ASSET MANAGEMENT
Théories et croyances, 3

Thierry Béchu, Kanopy AM -- 2025

Plan du cours

1. Introduction à l'asset management et à la gestion multi-asset (2 séances)

2. Alpha, beta & factor investing : Quantitative Investment theory from beliefs to contradictions (1 séance)

3. Behavioral Finance & Technical Analysis : psychological interpretations and empirical behaviors (2 séances)

4. Stock selection and security analysis

I/ Beta & smart beta ;

Market Reference: Beta & Market Cap indexes

Smart beta & Risk Based solutions

Multi-asset portfolios

Multi-asset in practice: from Markowitz to risk-based solutions

II/ Alpha & Equity Risk Premium

How academics found the way to kill alpha

Equity Return decomposition : the case of S&P 500

The Equity Premium Puzzle

Do Stocks Outperform Treasury Bills?

III/ Factor investing : The Risk Premia Story

Fama & French 3 factors model

The key risk Premia: from value to quality

What about momentum & Low Volatility premia

Multi risk premia portfolio

Beta definition & criticisms

From pure beta to smart beta

Optimal / equilibrium portfolio

Black & Litterman define various possibilities to build equilibrium portfolios using :

- Historical averages : in a non constraint portfolio, an optimization will go short the negative or low returns. Going short assets that have done poorly and long the others is not neutral and will probably be wrong (returns aren’t stable of course!)
- Equal means : all assets have the same expected excess return
- Risk-adjusted Equal means: assuming that bonds and equities have the same expected excess return per unit of risk where volatility is the risk measure.

- Market cap is the most logical and robust definition of equilibrium

Beta definition : Beta is the market

- The CAPM says that the “market portfolio” is mean-variance optimal. It leads to the conclusion that a passive investor/manager can do no better than holding a market portfolio. The market efficiency is key to explain this concept.

- The finance industry, with considerable inspiration from Harry Markowitz, Bill Sharpe and many others, has translated that investment advice into trillions of dollars invested in or benchmarked to capitalization weighted market indexes such as the S&P500 and the Russell 1000. Nevertheless, Many academic papers reject the idea that capitalization-weighted indexes are good CAPM market proxies (concentration risk, small cap cannot be incorporated, market anomalies like momentum biais…)

- What is the best definition of market?
  - Logically it could be the **Market Cap reference**: the sum of all the value of disposable stocks
  - Or the **flotting reference**: sum of flotting stocks potentially available in the market. what’s the investor can really purchase
  - The first definition has been kept but is fondamentally wrong: the objective is to give a macro picture of what all the investors can find as disposable assets. Aramco is a good exemple: 2$T value but less than 40$B available (less than Air Liquide)

Why market cap makes sense…

- Market flotting or Market Cap is the best way to build a reference index.
  - It gives a good macro view of market value
  - without creating potential disruption when investors decide to buy or sell it
  - Capitalization weighting is a passive strategy requiring little trading (lower trading costs and fees than active management).
  - Capitalization-weighted portfolios automatically rebalance as security prices fluctuate (ie no intervention), except in case of stock buybacks and secondary equity offerings or new constituent security in the portfolio.

- If Bmk is based on EW or other type of reference,
  - Does it make sense to give the same weight to a big cap with thousand of jobs and to a small cap without major economic impact?
  - It will lead to periodic rebalancing
  - There will be a high risk of market disruption (all investors won't be able to buy/sell small or mid cap witout major price impact) leading to major mis-pricing creating then a lot of opportunities due to a non-efficient market

- So, market Cap is the best solution to satisfy a macro constraint.

- However, market cap is far to satisfy micro and individual constraints. The features of market cap have nothing to do with portfolio financial constraints (risk and returns) and extra-financial objectives (ESG or others). It cannot be optimal.
  - Especially, there is a major risk of sectorial concentration

Market cap weighted indexes pros & cons

Pros

- Market-cap indexes provide investors with access to a wide variety of companies both large and small
- Large well-established companies have a greater weighting providing steady growth for the index
- Small companies tend to have a lower weighting, which can reduce risk if the companies don't survive

Cons

- As a stock price rises, a company can have an excessive amount of the weighting in an index
- Companies with larger weightings can have a disproportionate impact on the fund's performance
- Fund managers can often add shares of overvalued stocks assigning a larger weighting and create a bubble

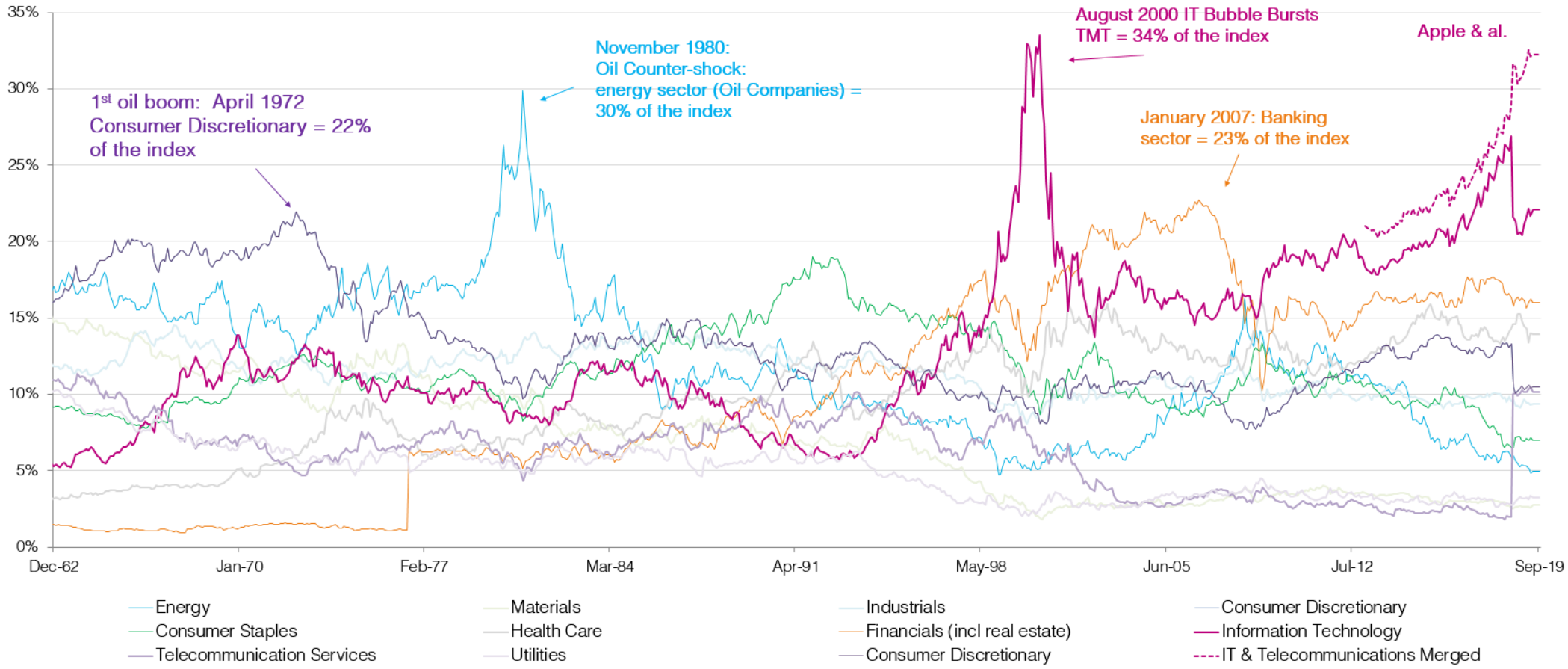
There are at least 3 major contradictions with beta and CAPM

- 1- There is a dual objective: to be both universal and to match with micro and very specific financial (or extra-financial) constraints / objectives which are probably unlikely to be reached…

- 2- High risk of market inefficiencies: if all investors follow the market cap bmk (because the market is supposed to be efficient), it will automatically create market ineficiencies because market valuation will only dépend on flows and on various demand & supply fonctions (mainly dependant on the available flotting). Aramco will have furious demand in front of very limited supply for instance…
    - Additionnally, market cap is summarized into benchmarks which means that a lot of stocks aren't included in portfolios

- 3- The CAPM doesn't really explain how adjustments can work.
    - The market portfolio consists of all assets in all markets, where each asset is weighted by its market capitalization. This assumes no preference between markets and assets for individual active and potential shareholders, and that active and potential shareholders choose assets solely as a function of their risk-return profile. So, who will trigger the price adjustment when a specific information affect a single stock? Nobody or everybody which could lead to huge inefficiencies…
    - So the CAPM needs investors able to believe in inefficiencies to warrant a kind of efficient market… But if it is the case, it just confirms that markets are not efficient all the time !
    - Which then hints that beta is not the most efficient investment…

Cap weighted indexes are strongly biased and influenced by mania
Exemple: Sector weighting variations of the S&P500



Source: TOBAM

Poids du Top 5 du S&P 500= Poids des “Bottom 291”

Top 5 S&P 500	Bottom 291 S&P 500
15.9%	15.9%

Microsoft

Apple

amazon

Alphabet Corporation

- Poids des 5 plus gros titres de l’indice: 15.9%
- Poids des 320 plus petits titres de l’indice: 15.9%
- Nombre total de titres dans l’indice: 504

Chart 4: “Nouveau bulls” hoping no double-top in Magnificent 7

“Magnificent Seven” market cap as a % of S&P 500

Source: BofA Global Investment Strategy, Bloomberg; Magnificent Seven = AAPL, AMZN, MSFT, META, NVDA, GOOGL, TSLA)

BofA GLOBAL RESEARCH

TOBAM*
CORE INVESTMENTS

Investors face too many constraints and bias to warrant market efficiency

- No leverage / fully invested (or imposed ratios)
- Turnover constraints (commissions, solvency ratio…)
- Size, geographic, sectorial (…) exposures due to behavioral biais
- Information bias (knowledge, cost of information, lack of information or delay to get it and analyze it, lack of ressources to deal with it, behavioral bias in information analysis…)
- Decision making (monthly/quaterly committees, consensus decisions vs emotional decisions leading to sticky decisions…)

+ so many behavioral bias and market anomalies which eventually create major inefficiencies

Beta & smart beta in Multi-Asset Portfolios: from traditional beta to risk-based solutions

Empirical exemples
Theoretical solutions

Risk-Based solutions: a theoretical review

Minimum variance (Haugen and Baker [1991]; Clarke, De Silva, and Thorley [2006]),
Maximum diversification (Choueifaty and Coignard [2008]),
Risk parity/equal risk contribution (Qian [2006]; Maillard, Roncalli, and Teiletche [2010])

Mean-Variance Optimization key issues prevent the Markowitz portfolios from having an investment value

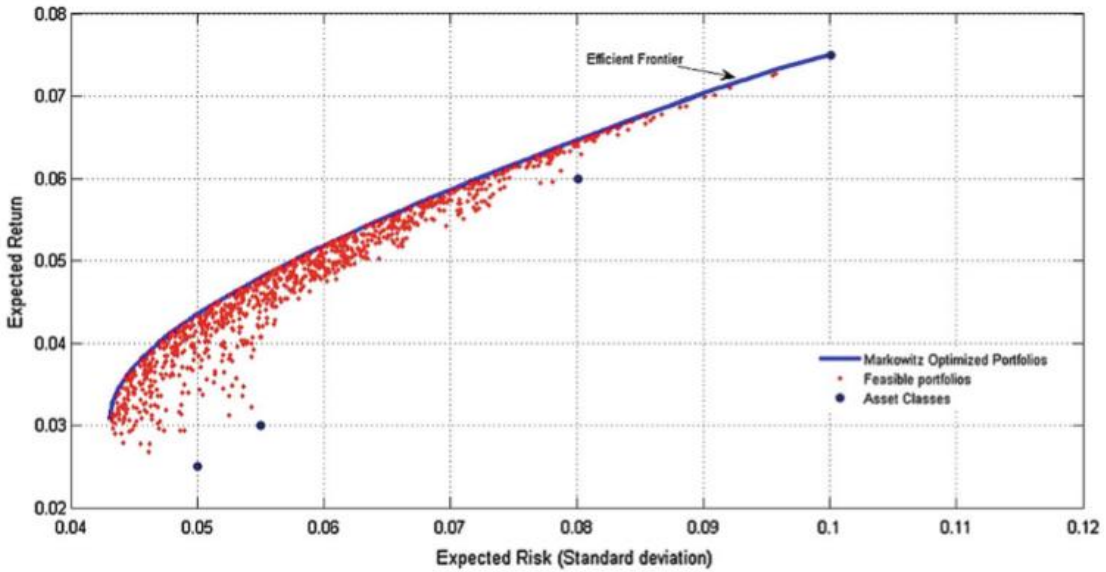


Fig. 2.1 Feasible portfolios and Mean-Variance Efficient Frontier

- **Lack of diversification** of optimal portfolios which contrasts with one of the main ideas of Markowitz. Efficient allocations frequently completely exclude some asset classes of the chosen investment universe and give extremely large weights to some others.
  - They also show sudden shifts along the Efficient Frontier.
  - The most northeast point of the Mean-Variance Efficient Frontier **lacks completely diversification** and is equivalent to a mono-asset portfolio.
  - The mean-variance optimizer tends to heavily weigh those asset classes that show **high estimated returns** compared to low variances (or standard deviations) and negative correlations
- The second major drawback is their **instability**. Especially changes in expected returns tend to impact dramatically on optimal portfolio weights
- Third limitation: Optimizers, in general, produce, a unique optimal portfolio for a given level of risk instead of several types of portfolio: **too accurate to be true**
- the most serious drawback is the **poor out-of-sample performance**: outside the sample period used to estimate input parameters, classical Markowitz's portfolios show a considerable deterioration of performance

Risk-based approaches: key characteristics

- They do not require explicit forecasts of expected returns, only risk forecasts which is supposed to be more stable then returns (Clarke, De Silva, and Thorley [2013]).

