Approach for Smart Beta

## KIC invested High quality equity risk premium in 2013

### Reason to invest High Quality Equity index in 2013

- Higher Equity Dividend Yield than Bond Yield in 2012 (16 Oct 2012: 10Y us bond: 1.66%, Dividend Stock Dividend yield : 4.2% )
- Investment horizon: 1year (24 Oct 2012 ~ 30 Oct 2013)
- We believe that High quality factor will be working better than high beta factor

### Equity vs. Bond



## How to implement for Pure High quality factor with hedging the other factor

- Long: High dividend Basket Equity 100Mil
- Short: JGB10Y future 80M + IDR Currency 80M + High beta Equity 20M

### Dividend Factor

Long	Short
High Dividend Basket (Equity) 80 Mill (+20%)	JGB 10Y Short (Bond) 80 Mill (%) (-1,5%)
	IDR Currency (Currency) 80 Mill (+10%)

### High Quality Factor

Long	Short
High Dividend Basket (Equity) 20 Mill (+20%)	High Beta South Africa (Equity) 20 Mill (-4,5%)

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# TAA Dynamic Switching (Sentiment –led risk based portfolio) for Smart Beta



## Currency Risk Premium

### Carry

Carry (Bloomberg ticker: DBHTG10U Index): buy the higher yielding currencies, sell the lower yielding on the premise that the FX forward is a biased estimator of the future spot rate. The carry trade is the purest long "risk" strategy in FX, somewhat analogous to being long the index in equities, and its return profile therefore also tends to be correlated to that of risk assets. The DBCR Carry strategy buys the G-10 currencies with the 3 highest money market rates, and sells those with the 3 lowest rates, rebalancing every quarter.

### Momentum

Momentum (Bloomberg ticker: DBMOMUSF Index): buy the outperforming, sell the underperforming currencies. The strategy is based on the idea that currency pairs trend over time for a variety of reasons, and that trend behaviour can be proxied by ranking recent returns. Momentum strategies tend to outperform under trending markets (typically high and low volatility) and underperform under choppy markets, which typically correspond to medium volatility. The DBCR Momentum index buys the currencies which appreciated the most over the past year, and sells the weakest for the same horizon, rebalancing every month.

### Valuation

Valuation (Bloomberg ticker: DBPPPUSF Index): buy the cheapest, sell the dearest currencies using a specific valuation metric, on the premise that currencies will revert to their "fair" value over the long run. The returns can be counter-cyclical in the sense that the cheapest currencies typically outperform under strong risk aversion. The DBCR Valuation strategy buys the 3 cheapest currencies relative to fair value according to the OECD's PPP estimate, and does the opposite for the 3 dearest currencies. The positions are rebalanced every 3 months.

