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Evaluating Alternative Betas
When Is a Portfolio Efficient Enough?

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Agenda

Section 1	Discuss CAPM and Alternative Betas
Section 2	A Study of Efficient Enough Portfolio
Section 3	Conclusion

CAPM and Capital-weighted Portfolio

Capital-weighted Portfolio is supreme under CAPM

- Approximates the "true" market portfolio
- Mean variance efficient (MVE)
- All investors hold the same portfolio

CAPM – a Theoretical Tour de Force?[1]

- Widely studied and used in the financial world; **BUT**
- Empirical tests generally rejected the validity of its predictions[1]
- Some even suggested the theory is untestable as the "market portfolio" is un-observable[2]

If CAPM is rejected, a capital-weighted portfolio is

- Not necessary MVE
- No better than other possible portfolios?

Are there *any other portfolios with more attractive risk-to-reward trade-offs?*

1. Fama, E.F. and French, K.R. "The Capital Asset Pricing Model: Theory and Evidence", Journal of Economic Perspectives, 8:3 (Summer 2004), PP 25 - 46

2. Roll, Richard "A Critique of the Asset Pricing Theory's Tests' Part I: On Past and Potential Testability of the theory.", Journal of Financial Economics, (1977) 4:2, pp. 129-176

Some Alternative Beta Examples

Portfolio constructed by only considering risks

Minimum Variance Porfolio[1]

- Allocation to assets in a way such that the portfolio volatility is minimised
- Satisfactory expected return relative to risk if expected returns for all assets are the same or so uncertain that assuming they are the same is as good an estimate as any

Risk Parity Portfolio

- Marginal risk contribution of each asset is equal
- Justifiable if each asset's expected return is roughly proportional to its risk (volatility)
- Allocation to each asset would be inversely proportional to its expected return[1]

1. See calculations in Andrew Harmstone "Evaluating Alternative Betas: When is a portfolio efficient enough, Journal of Index November/ December 2014, PP 108-117

Investor Preference

Regardless of whether CAPM is valid, an investor may still prefer a portfolio that has

- Smallest standard deviation of returns (risk)
- With a given expected return (reward)[1]

These characteristics lead to the use of Efficient Enough (EE) Portfolio:-

- A particular investor looking at a well-defined set of assets may want to a portfolio of these assets that has the smallest risk for a given reward
- This portfolio may be called “Efficient Enough”

1. See for example Fama and French, p. 26 that discusses the “Logic of CAPM”. The discussion there describes how Harry Markowitz (in 1952, “Portfolio Selection”, Journal of Finance 7:1 pp 77-99 and in 1959 Portfolio Selection: Efficient Diversification of Investments, Cowles Foundation Monograph No 16. New York: John Wiley & Sons, Inc.) developed the model of investor preference such that the investor prefers a portfolio that has the highest expected return for a given variance or alternatively the minimum variance for a given expected return. Sharpe and Linter then elaborated this into the full CAPM.

Construct An Efficient Enough Portfolio

- A standard optimization problem if expected returns and risks are known
- Not so straightforward especially when estimating the expected returns
- An indirect approach to test if a given anchor portfolio is Efficient Enough (EE):

For illustrative purposes only.

Anchor Portfolios "Inspired" by Alternative Beta Methods

Five portfolios considered:

- GDP weighting
- Capitalization weighting
- Equal weighting
- Minimum variance
- Risk Parity

Assets	GDP Weighted	CAP Weighted	Equal Weight	Min Var	Risk Parity
S&P 500 INDEX	15.8%	25.5%	6.7%	0.4%	2.4%
MSCI EUROPE exc. UK	14.5%	11.8%	6.7%	1.9%	2.6%
MSCI UK	2.4%	4.6%	6.7%	0.0%	2.6%
MSCI JAPAN	4.6%	5.6%	6.7%	2.9%	2.8%
MSCI EM	22.7%	12.4%	6.7%	0.0%	1.5%
Citigroup Japan GBI All Maturities	6.2%	9.1%	6.7%	47.1%	23.1%
Citigroup Germany GBI All Maturities	4.6%	2.3%	6.7%	7.8%	11.6%
Citigroup France GBI All Maturities	3.5%	2.8%	6.7%	0.0%	9.7%
Citigroup UK GBI All Maturities	3.2%	2.3%	6.7%	0.0%	6.9%
Citigroup US GBI All Maturities	9.4%	10.2%	6.7%	0.0%	8.6%
Barclays US Treasury Inflation	1.4%	1.5%	6.7%	0.0%	5.2%
Barclays GNMA Total Return Ind	2.1%	2.3%	6.7%	39.9%	12.0%
Barclays US Agg Corporate Total Return	6.3%	6.9%	6.7%	0.0%	4.2%
Barclays US High Yield 2% Issuer Cap	2.1%	2.3%	6.7%	0.0%	3.6%
JPMorgan EMBI Global Diversified IG	1.1%	0.4%	6.7%	0.0%	3.2%
Equity	**60.0%**	**60.0%**	**33.3%**	**5.2%**	**11.8%**
Fixed Income	**40.0%**	**40.0%**	**66.7%**	**94.8%**	**88.2%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

For illustrative purposes only.