  Risk-based strategies are **agnostic** by nature.

- This no-views feature simplifies the portfolio selection process considerably— expected returns are notoriously more difficult to predict than covariances (Merton [1980]) which provides a sizeable advantage over Markowitz mean– variance optimization (MVO) strongly dependent on forecasted returns.

- Empirical studies -Kirby and Ostdiek [2012] - have shown that volatility-weighted portfolio strategies have historically outperformed other traditional asset allocation methodologies such as MVO or 1/N

Risk-based portfolios offer an attractive alternative

- Different solutions corresponding to this description have been suggested in finance literature :
    - Volatility Target
    - Equally Weighted
    - Risk Parity
    - ERC
    - Most diversified portfolio

Volatility target

- The objective is to define the weigths Wi in order to reach a volatility target for the portfolio. Leverage can be used to reach it, if necessary

- In that case we use the historical data of each asset and backtest the volatility of the portfolio
  - Additional constraints can be added to obtain the various weightings like: Maximum weight, Minimum Leverage
  - In the case of a multi-asset portfolio, having the maximum of asset is much better (possible to give a constraint of minimum weighting)
  - In principle, the weightings are modified regularly according to observed volatility. To avoid too many interventions, we can use a TE budget between the observed portfolio volatility and its target. For instance, if we have a target of 7%, we will make some changes beyond 0,35% volatility.

  - Pratically, there’s always a difference between the target and the observed volatility because market volatility and correlations are never stable over time

The Equally Weighted Portfolio

- Naïve diversification can be the result of the search for variety when several choices have to be made simultaneously under uncertain conditions.

- DeMiguel et al. (2009) conclude that none of the theoretically more robust asset allocation models was consistently better out-of sample than the “1 over N” rule, but an opposite conclusion comes from Kritzman et al. (2010).

$$w_i = w_j = \frac{1}{N} \quad \forall i,j$$

	Weights (%)	Marginal risk	Risk contribution	Percentage risk contribution (%)
A	20.00	−0.002948	−0.000590	−0.59
B	20.00	0.024125	0.004825	4.81
C	20.00	0.126998	0.025400	25.30
D	20.00	0.166741	0.033348	33.22
E	20.00	0.187061	0.037412	37.26

Asset A has a negative risk contribution!
Total standard deviation is 10% vs 4,6% for RP solution

Equally Weighted vs Market Cap Weighted

	Year 1		Year 5		
	Cap-weighted	Equal-weighted	Cap-weighted	Equal-weighted	% gain (loss)
Stock A	$ 1,500	$ 1,000	$ 1,000	$ 670	-33.0%
Stock B	$ 500	$ 1,000	$ 1,000	$ 2,000	100.0%
	$ 2,000	$ 2,000	$ 2,000	$ 2,670	33.5%

EW strategy considers the same weight for each component: This weighting is obviously very naïve, but:

* It offers a better diversification with less idiosyncratic risk (cf exemple)
* It prevents the risks of market manias (Tech bubble in 2000's or banks krash in 2007/8)


S&P 500 Index
S&P 500 Equal Weighted Index
500
400
300
200
100
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
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S&P 500 Index
S&P 500 Equal Weighted Index
100
80
60
40
20
0
-20
Dec
2015
Mar
Jun
2016
Sep
Dec
Mar
Jun
2017
Sep
Dec
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2018
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Jun
2020
Sep
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EURO STOXX 50 Net Return EUR
EURO STOXX 50 Equal Weight EUR
250
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
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EURO STOXX 50 Net Return EUR
EURO STOXX 50 Equal Weight EUR
40
30
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10
0
-10
-20
Dec
2015
Mar
Jun
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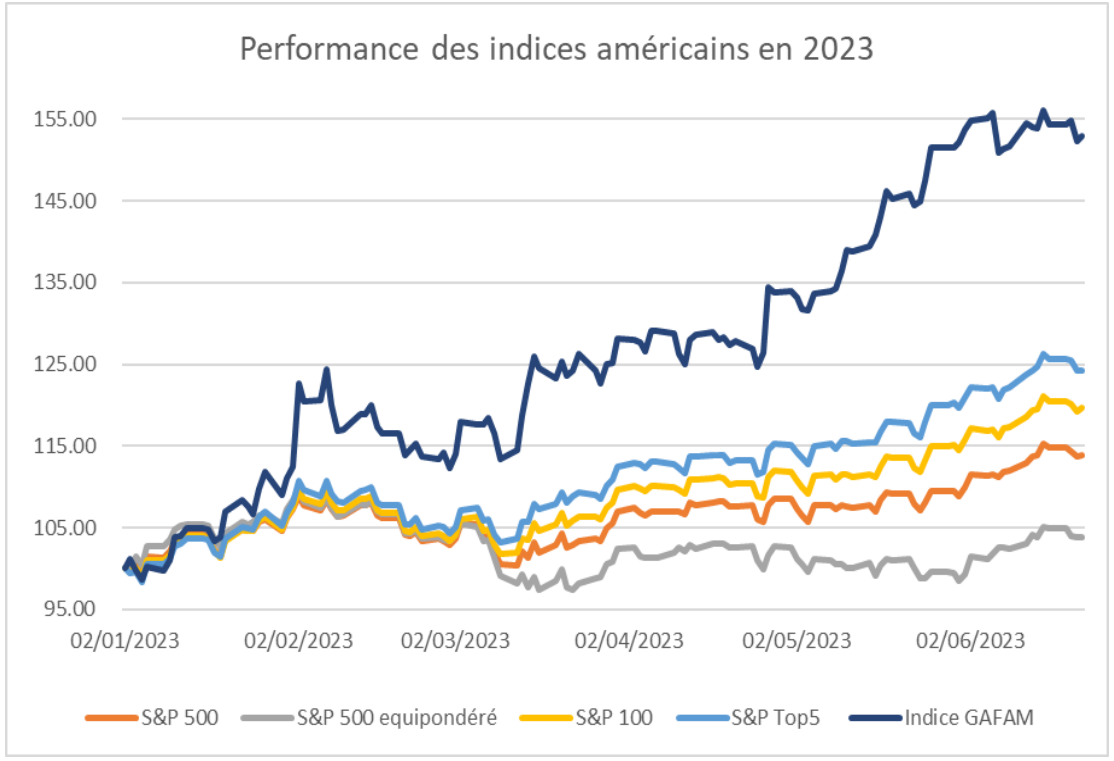
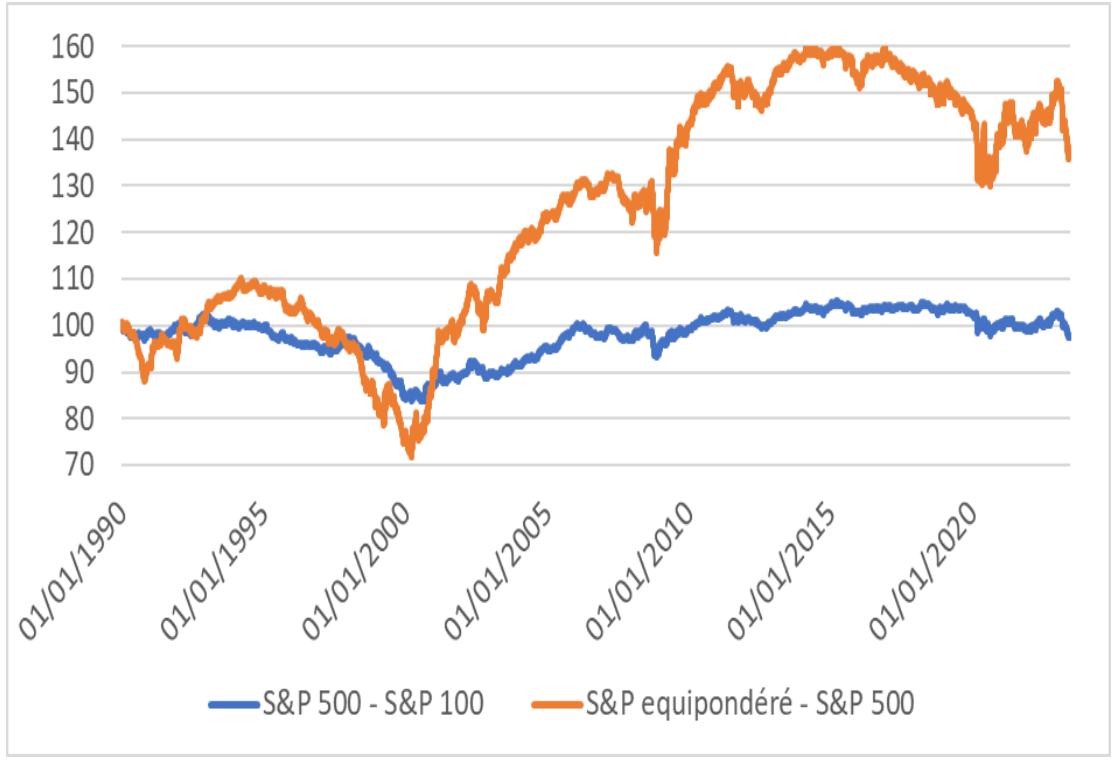
S&P market cap vs S&P equally weighted





The naïve Risk Parity:
Risk decomposition for portfolio standard deviation

- MRi, the marginal risk or the marginal risk contribution for each asset class exposure i defined as d(RM) / d(wi) , that is the first derivative of the selected portfolio risk measure with respect to its weight wi;

$$RM(\mathbf{w}) = \sum_{i=1}^{N} w_i \cdot \frac{\partial RM}{\partial w_i}$$

- TRCi, the risk contribution sometimes also mentioned as component risk or total risk contribution of asset class i defined as wi * d(RM) / d(wi) , that is the product of the allocation to asset class i with its marginal risk.

$$TRC_i = w_i \cdot \frac{\partial RM}{\partial w_i}$$

The naïve Risk Parity:
Risk decomposition for portfolio standard deviation

- Since risk contributions add up to the overall portfolio risk, dividing the component risk by the total risk leads to the percentage **total risk contribution** for each asset class exposure, PTRCi :

$$PTRC_i = \frac{w_i \cdot \frac{\partial RM}{\partial w_i}}{RM} = \frac{TRC_i}{RM}$$

- To determine the **marginal risk of A** we take the first derivative with respect to wA that is given by:

$$MR_{\sigma\_A} = \frac{\partial \sigma_P}{\partial w_A} = \frac{2\sigma_A^2 w_A + 2\sigma_A \sigma_B w_B \rho_{A,B}}{2\sqrt{(\sigma_A w_A)^2 + (\sigma_B w_B)^2 + 2\sigma_A \sigma_B w_A w_B \rho_{A,B}}}$$

$$= \frac{\sigma_A^2 w_A + cov_{A,B} w_B}{\sqrt{(\sigma_A w_A)^2 + (\sigma_B w_B)^2 + 2\sigma_A \sigma_B w_A w_B \rho_{A,B}}}$$

The naïve Risk Parity:
Risk decomposition for portfolio standard deviation

$$MR_{\sigma\_A} = \frac{\partial \sigma_P}{\partial w_A} = \frac{2\sigma_A^2 w_A + 2\sigma_A \sigma_B w_B \rho_{A,B}}{2\sqrt{(\sigma_A w_A)^2 + (\sigma_B w_B)^2 + 2\sigma_A \sigma_B w_A w_B \rho_{A,B}}}$$