## Optimization for Risk budgeting

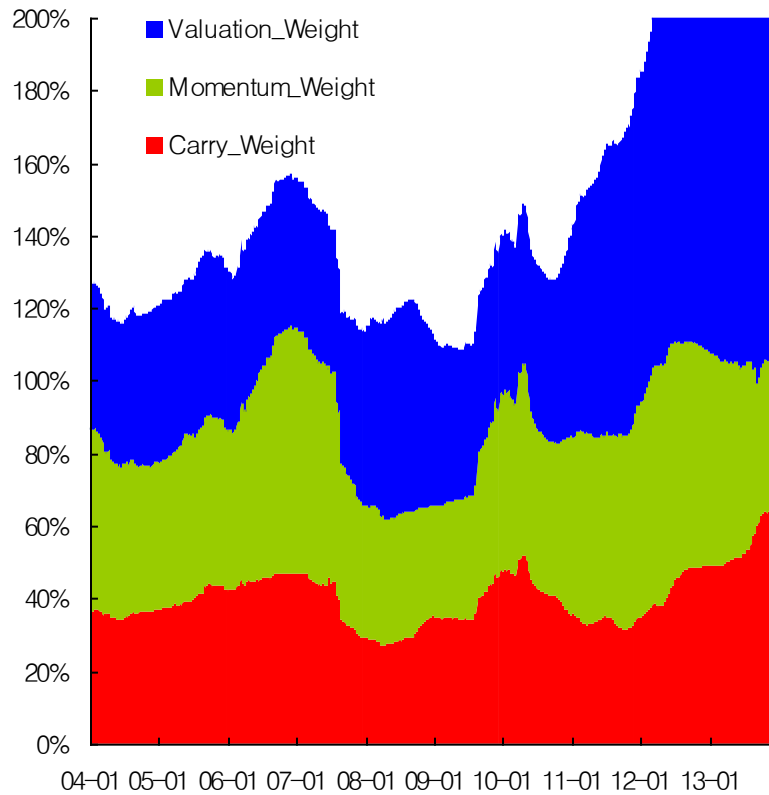
### Optimization for Risk budgeting

- Minimum Variance:
  - Optimize portfolio weights to generate the lowest possible portfolio volatility
- Risk Parity:
  - Optimize portfolio weights so that each asset class has an equal contribution to overall portfolio risk
- Maximum Diversification:
  - Optimize portfolio weights to produce the lowest possible cross correlation between asset classes

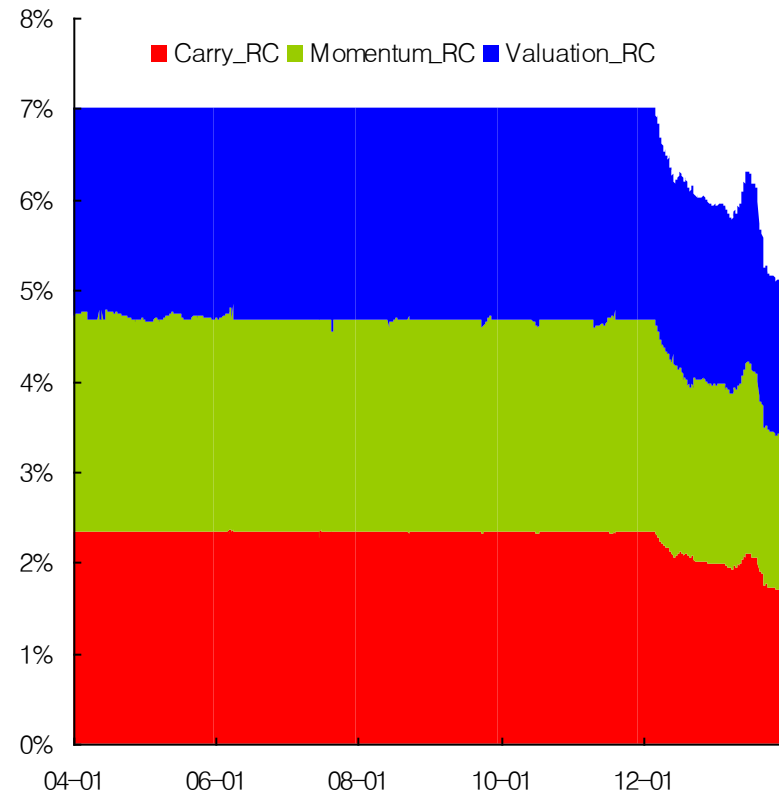
Approach	Formula	Rationale
Inverse Volatility	$w_i^{IV} = \frac{1/\sigma_i}{\sum_n 1/\sigma_i}$	Same volatility budget for all components
Equal Risk Contribution	$w_i^{ERC} = \arg \min_w \sum_{i=1}^n \sum_{j=1}^n (w_i \text{cov}(r_i, r_p) - w_j \text{cov}(r_j, r_p))^2$	Same contribution to risk for all components
Alpha Risk Parity	$w_i^{ARP} = \arg \min_w \sum_{i=1}^n \sum_{j=1}^n \left( \frac{w_i \text{cov}(r_i, r_p)}{\alpha_i} - \frac{w_j \text{cov}(r_j, r_p)}{\alpha_j} \right)^2$	Sets risk budget proportional to alpha (Normalized IR in this case)
Maximum Diversification	$w_i^{MD} = \arg \max_w \frac{\sum w_i \sigma_i}{\sqrt{w' \Sigma w}}$	Reduces diversification risk for the portfolio