* Source: Bloomberg, MSIM. The historic time period for monthly local currency returns is from April 1997 to July 2014 except for MSCI exc UK, which starts from December 1998, MSCI EM and JPMorgan EMBI Global Diversified IG, which are denominated in US dollar. For the GDP weighted portfolio, the returns of the GDP weighted indices are used for MSCI Europe exc. UK and MSCI EM. Note that all the equity indices are total return indices so the equity returns data include dividends.

Implied Returns from Reverse Optimisation

Assets	GDP Weighted	CAP Weighted	Equal Weight	Min Var	Risk Parity
S&P 500 INDEX	5.8%	5.4%	5.6%	3.8%	9.2%
MSCI EUROPE exc. UK	8.6%	5.5%	5.7%	3.8%	8.4%
MSCI UK	5.0%	4.6%	4.9%	3.9%	8.3%
MSCI JAPAN	5.0%	4.6%	5.3%	3.8%	7.8%
MSCI EM	9.5%	8.1%	8.9%	7.2%	15.0%
Citigroup Japan GBI All Maturities	-0.1%	-0.1%	0.0%	3.8%	0.9%
Citigroup Germany GBI All Maturities	-0.5%	-0.4%	-0.2%	3.8%	1.9%
Citigroup France GBI All Maturities	-0.4%	-0.3%	0.0%	4.2%	2.2%
Citigroup UK GBI All Maturities	-0.2%	-0.2%	0.1%	5.1%	3.1%
Citigroup US GBI All Maturities	-0.4%	-0.4%	-0.1%	5.3%	2.5%
Barclays US Treasury Inflation	0.5%	0.2%	0.7%	6.3%	4.2%
Barclays GNMA Total Return Ind	0.0%	0.0%	0.2%	3.8%	1.8%
Barclays US Agg Corporate Total Return	1.0%	0.7%	1.2%	6.9%	5.1%
Barclays US High Yield 2% Issuer Cap	3.0%	2.4%	3.0%	3.9%	6.0%
JPMorgan EMBI Global Diversified IG	1.7%	1.5%	2.2%	7.7%	6.8%

Returns are scaled to minimise the square deviations from historical returns.

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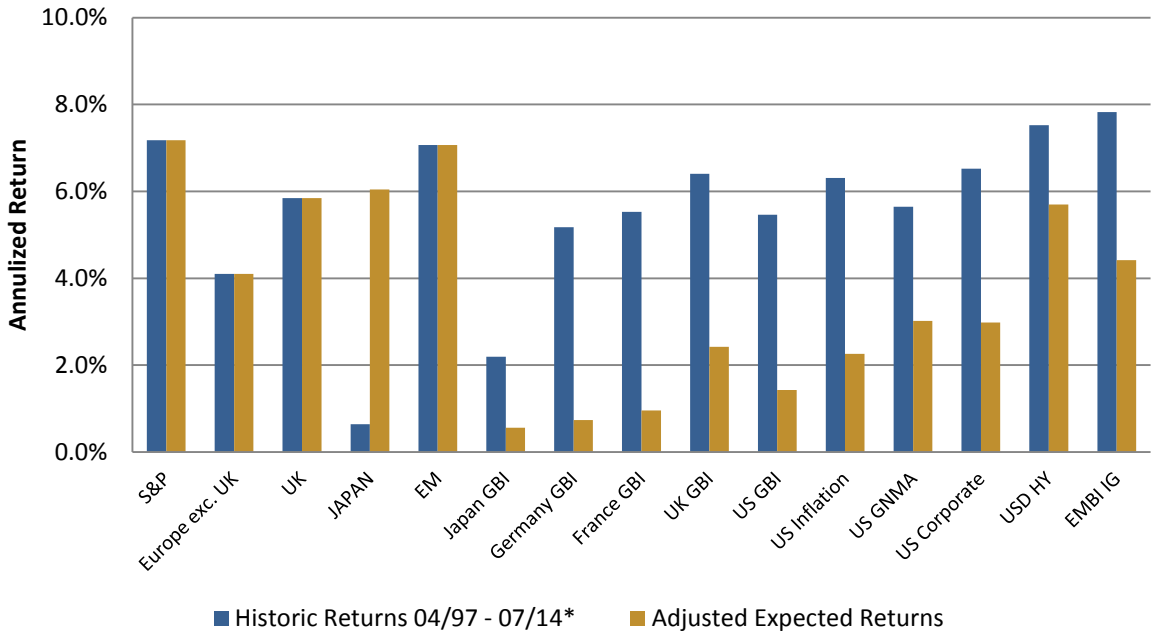
A Priori Expected Returns