Parameters	Parameters computation
$w_{\text{JPM Emu Gov. All Mats}}$	60 %
$w_{\text{MSCI World}}$	40 %
$\sigma_{\text{JPM Emu Gov. All Mats}}$	4.02 %
$\sigma_{\text{MSCI World}}$	12.47 %
$MR_{\sigma\_\text{JPM Emu Gov. All Mats}}$	$\frac{4.02\%^2 \cdot 60\% + 4.02\% \cdot 12.47\% \cdot 40\% \cdot (-0.12)}{\sqrt{(4.02\% \cdot 60\%)^2 + (12.47\% \cdot 40\%)^2 + 2 \cdot 4.02\% \cdot 12.47\% \cdot 60\% \cdot 40\% \cdot (-0.12)}} = 0.013824$
$MR_{\sigma\_\text{MSCI World}}$	$\frac{12.47\%^2 \cdot 40\% + 4.02\% \cdot 12.47\% \cdot 60\% \cdot (-0.12)}{\sqrt{(4.02\% \cdot 60\%)^2 + (12.47\% \cdot 40\%)^2 + 2 \cdot 4.02\% \cdot 12.47\% \cdot 60\% \cdot 40\% \cdot (-0.12)}} = 0.111103$
$TRC_{\sigma\_\text{JPM Emu Gov. All Mats}}$	$60\% \cdot 0.013824 = 0.83\%$
$TRC_{\sigma\_\text{MSCI World}}$	$40\% \cdot 0.111103 = 4.44\%$
$PTRC_{\sigma\_\text{JPM Emu Gov. All Mats}}$	$0.83\%/5.27\% = 15.73\%$
$PTRC_{\sigma\_\text{MSCI World}}$	$4.44\%/5.27\% = 84.27\%$

Naïve Risk-Parity

It provides a perfect balance in terms of risk contributions:

- in the case of a bivariate investment universe, thus in case the portfolio constituents are just two;

$$\begin{bmatrix} w_{JPM\ Emu\ Gov.All\ Mats} \\ w_{MSCI\ World} \end{bmatrix} = \begin{bmatrix} \frac{1/4.02\%}{1/4.02\% + 1/12.47\%} \\ \frac{1/12.47\%}{1/4.02\% + 1/12.47\%} \end{bmatrix} = \begin{bmatrix} 75.6\% \\ 24.4\% \end{bmatrix}$$

Asset weighting formula:

$$w_i = \frac{\sigma_i^{-1}}{\sum_{j=1}^{N} \sigma_j^{-1}} = \frac{\frac{1}{\sigma_i}}{\sum_{j=1}^{N} \frac{1}{\sigma_j}}$$

	JPM Emu Gov. All Mats	MSCI World
Naïve risk parity portfolio weights (%)	75.6	24.4
Marginal risk	0.026666	0.082717
Risk contribution (%)	2.016	2.016
Percentage risk contribution (%)	50	50

The Optimal Risk Parity Strategy or Equally Risk Contribution (ERC)

Maillard defines the risk contribution of asset i as follows:

$$TRC_{\sigma\_i} = w_i \beta_i \sigma_P$$

Considering the condition of homogeneous risk contributions for the optimal risk parity strategy equivalent to σ_P/N, they conclude that:

$$w_i = \frac{\beta_i^{-1}}{\sum_{j=1}^{N} \beta_j^{-1}} = \frac{\beta_i^{-1}}{N} = \frac{1}{N\beta_i}$$

- The weight of asset i belonging to a risk parity portfolio should be inversely proportional to its beta: the higher the beta, the lower the weight and vice versa.
- This also implies that an asset class with high individual volatility and/or with high correlation with the other asset classes becomes penalized in the portfolio allocations.

ERC targets to distribute the same risk budget/contribution to each component, so that none has a dominant role on the portfolio risk

Now, the optimization problem to solve for w^* (the optimal risk parity portfolio weights) can be fully stated as follows:

$$\underset{w*}{Min} \sum_{i=1}^{N} \sum_{j=1}^{N} \left(w_i \cdot \frac{\partial \sigma_P}{\partial w_i} - w_j \frac{\partial \sigma_P}{\partial w_j} \right)^2$$

$$s.t.$$

$$\sum_{i=1}^{N} w_i = 1$$

$$0 \leq w_i \leq 1$$

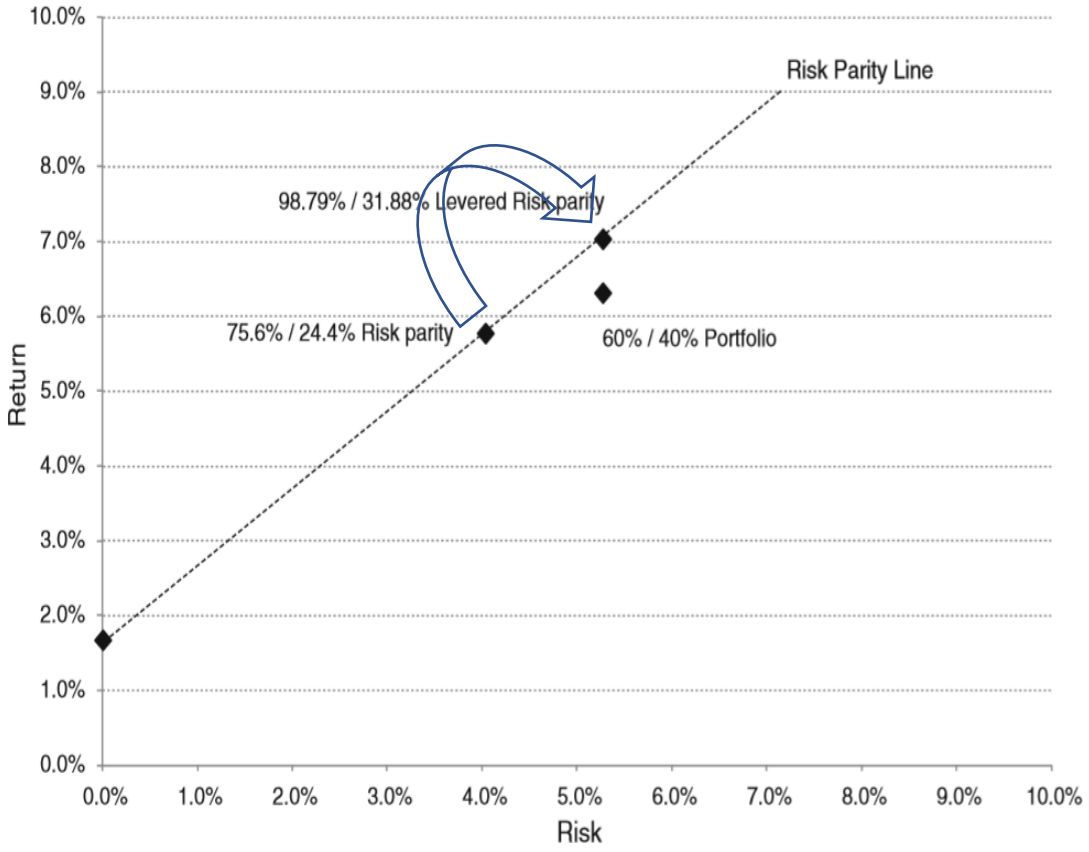
The use of leverage in risk based solutions

Risk parity investors, in addition to preserving the equally weighting of risk contributions, want to make a choice on the level of the overall risk to take in order to influence the potential of return Which motivates the introduction of leverage in the discussion of risk parity strategy.

- traditional portfolios that are rebalanced to become truly risk balanced across asset classes frequently need to have a greater portion in less aggressive asset classes than the actual structure;

- some less volatile asset classes exhibit higher risk-adjusted performance (higher Sharpe Ratios) than riskier asset classes but also lower raw returns. As a consequence, the risk parity portfolio dominates the actual portfolio in terms of risk and return trade-off but underperforms in terms of pure return.

Leverage in risk-based portfolio: implementation



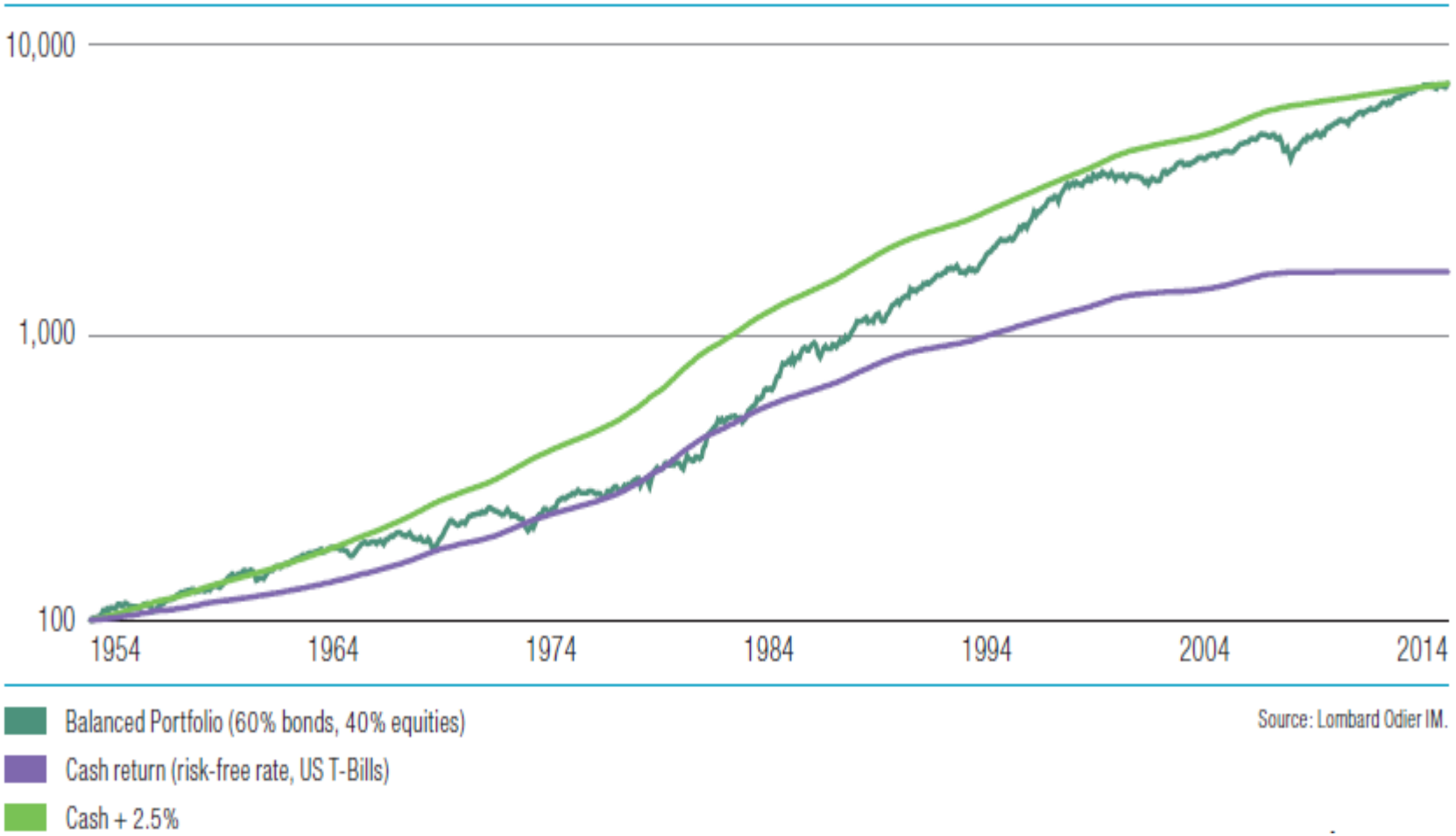
- Applying leverage to a risk parity portfolio is the way to get the best of both alternatives.
- For example, to preserve risk parity and achieve a 5.27 % volatility (the same as the 60/40 portfolio), a leverage ratio of 1.31 (5.27 %/4.03 %) is required.
- The resulting levered risk parity portfolio borrows additional funds for 30.67 % of the capital initially available and arrives at an exposure of 98.79 % in the fixed income component and 31.88 % in the equity component.
- Its mean return is higher than that of the traditional portfolio and preserves the risk parity risk-adjusted performance.
- If borrowing is added exclusively to the low-risk component, the amount of leverage (LEV) that is necessary can be written, according to Ruban and Meles (2011), as follows:

$$LEV = \frac{\sigma_{Equity} \cdot w_{Equity}}{\sigma_{Bond} \cdot \left(1 - w_{Equity}\right)}$$

From traditional benchmark to risk based portfolios

- March 1952, Markowitz's seminal article « Portfolio Selection » delivered a major breakthrough for investors: More investment return for less risk.
    - This method took centre stage in the 70s and led to the widespread adoption of portfolios built by combining market-cap-indices of stocks and bonds, commonly referred as 60/40. These portfolios delivered an average annual return of 7%+ from 1955 to 2015.
    - This approach offered the foundation on which pension systems worldwide are built
- In fact, a typical 60/40 portfolio invested in USD indices delivered a compound return of 7.4% which translates into an average excess return over cash of 3.6%, with a Sharpe ratio of 0.56.
- However, investors also discovered that these returns often came with a severe penalty: sizeable drawdowns (like in 1968, 1974/75, 1987, 1997,2002 and 2008) reaching up to 20% to 25%. Despite such negative events, patient investors have been well rewarded.