## Equal Risk Contribution

**Risk Premium Weight (Target Vol: 7%,  
Maximum Leverage Ratio: 100%)**



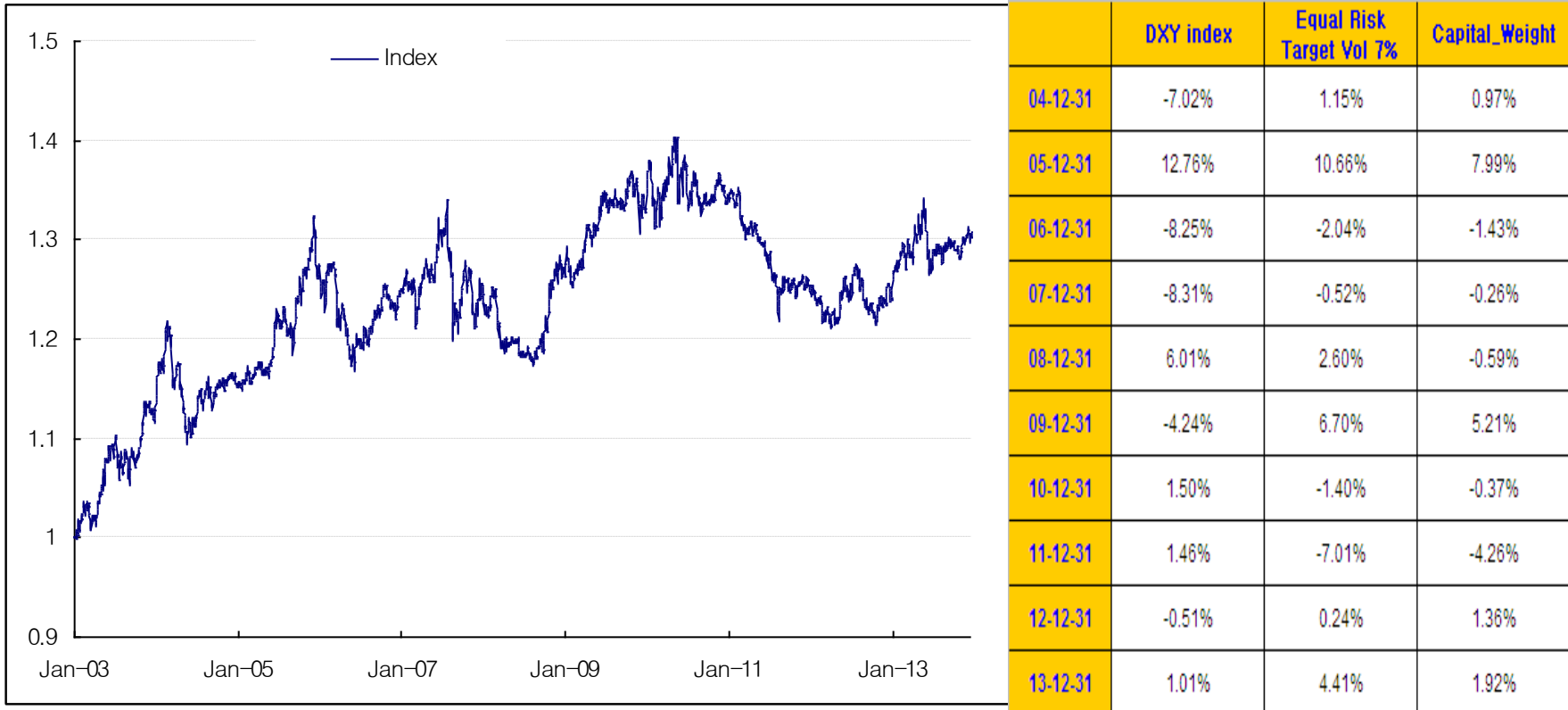
**Risk Contribution**



Source: KIC

## G10 Currency Risk Factor Allocation Performance

### G10 Currency Risk