Two sets of expected returns:

- Annualised Historic returns
- Adjusted expected returns
  - All equity indices except for MSCI Japan: historic returns
  - MSCI Japan: the average historic returns of other equity indices
  - Fixed income assets: current yields



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* Source: Bloomberg, MSIM. The historic time period for monthly local currency returns is from April 1997 to July 2014 except for MSCI exc UK, which starts from December 1998, MSCI EM and JPMorgan EMBI Global Diversified IG, which are denominated in US dollar. The adjusted annualized returns equal the historic returns for equity assets except MSCI Japan. This is because it appears unlikely investors would expect a substantially underperforming return for any asset if they invest in it. So the adjusted return for MSCI Japan is set to the average of the historical returns for all the other equity indices. In the case of fixed income assets the adjusted return is set to their recent yield levels.

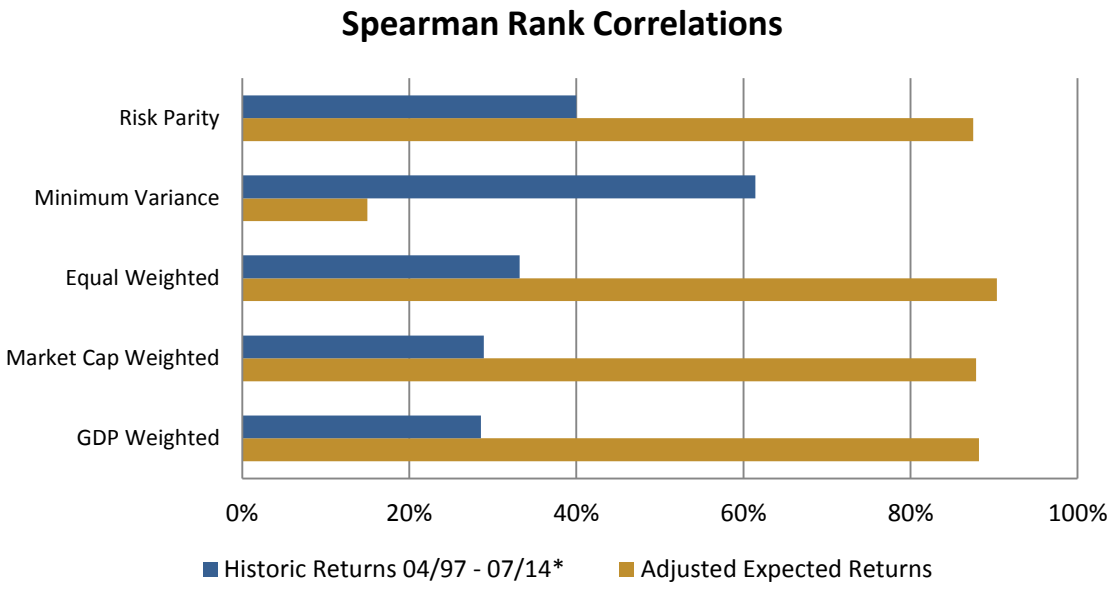
Evaluate Against A Priori Returns

Historic returns:

Minimum variance portfolio ranks the highest. Greater than the 1% significance level of 60% correlation.

Adjusted expected returns:

Risk Parity, Equal Weighted, Market Cap Weighted and GDP Weighted are the preferred anchor portfolios.



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Conclusion

1. CAPM - a "Theoretical Tour de Force, but with various issues in practice

- Rejected by empirical tests and "market portfolio" is difficult to observe
- Direct optimisation stymied by large estimation error particularly for expected returns
- Passive capital-weighted indices may not be mean-variance efficient if CAPM is not true

2. Efficient Enough Portfolios

- Preference ordering consistent with CAPM: highest expected return for a given risk level

3. Seeking Efficient Enough Portfolio amongst different Alternative Beta portfolios

- Proposed EE portfolio constructed without explicit expected return assumptions, inspired by Alternative Beta Methods
- Test proposed EE portfolios by comparing their implied returns to "a priori" expected returns
- If historical returns are the priori expected returns, then minimum variance will be the anchor portfolio
- If our adjusted expected returns are the priori expected returns, GDP, market capitalisation, risk parity or equal-weighted portfolios might be chosen as the anchor portfolio
- Once the anchor portfolio is found, the EE frontier follows

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