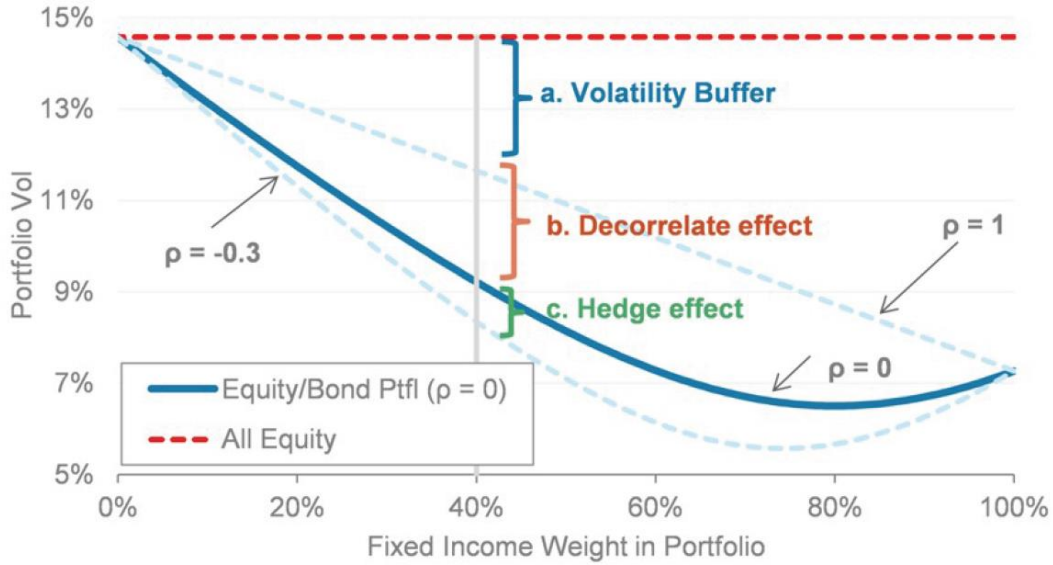
Historical performance of 60/40 portfolio



Why 60/40 has worked so well: the role of diversification

- Diversification is comprised of 3 elements:
  - Buffering effect : low relative volatility creates ‘cushion’
  - Decorrelation effect : low but positive correlation boosts diversification further
  - Hedging effect : negative correlation reduces portfolio volatility, but less than expected

Decomposing diversification effects – an illustration



Historical returns, volatility and correlation for stocks and bonds in the US and Europe

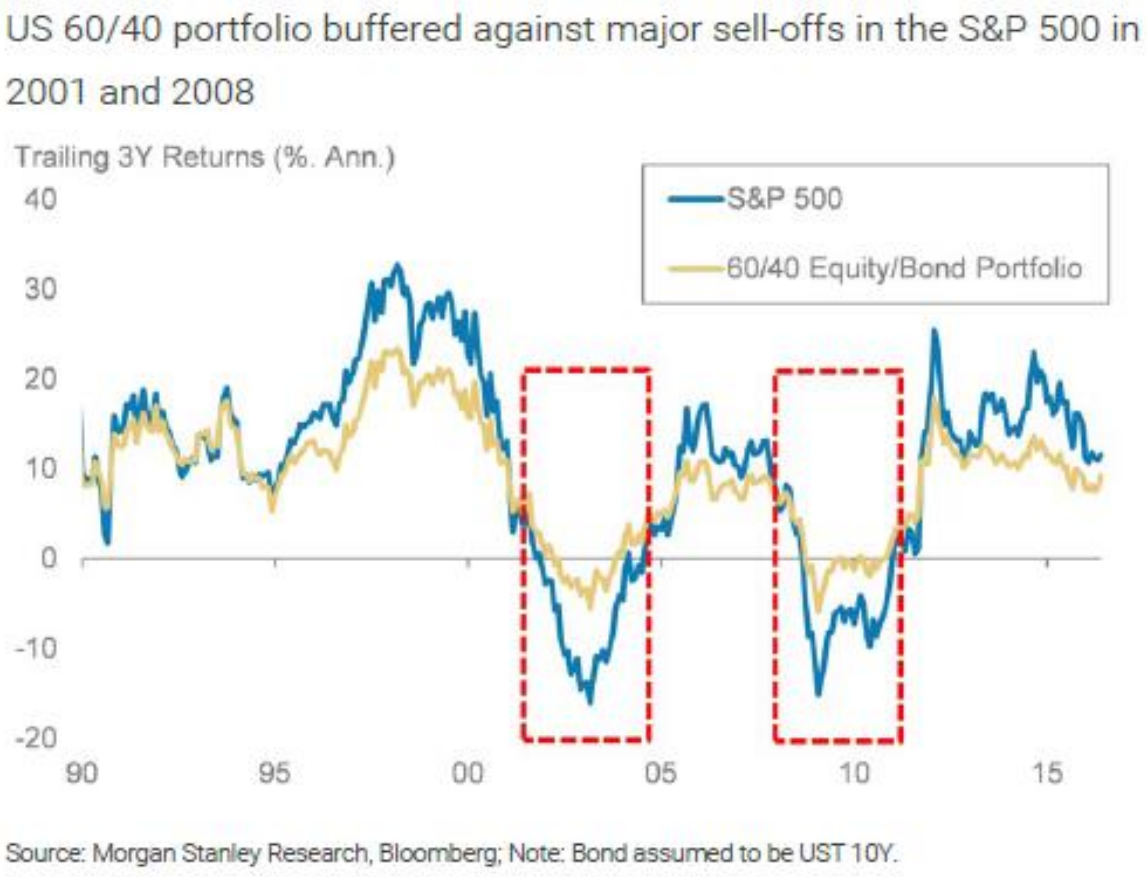
Historical returns, volatility and correlation for stocks and bonds in the US and Europe

	Avg Rtns (ann.)	Vol (Ann.)	Rtn/ Vol	Correl (vs. Stocks)
S&P 500	9.3	14.6	0.64	1.00
Cash	3.5	0.7	4.92	0.00
UST 2Y	4.1	1.8	2.25	-0.12
UST 5Y	5.3	4.4	1.21	-0.13
UST 10Y	6.4	7.3	0.88	-0.10
UST 30Y	7.6	12.8	0.59	-0.11
USD Agg	6.3	3.7	1.71	0.11
USD IG	6.9	5.3	1.30	0.29

	Avg Rtns (ann.)	Vol (Ann.)	Rtn/ Vol	Correl (vs. Stocks)
MSCI Europe	7.6	15.5	0.49	1.00
Cash	2.2	0.5	4.81	-0.19
DBR 2Y	4.1	1.6	2.57	-0.21
DBR 5Y	5.5	3.4	1.60	-0.19
DBR 10Y	6.7	5.7	1.16	-0.08
DBR 30Y	8.0	12.3	0.65	-0.09
EUR AGG	5.0	3.3	1.51	-0.12
EUR IG	4.8	3.4	1.41	0.17

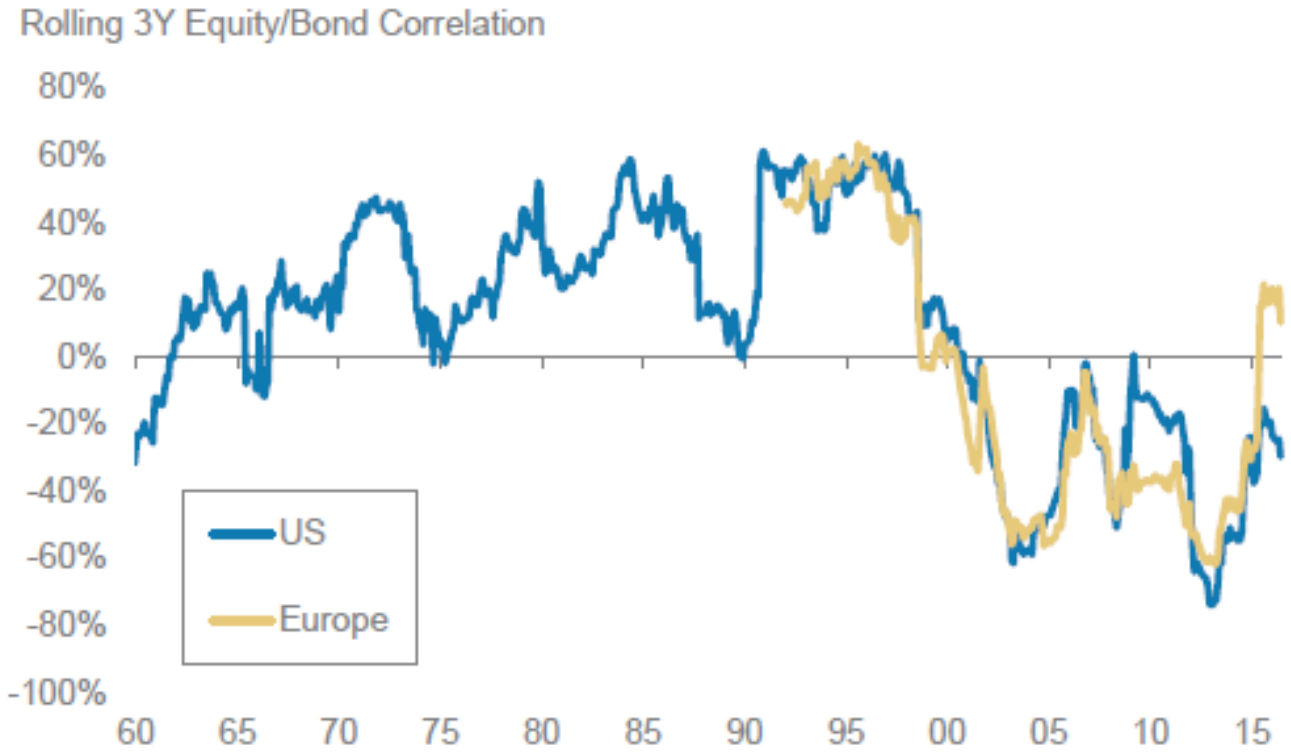
Source: Morgan Stanley Research, Bloomberg, MSCI, RIMES; Note: Data from 1990 (or when series begin) to 2015.

US 60/40 buffered against major sell-offs in the S&P in 2001 and 2008



Since 2000 : low to negative correlation between bonds & stocks helped a lot 60/40 strategies

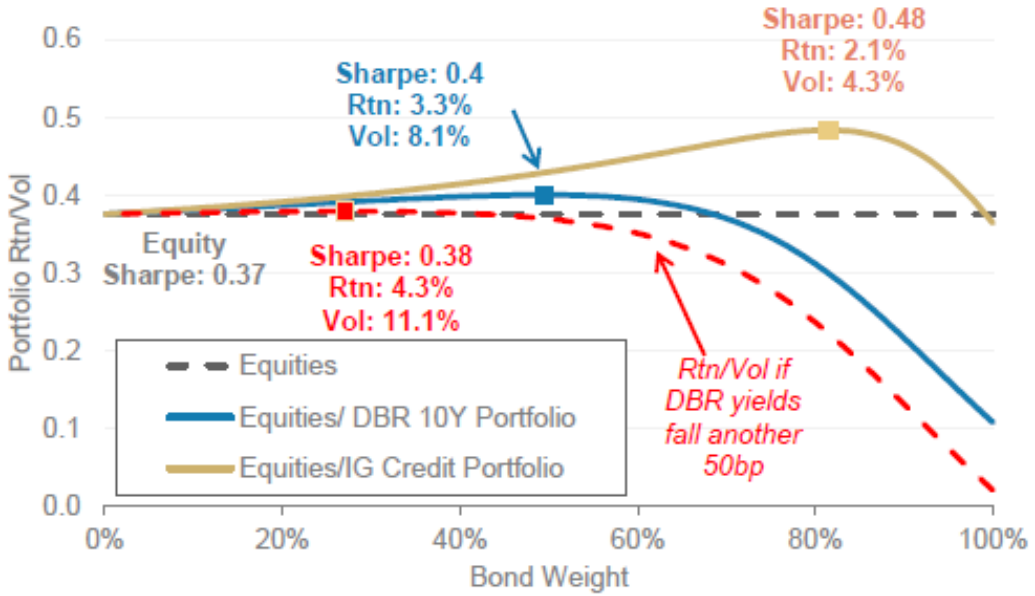
Correlation between bonds and equity has been low/negative over the last 25 years



Source: Morgan Stanley Research, Bloomberg; Note: Bond assumed to be UST 10Y for US and DBR 10Y for Europe.