Factor Allocation Performance

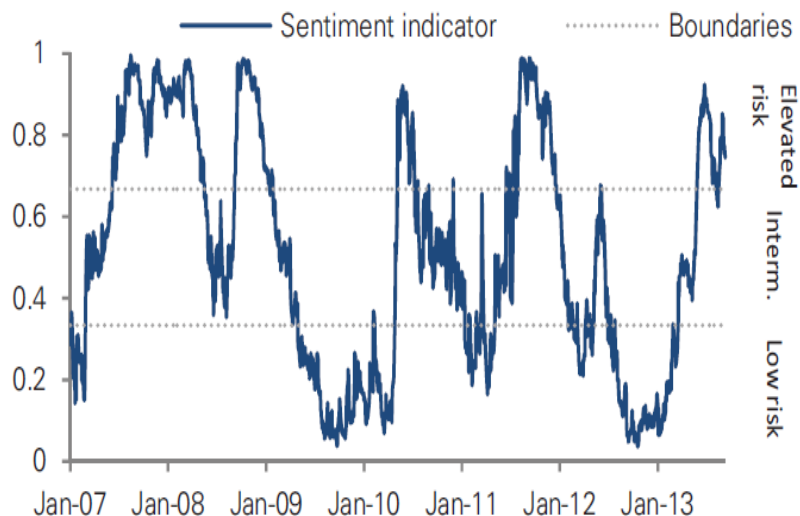


Source: KIC

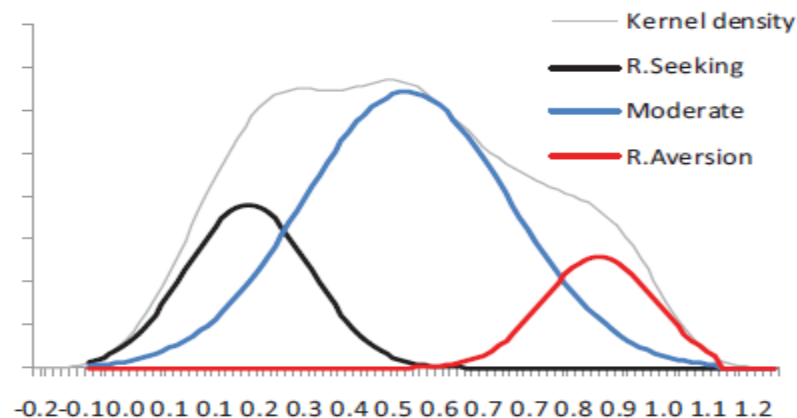
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# TAA Dynamic Switching (Sentiment –led risk based portfolio) for Smart Beta

