Risk Management
No Risk, No Return

- Taking risk is a necessary condition for generating excess return
- Investment philosophy determines which risks to take
Investment Philosophy/Objective Defines Intended Risk

Opportunity Set
Individual risk sources

Intended Risks
Positive expected/anticipated return

Unintended Risks
Unknown expected/anticipated return
Two Examples

Factor Portfolio

Stock-picking Portfolio

Risk Share

Risk Share

Factors 1, 2, 3, 4, 5, and Stock Specific.
Reflecting Risk Preferences In Portfolio Construction

As at 30.09.2015. Source: Northfield, UBS PAS, Citi GRAM, Axioma
RBC Global Equities representative fund.
Diversification & “Diversification”

The traditional diversification result states that asset specific risk in a portfolio can be reduced if we add more assets.
Towards a More General Meaning of Diversification?

- Traditionally, diversification means risk reduction from adding more assets, given the budget constraint and no short selling.

- In the context of a systematic + idiosyncratic risk model, this means that we can diversify idiosyncratic risk but not systematic risk.

- We propose that making the distribution of systematic risk sources more uniform has a diversification like effect in terms of risk reduction.

- It makes sense to talk about traditional diversification, i.e. diversification of idiosyncratic risk, as $\alpha$-diversification and “diversification” of systematic risk as $\beta$-diversification.
Portfolio Risk

- Portfolio variance in asset terms can be written as:

\[
V(r_p) = w\Lambda w' = \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j \rho_{ij} \sigma_i \sigma_j
\]

where \( w \) is an \( N \)-vector of asset weights, \( w_i \), \( \Lambda \) is an \((N \times N)\)-asset covariance matrix with asset variances, \( \sigma_i^2 \), along the diagonal and covariances, \( \rho_{ij} \sigma_i \sigma_j \), off the diagonal, and \( \rho_{ij} \) is the correlation coefficient between asset \( i \) and \( j \). \( N \) is the number of assets.

- or in terms of systematic factors

\[
V(r_p) = w\Lambda w' = wB\Omega B' w' + w\Sigma w' = \beta\Omega\beta' + w\Sigma w'
\]

where \( B \) is an \((N \times K)\)-matrix of asset factor exposures, \( \Omega \) is a \((K \times K)\)-factor covariance matrix, \( \Sigma \) is an \((N \times N)\)-matrix with asset-specific variances and \( \beta \) is a \( K \)-vector of portfolio factor exposures. \( K \) is the number of factors.
Contributions to Portfolio Risk

- The contribution to portfolio risk can be written as:

\[ c = \left( \frac{\beta c}{\alpha c} \right) = \left( \frac{\beta \cdot (\Omega \beta')}{w \cdot (\Sigma w')} \right) \]

or in terms of risk share

\[ mc = \left( \frac{\beta mc}{\alpha mc} \right) = \left( \frac{\beta \cdot (\Omega \beta')}{w \cdot (\Sigma w')} \right) / V(r_p) \]

where \( \beta c \) is a \((K \times K)\)-matrix of factor or \( \beta \) contributions, \( \alpha c \) is an \((N \times N)\)-matrix with asset-specific or \( \alpha \) contributions and \( \beta mc \) and \( \alpha mc \) are the marginal contributions to risk and the relative versions of \( \beta c \) and \( \alpha c \), respectively.
Reducing Portfolio Risk

- Two ways to reduce portfolio risk
  - Increase $\alpha$-diversification.
    - Add more names without increasing the weight allocated to idiosyncratic risk
    - Rebalance to increase uniformity of $\alpha$-contributions
  - Hedge systematic risks

- … but is there a third way?

- $\beta$-diversification - “diversify” systematic risk
Risk Management Objectives

- **Portfolio Risk (relative or absolute)**
  - **Intended Risk**
    - Monitor and control level of intended risk and diversification
    - Ensure that the amount of risk allocated to individual bets is increasing in anticipated return and/or level of conviction
  - **Unintended Risk**
    - Manage (minimize) level of unintended risk
    - Manage distribution of unintended risk sources, e.g. manage (maximize) diversification of unintended risk sources

At the same level of risk, we prefer a more uniform or diversified risk source distribution
Can We Measure How Uniform or Diversified a Distribution Is?

- Yes, we can
  - The Shannon Entropy
    \[ S = - \sum_{i=1}^{N} p_i \ln p_i, \quad \text{where } p_i \text{ is the probability of } i \]

- We know that the marginal contributions add to 1
- However, marginal contributions can be negative, hence they can’t be treated as probabilities
- How can we eliminate the negative marginal contributions?
How To Get Non-Negative Marginal Contributions?

- One possibility is to decorrelate the covariance matrix
- A couple of alternatives:
  - Principal Component Analysis (PCA)
  - Minimum-torsion (Meucci et al 2014)*
- Both methods ensures non-negative marginal contribution but, unlike PCA, minimum-torsion is optimized to closely track the original factors in the risk model (if one is used)

- A nice side-effect; being able to calculate the entropy means that we can also compute a number we can interpret as “Effective number of independent bets”

\[ EN = e^{-\sum_{i=1}^{N} p_i \ln p_i} \]

• Summary of framework

• Three case studies…
Case Study – Stock-picking Portfolio

Global equity portfolio with approximately 35 names

**Risk Model: Axioma**
- **Risk and diversification**
  - Bubble size proportional to share of risk
  - Bubble sizes:
    - Anti-benchmark (5.1%)
    - Common risk (27.7%)
    - Stock specific (67.2%)

**Risk Model: UBS PAS**
- **Risk and diversification**
  - Bubble size proportional to share of risk
  - Bubble sizes:
    - Anti-benchmark (4.7%)
    - Common risk (24.6%)
    - Stock specific (70.7%)
Case Study – Stock-picking Portfolio