In Zero to negative yield environment, diversification doesn't work anymore…

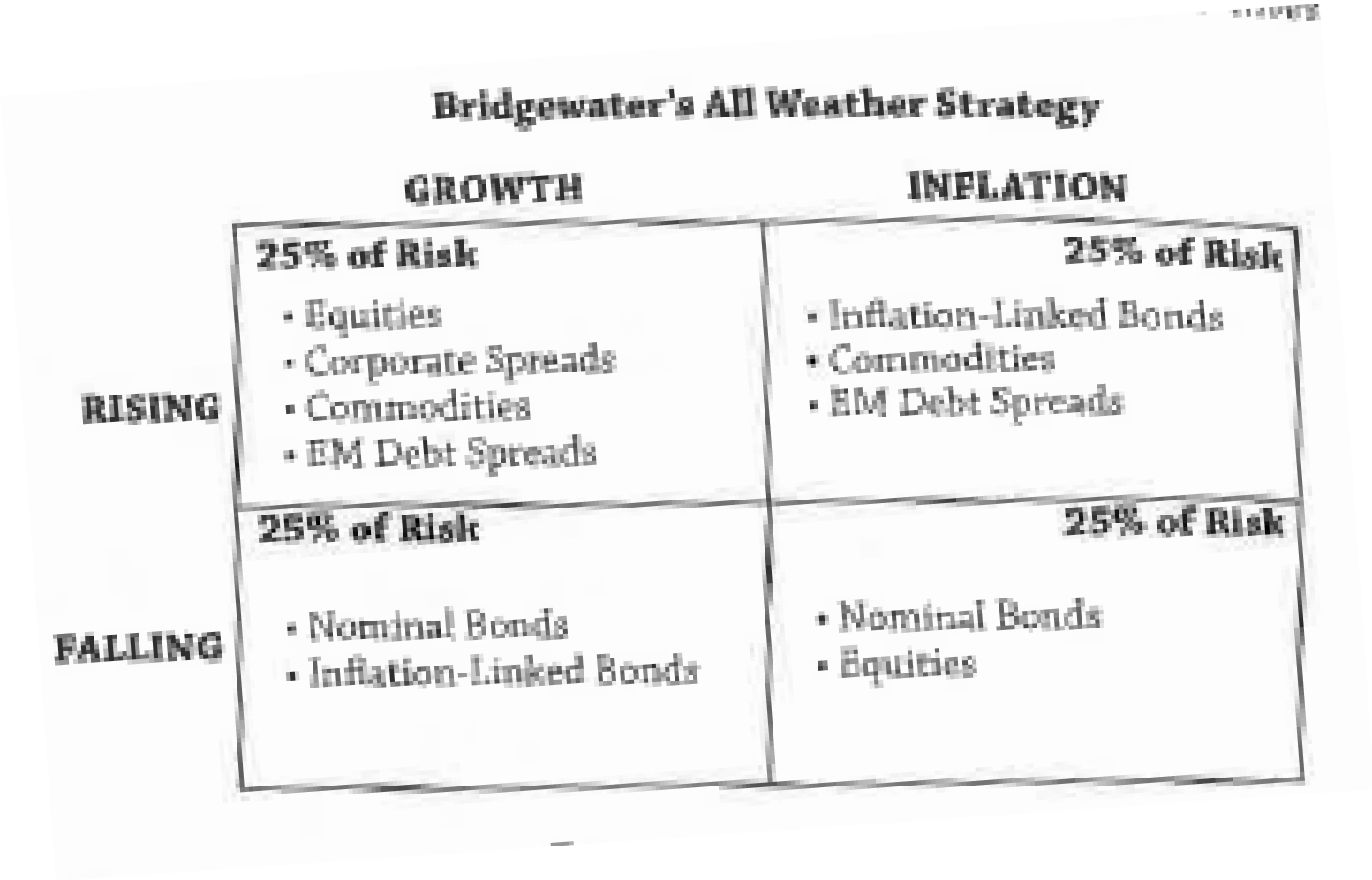
Europe: As bond expected returns fall towards zero, bonds become less effective as diversifiers



Source: Morgan Stanley Research forecasts; Note: Stocks and bonds expected returns based on MS models. Volatility based on historical data from 1990 to 2015.

A drop of 1% in yields is needed to offset any 20% drop in equities… Difficult when yields are negative!

Bridgewater's All Weather : how they consider macro factors in their allocation



Bridgewater's All Weather Strategy

	GROWTH	INFLATION
RISING	**25% of Risk** • Equities • Corporate Spreads • Commodities • EM Debt Spreads	**25% of Risk** • Inflation-Linked Bonds • Commodities • EM Debt Spreads
FALLING	**25% of Risk** • Nominal Bonds • Inflation-Linked Bonds	**25% of Risk** • Nominal Bonds • Equities

From 60/40 portfolios to Risk Based approach : A better way for investing?

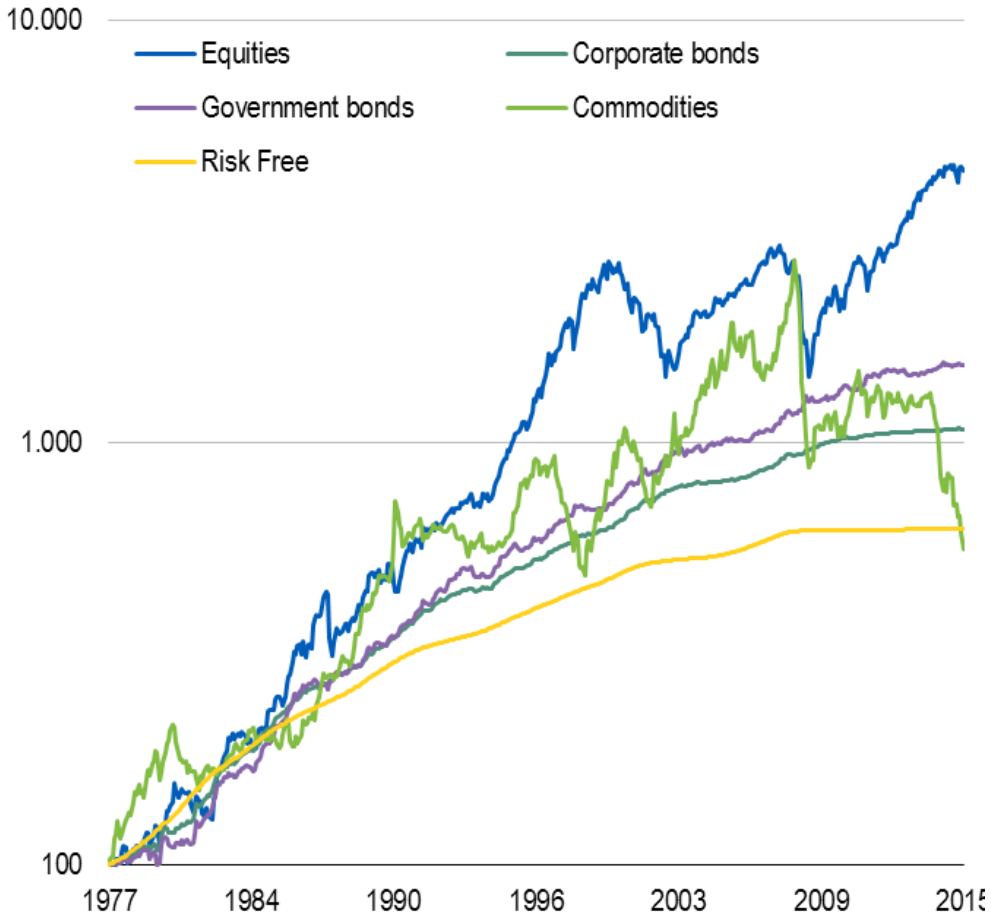
- Investing can be summarised as taking a risk in order to achieve financial return. In this context, **performance represents the quality of returns according to the risk taken**. The performance cannot be only considered on returns or Sharpe ratio but should principally be measured on two dimensions :
  - Controling risk so that it remains at a level acceptable to the end-investor and
  - Maximising prospective return relative to risk

- Any investor has at his disposal three levers that can be acted upon to maximise the performance of a multi-asset portfolio:

  - **Concentration** refers to tilting the portfolio towards specific, non-systematic market views
  - **Diversification** means extending the set of risk premia, provided every incremental investment is somewhat uncorrelated with the portfolio
  - **Risk calibration** means actively managing a portfolio's risk level over time

Taking diversification to its logical extremes
Harvesting traditional risk premia

Long Term Return of Traditionnal Risk Premia



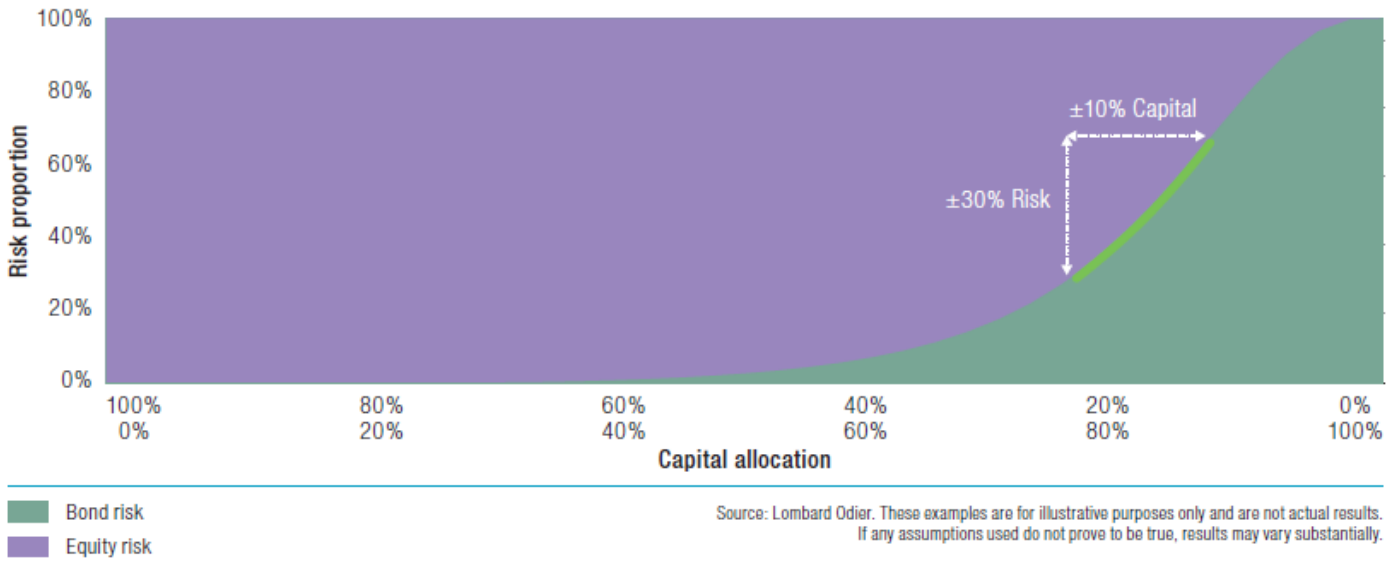
	ANNUAL RETURN	EXCESS >CASH	ANNUAL VOLATILITY	SHARPE RATIO
Cash (risk free)	4.9%	–	1.0%	–
Government bonds	7.4%	2.5%	5.1%	0.49
Corporate bonds	8.0%	3.1%	7.1%	0.43
Equities	10.5%	5.6%	15.3%	0.36
Commodities	4.6%	-0.3%	23.2%	-0.02
Balanced allocation(60/40)[1]	9.0%	4.1%	7.4%	0.55

Allocating Risk for better control

- As soon as **equities represent 40% or more of capital, they account for 80-90% of the portfolio risk**. So what appears to be a balanced portfolio (in capital terms) is actually a one-way bet on equities, and thus on a specific economic scenario of persistent growth and moderate inflation. In addition, a +/-10% variation in capital allocation translates into a +/-30% change in risk profile, a substantial variation.

- Conversely, when allocating risk, a +/-10% deviation in risk proportion only translates into +/-5% change in capital allocation. Risk-based allocation is therefore more robust to small changes, rather than capital allocation. In other words, it is more stable.

FIG. 5 – RISK CONTRIBUTION AS A FUNCTION OF CAPITAL ALLOCATION



Source: Lombard Odier. These examples are for illustrative purposes only and are not actual results. If any assumptions used do not prove to be true, results may vary substantially.

Dynamic Risk-Based rebalancing

FIG. 6 – DYNAMIC RISK-BASED REBALANCING OF A TRADITIONAL 60/40 PORTFOLIO

RISK-WEIGHTED OUTPERFORMANCE	
Annualised excess returns	0.5%
Tracking error	1.5%
Information ratio	0.3%
Hit ratio	60%

Source: Lombard Odier. These examples are for illustrative purposes only and are not actual results. If any assumptions used do not prove to be true, results may vary substantially.

- Analysis shows that dynamic rebalancing on a risk-allocation basis can add incremental returns and improve the Sharpe ratio
- In other words, even in the case of an average capital allocation of 60% bonds and 40% equities, the mere rebalancing of risk contribution (instead of capital allocation) can yield better performance at the portfolio level.