## Sentiment-led risk based portfolio Construction



### Frequency histogram and decomposition into 3 distributions



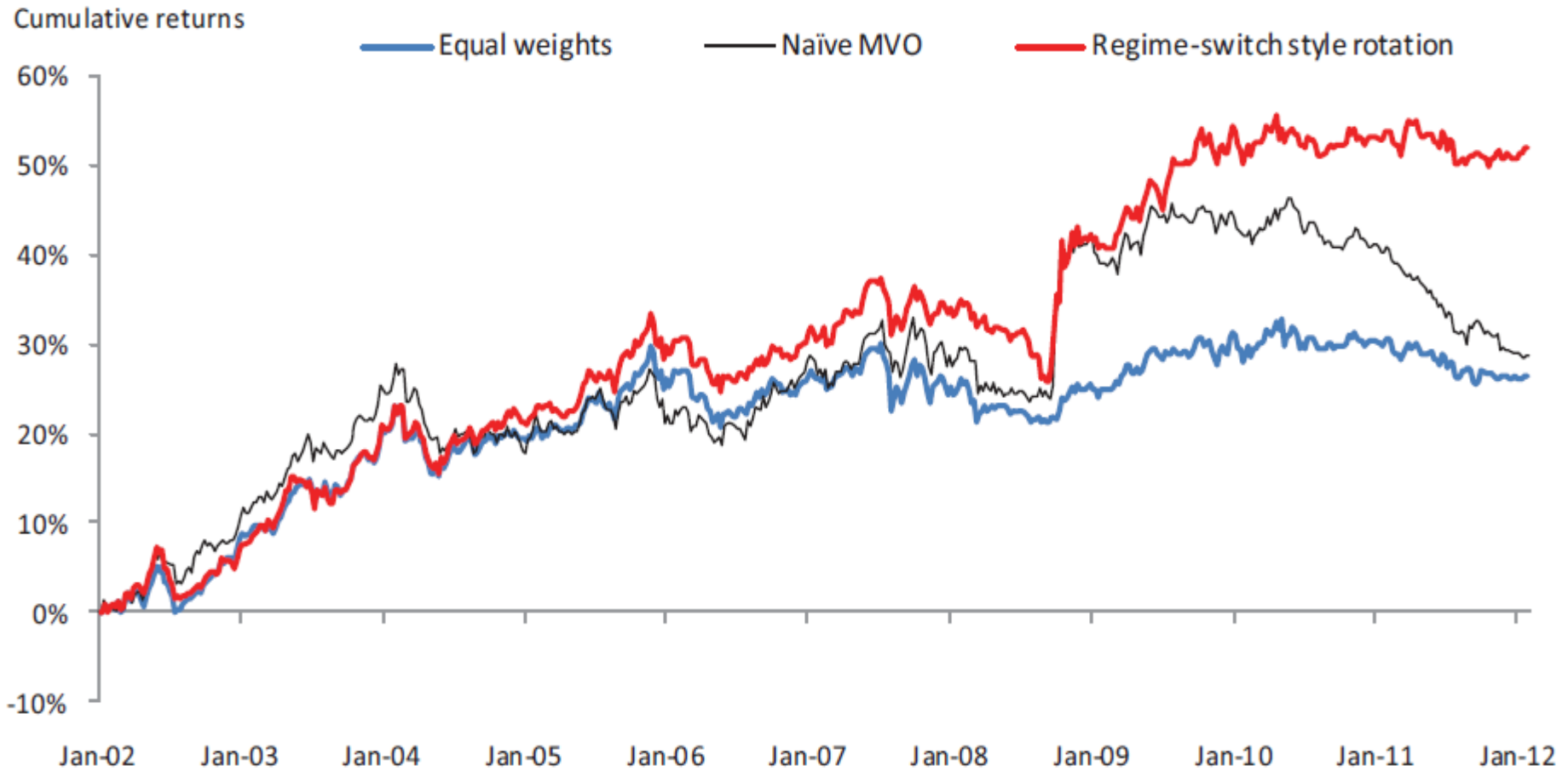
- Step 1: Calculate the state-conditional variance-covariance matrix  $\Sigma^i$  from historical data under state  $i$ .
- Step 2: Calculate the probability of next month's regime from the empirical transition matrix and the current state.  $P(s_{t+1} = i | s_t = j) = p^{ji}$
- Step 3: Calculate state-contingent portfolio allocation:  $w^i = MD(\Sigma^i)$ , i.e., the weight should be  $w^1$  if next month is risk-on; and  $w^2$  if it is risk-off. In calculating  $w^2$ , we filter out the styles which have significantly positive correlation with the sentiment index.

Mathematically, if we write  $w^2 = [w_1^2, w_1^2, \dots, w_k^2, \dots, w_N^2]$ , where subscript  $k$  indicates each individual style, then

$$w_k^2 = \begin{cases} 0 & \text{where } k \in \{cor(r_k, sentiment) \text{ is significantly positive}\} \\ MD(\Sigma_k^2) & \text{otherwise} \end{cases}$$

- Step 4: Calculate the final weight:  $w = p^{j1}w^1 + p^{j2}w^2$

## Style-switching strategies



## Some closing observations

- To invest in smart beta strategies, an SWF needs to hold investment beliefs that are consistent with the existence of certain risk premia in the capital markets. These premia may arise because not all investors can invest in all markets.
- Many of these risk premia are available for a low management fee. Investors should not pay high active management fees for the “pseudo alpha” associated with smart beta.
- Certain smart beta strategies (for example, momentum) involve more turnover and higher transaction costs than other smart beta strategies. Transaction costs are an essential consideration. One way to control transaction costs is to implement smart beta strategies as incremental “tilts” to market cap-weighted portfolios.
- SWFs who invest in these strategies should have a medium to long investment horizon. KIC evaluates the performance of smart beta portfolios over three-year periods, not annually. Their performance may vary widely from year to year.
- A portfolio of smart beta strategies that diversify one another can provide more stable performance across investment regimes. When constructing portfolios of these strategies, historical correlation is at least as important as historical returns.