Global equity portfolio with approximately 35 names

**Risk Model: Axioma**

- Risk and diversification
- Bubble size proportional to share of risk

**Risk Model: UBS PAS**

- Risk and diversification
- Bubble size proportional to share of risk

Bubble size proportional to share of risk
Case Study – Stock-picking Portfolio

Global equity portfolio with approximately 35 names

Risk Model: Axioma

Risk and diversification

- Anti-benchmark (5.1%)
- Country (8.7%)
- Currency (3.3%)
- Market (0.0%)
- Sector (10.5%)
- Stock specific (67.2%)
- Style (5.2%)

Bubble size proportional to share of risk

Risk Model: UBS PAS

Risk and diversification

- Anti-benchmark (4.7%)
- Equity Market (0.1%)
- Regions (7.8%)
- Sector (12.4%)
- Stock specific (70.7%)
- Style (4.3%)

Bubble size proportional to share of risk
Case Study – Stock-picking Portfolio

Global equity portfolio with approximately 35 names

Risk Model: Axioma

Risk Model: UBS PAS
Case Study – Single Factor Replicating ETF

Global equity portfolio with approximately 300 names

Risk Model: Axioma

Risk and diversification

Risk Model: UBS PAS

Risk and diversification

Bubble size proportional to share of risk
Case Study – Single Factor Replicating ETF

Global equity portfolio with approximately 300 names

Risk model: Axioma

Risk and diversification

- Anti-benchmark (3.5%)
- Country (7.8%)
- Currency (8.3%)
- Market (0.0%)
- Sector (37.4%)
- Stock specific (13.9%)
- Style (29.1%)

Bubble size proportional to share of risk

Risk model: UBS PAS

Risk and diversification

- Anti-benchmark (3.0%)
- Equity Market (13.4%)
- Regions (2.9%)
- Sector (45.2%)
- Stock specific (17.4%)
- Style (18.2%)

Bubble size proportional to share of risk
Case Study – Single Factor Replicating ETF

Global equity portfolio with approximately 300 names

Risk Model: Axioma

Risk and diversification

- Anti-benchmark (3.5%)
- Country (7.8%)
- Currency (8.3%)
- Market (0.0%)
- Sector (37.4%)
- Stock specific (13.9%)
- Style (29.1%)

Bubble size proportional to share of risk

Risk Model: UBS PAS

Risk and diversification

- Anti-benchmark (3.0%)
- Equity Market (13.4%)
- Regions (2.9%)
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Bubble size proportional to share of risk
Case Study – Single Factor Replicating ETF

Global equity portfolio with approximately 300 names

**Risk Model:** Axioma

**Risk Model:** UBS PAS
Case Study - Smart Beta, Dynamic Factor Selection ETF

Global equity portfolio with approximately 1900 names

Risk Model: Axioma

Risk and diversification

- Anti-benchmark (9.0%)
- Common risk (86.8%)
- Stock specific (4.2%)

Risk Model: UBS PAS

Risk and diversification

- Anti-benchmark (8.8%)
- Common risk (87.0%)
- Stock specific (4.2%)

Bubble size proportional to share of risk
Case Study - Smart Beta, Dynamic Factor Selection ETF

Global equity portfolio with approximately 1900 names

Risk Model: Axioma

Risk and diversification

Risk Model: UBS PAS

Risk and diversification

Bubble size proportional to share of risk
Global equity portfolio with approximately 1900 names

Risk Model: Axioma

Risk and diversification

Bubble size proportional to share of risk

Risk Model: UBS PAS

Risk and diversification

Bubble size proportional to share of risk
Case Study - Smart Beta, Dynamic Factor Selection ETF

Global equity portfolio with approximately 1900 names

Risk Model: Axioma

Risk Model: UBS PAS
Conclusion

- Investment philosophy (or objective) defines which risk sources are intended and unintended.

- Risk management of intended and unintended risk sources is different.
  - Volatility aversion for unintended risks
  - Downside aversion for intended risks

- Diversification can be measured and may be a valuable framework for managing both idiosyncratic and systematic risk.
A Final Thought

- What about using the effective number of bets instead of number of assets in the Fundamental Law of Active Management?
- For a given Information Ratio, would we see a more reasonable Information Coefficient?
Habib Subjally
22 years of experience
Head, RBC Global Equity

Habib leads the RBC Global Equity team of 10 global equity specialists (sector, portfolio and risk management) and has more than 20 years of industry experience.

Prior to joining RBC Global Asset Management in 2014, Habib and his team spent eight years together at First State managing Global equities. Previously, Habib was Head of Small & Mid Cap Research at Credit Suisse and Head of the Global equities team at Invesco. Habib began his fund management career at Merrill Lynch Investment Managers where he was Head of North American and Global equities research and Manager of the Mercury Global Titans Fund.

Habib is a Certified Chartered Accountant and holds the ASIP designation with the CFA Society of the U.K. He has a BSc (Hons) from the London School of Economics.

Dag Wetterwald
24 years of experience
Risk & Portfolio Construction, RBC Global Equity

Dag, Risk and Portfolio Construction expert, joined RBC Global Asset Management in early 2014, after having spent eight years with the Global Equity team at First State in the same capacity. Prior, Dag was at Dimensional Fund Advisors (DFA) where he held various quantitative research roles in London and California between 2002 and 2006. Dag was also a member of the London investment committee. Before DFA, Dag held various investment roles at Carnegie Asset Management in Norway, Finland and Sweden (1995-2001), and a research role at Statistics Norway (1992-1995).

Dag holds a Masters in Finance from the London Business School (2002) and a MSc in Economics from the University of Oslo in Norway (1993).