Is Alpha just Beta waiting to be discovered?

Rethinking Alpha

- Initially, alpha was considered as the difference between a specific investment and a riskless one.
  - With considerations about the sustainability over time and its consistancy (avoiding lasting losses / excessive volatility)

- Alpha should not be thought of as the return from active management, but rather as a return source that is not associated with any common risk factor. **Alpha = Return on top of beta exposure**

- The reclassification of a portion of alpha to a beta is a continuous evolution that is part of the history of financial innovation.

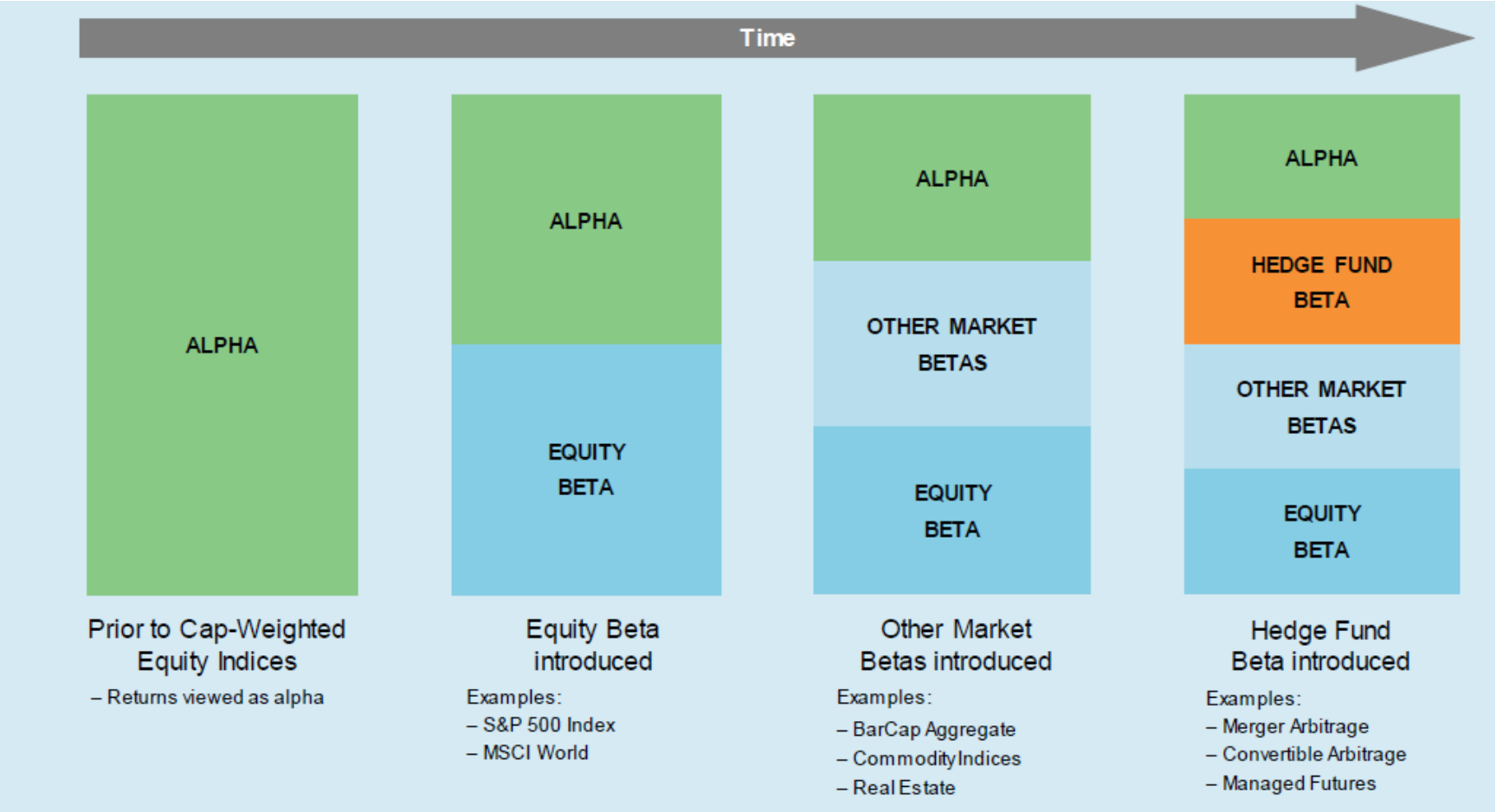
- As new risk factors emerge, alpha explains a smaller portion of portfolio returns.

What Is Alpha?

	Alpha	Beta
Colloquial Definition	Returns generated by active management	Returns from passive market exposure
Economic Definition	**Returns that cannot be explained by exposure to common risk factors**	**Returns from exposure to one or more common risk factors**

This definition makes it clear that “alpha” is not “returns from active management,” but rather “**returns that cannot be explained by betas.”**

The evolution of alpha into beta:
Is Alpha Just Beta Waiting To Be Discovered?



"Passive Factors," e.g.,
- Equity Risk Premium
- Term Premium
- Credit Premium

"Active Factors," e.g.,
- Merger Arbitrage Premium
- Trend-Following
- Value Premium
- Momentum Premium

Rethinking Alpha

- Eventually, the remaining alpha compensate investors / managers for specific skills that cannot be replicated :
    - Underlying selection (bottom-up)
    - Allocation (Top-down)
    - Portfolio construction
    - Other skills :
        - luck,
        - information skills : ability to gather and to deal massive information data
        - Analysis ability with very high dicretionnary bias (fondamental analysis, technical analysis, flow analysis…)
        - market access,
        - size of investment (entry barriers)

- Specific skills delivering this type of alpha is also the purpose of this course

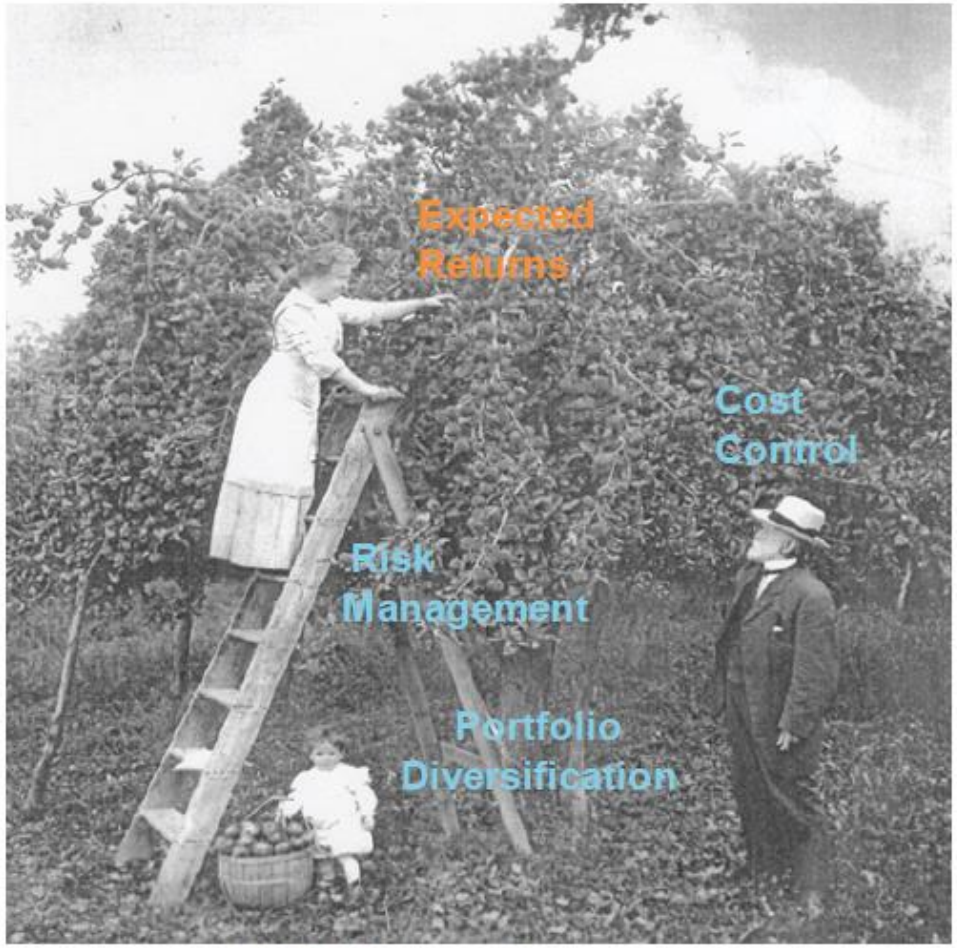
Rethinking Alpha

- Other various return that cannot be replicated or explained or leveraged

  - Idiosyncratic risk (well rewarded risk)
  - Asset class forbiden (commo / Private Equity/Real Estate…)
  - Minimum investment (PE, RE, tangible investissements…)
  - Liquidity constraints (Size…)
  - Quality constraints (Minimum ratings in credit…)
  - Market access (OTC markets like credit, forex, PE, RE…)
  - Lack of knowledge (education, ability to deal various informations…)
  - Market authorizations
  - Cost of information
  - Etc,,,

Alpha Beyond Expected Returns

Alpha Beyond Expected Returns



Source: Penrose, Colorado Chamber of Commerce. http://www.penrosechamber.com/LocalInformation/History.aspx

If investing were compared to apple harvesting with the classic mistakes made when reaching for the top while missing the low-hanging fruit.

- Look at the poor quality of diversification – all apples in one basket.
- What should we say about risk management when the poor girl is standing under the ladder?
- And cost control is hardly impressive when we see one overseer and one active worker.

Do not let your investment process be like this harvesting effort!

Rethinking alpha

- Many institutional investors focus primarily on one source of

alpha: expected returns, perhaps relative to a benchmark.

- There are many drawbacks to this approach, including manager search

costs, limited performance persistence, and (potentially) high fees.

There are 3 themes to improve alpha

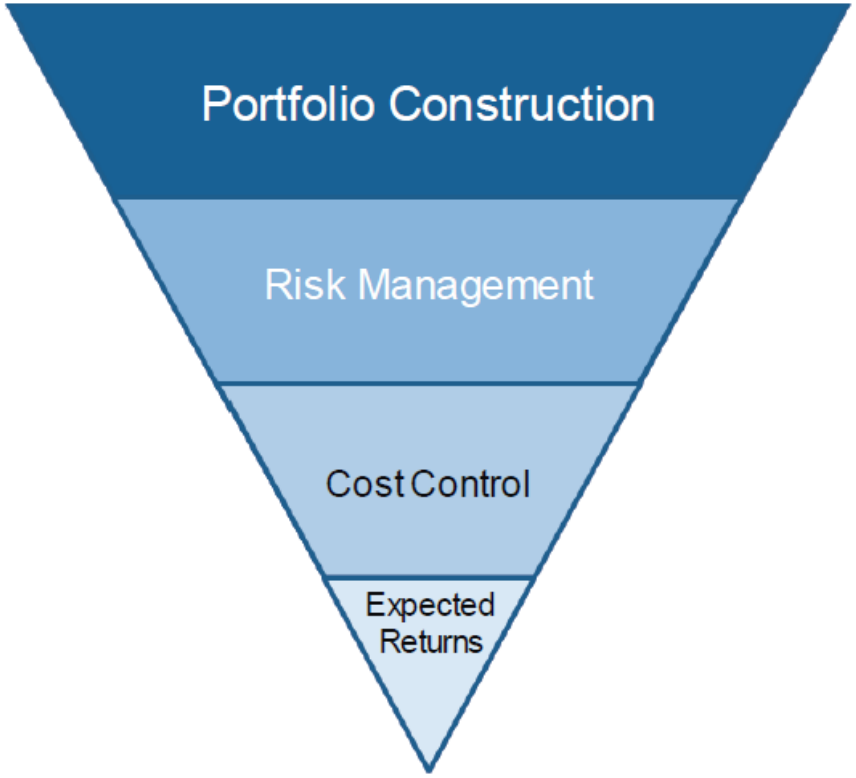
- **1- Portfolio Construction** – diversification can be applied in aggressive and innovative ways

- **2. Risk Management** – practices that generate a smoother ride enable investors to stick to their game plan in bad times

- **3. Cost Control** – cost-effective execution and fair fees gain importance in a world of low expected returns

Various sources of alpha

Key sources of alpha



- and how to catch them

1. Harvest many return sources
2. Allocate risk, not dollars
3. Seek negative/low correlations

4. Limit risk concentrations with well-chosen constraints
5. Target constant volatility over time
6. Use dynamic overlays to control drawdowns

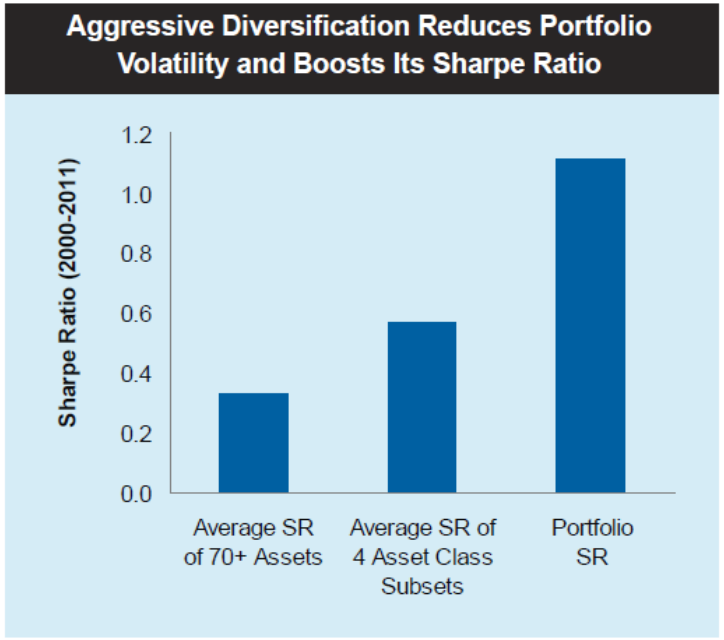
7. Keep trading costs low and pay fair fees

8. Identify investments with superior Sharpe ratios

Source: AQR. For illustrative purposes only.

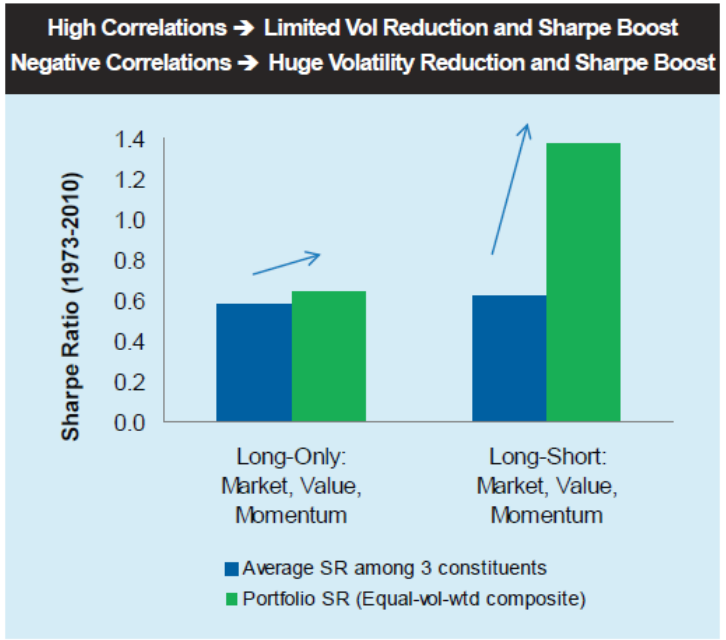
Sources of alpha : portfolio construction

1. Harvesting rewards from many return sources is essential



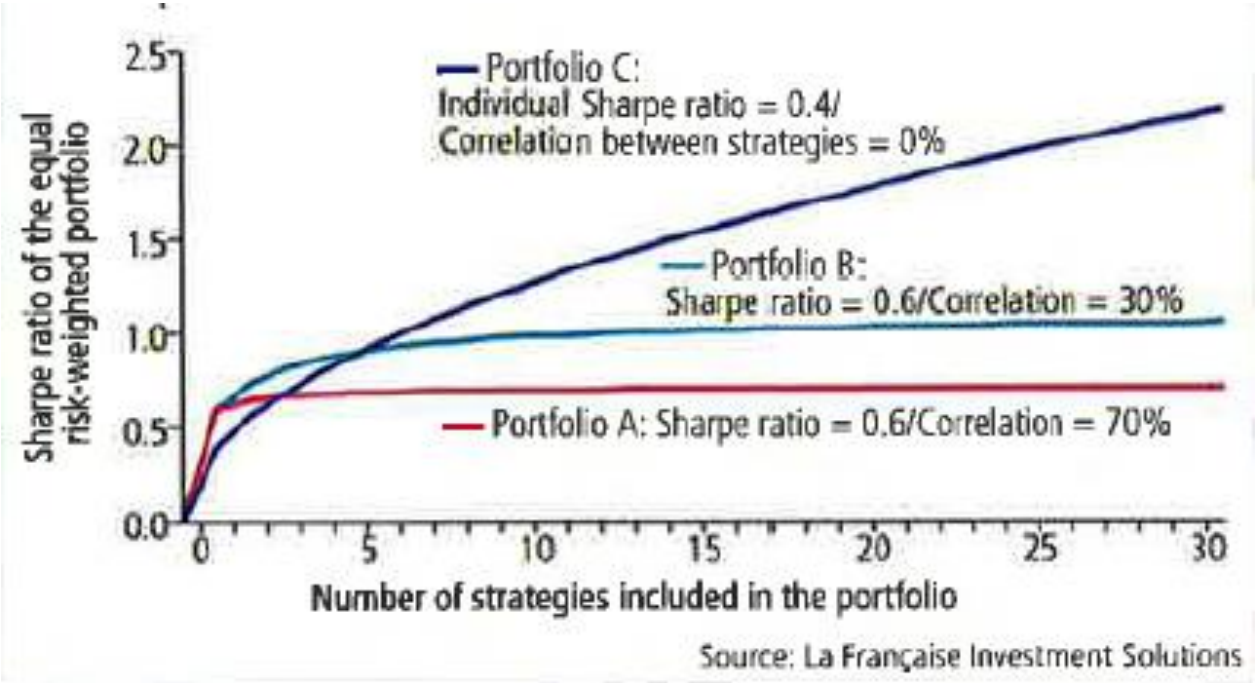
Source: AQR. Sharpe Ratios are based on backtested returns of a Global Risk Parity strategy, net of trading costs and gross of management fees.

Low to negative correlations are superb diversifiers, when available



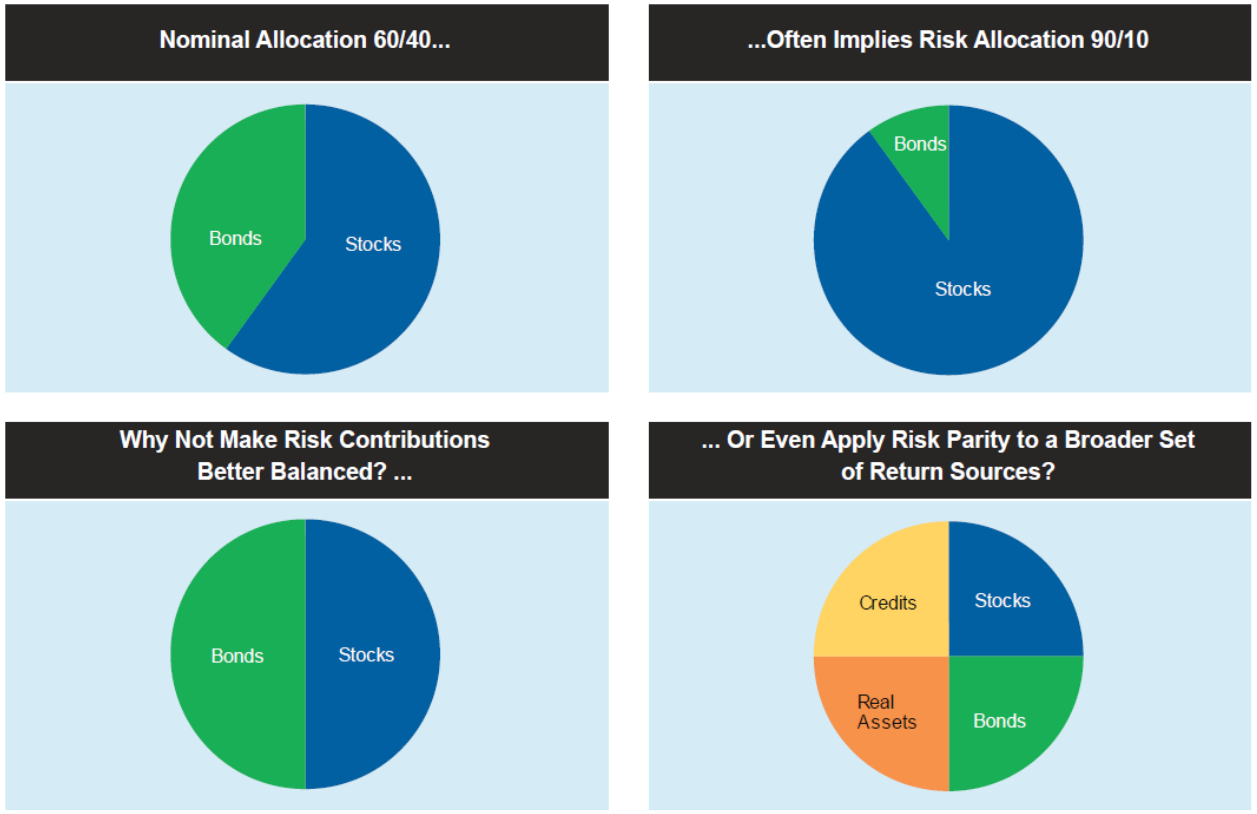
Note: Asness, Moskowitz, and Pedersen (2011) based on monthly returns of global stocks between 1973 and 2010.

The power of diversification with uncorrelated strategies



Sources of alpha : Risk management

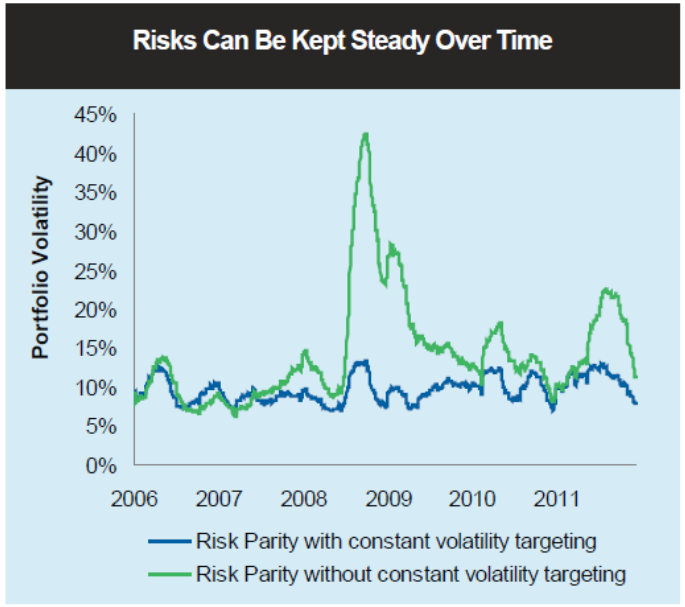
Return sources should be combined in a balanced way (allocate risk, not dollars)



Source: AQR Capital Management. Stylized examples of 60/40 portfolios and risk parity portfolios with two or four subsets.

Sources of alpha : Risk management

Volatility targeting improves risk accuracy and may improve the Sharpe ratio



Source: AQR. For illustrative purposes only. Sample Risk Parity Portfolios created using Equities (S&P 500 Index), Bonds (Barclays Capital Aggregate Bond Index) and Commodities (Goldman Sachs Commodities Index). Notional exposures for static portfolio are set at inception. Notional exposures for dynamic portfolio are adjusted based on a volatility forecasting model.

Dynamic overlays beyond volatility targeting may reduce drawdowns, and boost Sharpe ratios

- Mechanical drawdown rules may shift capital from risky investments to cash if pre-specified loss levels are reached
- Tail hedges may improve fund performance in the worst of times (but option-based tail insurance is too expensive). Prefer statistical hedges with better performance in normal times, such as trend-following strategies and defensive equity strategies.

Estimating Equity Risk Premia (ERP)

Equity Risk Premium is the price of risk in equity markets

- It is the premium that investors demand for the average risk investment. When equity risk premiums rise, investors are charging a higher price for risk and will therefore pay lower prices

- All the risk and return models in finance share basic assumptions about risk:

  1- They all define **risk in terms of variance in actual returns** around an expected return

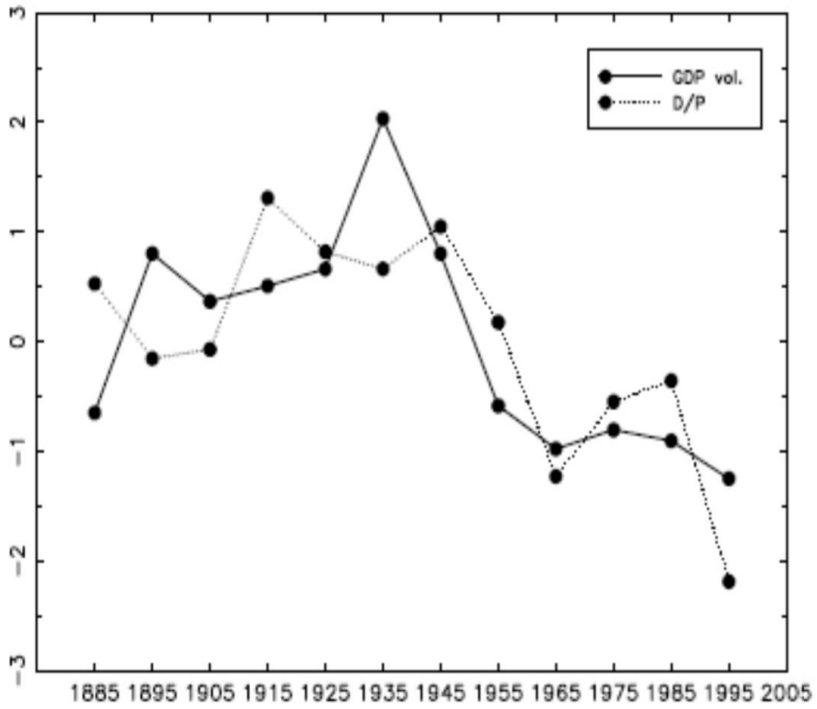
  2- The risk in any investment can be broken into two components:
  - Idiosyncratic risk
  - Market risk which is **not diversifiable** and should be **rewarded**

Déterminants of ERP

- Risk aversion: the collective risk aversion of investors determines ERP
    - Investor age: PE ratios are closely and positively related to the Middle-age/Old-age ratio for the US equity market from 1954 to 2010; since the equity risk premium is inversely related to the PE, this would suggest that investor age does play a role in determining equity risk premiums [Liu and Spiegel]
    - Saving rate / preference for current consumption: ERPs should be lower in markets where individuals are net savers. Consequently, ERPs should increase as savings rates decrease in an economy. [Rieger, Wang and Hens (2012)]
- Information: quantity and quality
    - For exemple, Russian ERP should be higher than US ERP
    - Or, current developped countries ERP is supposed to be lower than historical ones due to improvements in information
- Liquidity and flows
    - investors that pay high transaction costs with a high illiquidity risk should demand a higher ERP
- Catastrophic Risk
- Government policy and politics
    - Government stability and bureaucraty quality have an impact on ERP. ERP are higher in countries with more policy risk from either factor[Lam and Zhang, 2014]
- Monetary Policy
- Behavioral irrational component

Déterminants of ERP: Economic Risk

Volatility in GDP growth and Equity Risk Premiums (US)



Lettau, Ludvigson and Wachter (2008)

- The risk in equities as a class comes from more general concerns about the health and predictability of the overall economy.
- So, the ERP should be lower in an economy with predictable inflation, interest rates and economic growth than in one where these variables are volatile
- Brandt and Wang (2003) argue that news about inflation dominates news about real economic growth and consumption in determining risk aversion and risk premiums. They present evidence that equity risk premiums tend to increase if inflation is higher than anticipated and decrease when it is lower than expected
- It's admitted that it is more the uncertainty about **inflation level that determines ERP** and its variations

A short introduction to returns analysis

- Main inputs to judge expected returns are :
  - Historical performance
  - Theories
  - Forward looking indicators
  - Discretionnary views

- Forward looking indicators have a better track record than historical averages analysis.

- Tenuous relation between volatility and average returns.
  - What works for asset class doesn't work very well within asset class (the most volatile assets within each asset class often have relatively low returns).

- Investors should require high risk premia for assets that fare poorly in bad times,
  - whereas safe haven assets can justify low or even negative risk premia.
  - Left skewed strategies needs to be highly rewarded.

- **Assets returns are very dependant on market / macro environment** (equities returns are very high after a market krash while bonds returns are very high after an inflation period)

The Equity Premium Puzzle

Mehra, Rajnish, and Edward C.Prescott, 1985, The Equity Premium: A Puzzle, Journal of Monetary Economics, v15, 145–61.

Using a constant relative risk aversion utility function and plausible risk aversion coefficients, they demonstrate the equity risk premiums should be much lower (less than 1%).

The equity premium : a puzzle

- The equity risk premium is a reward for bearing losses during bad times, which are defined by low consumption growth, disasters, or long-run risks.

- Bad times occur when society, or all agents in the economy, are consuming less.

- The equity premium puzzle is that, using consumption as a risk factor, the equity premium should be very modest.

Log S&P 500 Returns, Consumption Growth

	Nominal Stock Returns	Real Stock Returns	Real Consumption Growth
Mean	10.4%	7.1%	3.3%
Stdev	16.5%	16.6%	1.7%
Sharpe Ratio	0.328	0.308	
	with 5% nom	with 2% real	

- Rajnish Mehra and Edward Prescott (« The equity Premium : a puzzle » 1985) claimed that equity premium should be well below 1% for reasonable levels of risk aversion (between 1 and 10) while the average excess return of US equities over bonds has been 6.2% (1900-2010). Puzzling, isn't it?

Equity premium puzzle : explanations

- First observation : market's risk aversion is extremely high (could be well beyond 20)

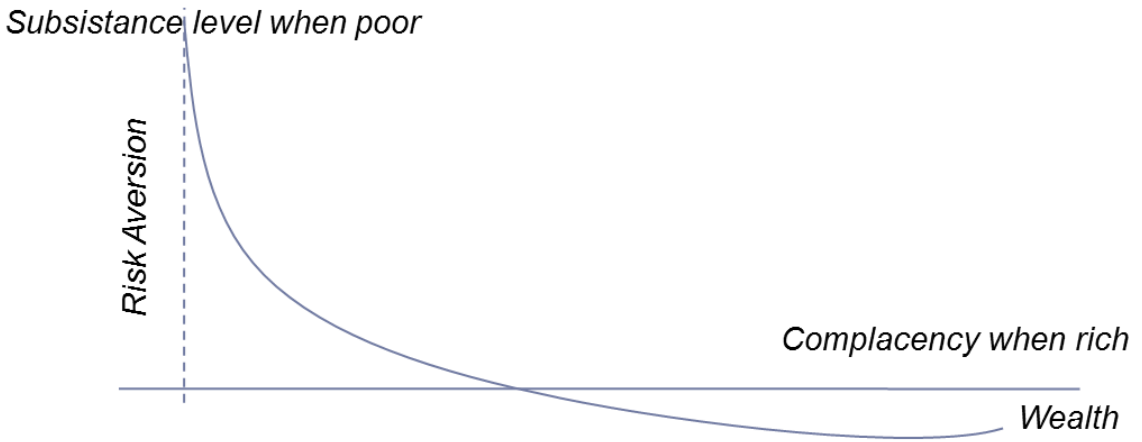
$$\gamma > \frac{Sharpe\ Ratio}{\sigma_c},$$

- Marginal utility can be very high during recessions : small reductions in consumption bring agents perilously close to their habits. Thus agents become very risk averse during bad times, generating high rquity risk premiums.

- Overall, **the very high risk aversion during bad times dominates the low risk aversion**

ERP puzzle

- ERP puzzle refers to the difficulty to explain the magnitude of historical ERP in a context of standard macro economic model
  - ERP reflects the way that asset returns covary with the marginal utility of an extra $ of investor wealth ➔ high marginal utility when consumption growth declines
  - Model based on Consumption growth (Mehra-Prescott,1985) predict very low ERP due to low volatility of cons. Growth and low correlation between cons. And asset returns
- Behavioral asymetry between good and bad times :
  - a specific loss implies a much higher (negative) stimulus than the positive stimulus led by a gain equivalent to the loss
  - Time varying risk aversion : assets which perform poorly in bad times should offer higher risk premia.



ERP puzzle

- Market RP should reflect the price of risk and the amount of risk
  - Mkt risk aversion varies with recent mkt moves & economic conditions
  - Amount of risk with stock mkt volatility and asset correlation

- Among explanations :
  - Rare disaster risk is overstated
  - Survivor bias (US economy is particularly successful)
  - Legacy of great depression may have sustained for decades (60’s) and recently the 2 recent major bear mkt in less than 10 years are supposed to weight
  - Structural uncertainty due to changes in the structure of the economic and political systems (cold war, globalization, Brexit, QE, DJT?...)
  - Long run risk : for investors, the bigger concern is the uncertainty about the long run growth rates

Risk premia determinants

- Skewness preferences : peaple don’t only care about mean and variance. They also care about skewness (lottery type payoffs). They dislike negative skewness (selling lottery tickets). The preference for such assets is also very time dependant and correlated to volatility (expensive premia in bad times and low rp in euphoria times)

- Investor irrationality : rational expectations involve making an optimal forecast using all available informations. But we observed expectations are biased, very often strongly influenced by recent history (cf inflation)

- Supply-demand factors and elasticity.
  - Supply : commodities offer few substitutes and a sudden shortage can trigger strong moves in commodity prices
  - Demand : demography developments can strongly interfer in asset prices (baby-boomer generation)

- Market frictions and illiquidity premia : trading costs, funding constraints and market irrationalities create frictions which are related to illiquidity.

- Market asymetries (impliying moral hazard, conflict of interest…) can cause momentum patterns

Equity Risk Premium (ERP)

- In US, excess return over Gov Bds = 3 to 5% over long data windows
  - Consider less returns for Europe and other developped countries

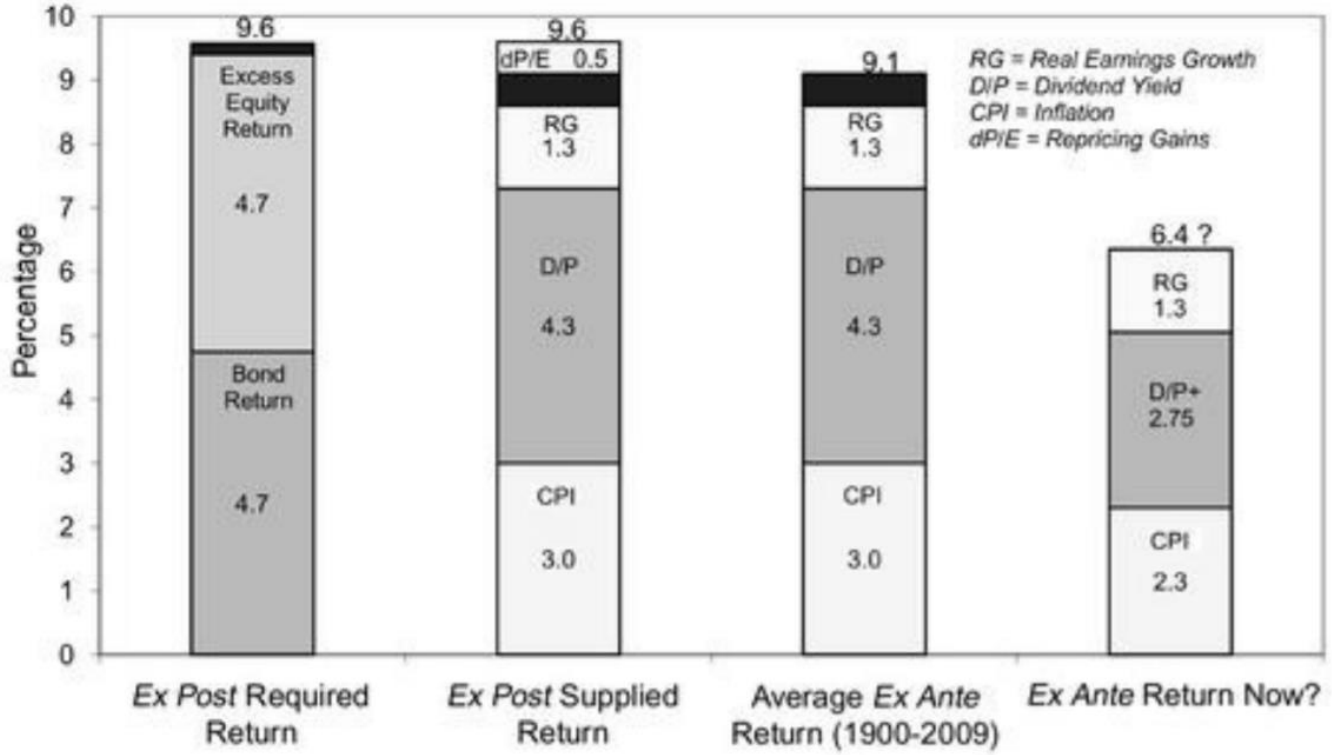
- Gordon model : long run real equity returns = Sum div. Yields + div growth (no valuation change (2% + 1%=3%)
  - Real LT growth of divid. And earnings/share lagged the GDP rate
  - Equity mkt valuation have been high admist low inflation and low macro volatility

- Standard economic models suggest the ERP should be negligible (~1%)

- Professional investors expect ERP of 3 to 4% well below academic estimates average near 6% for the 20th century

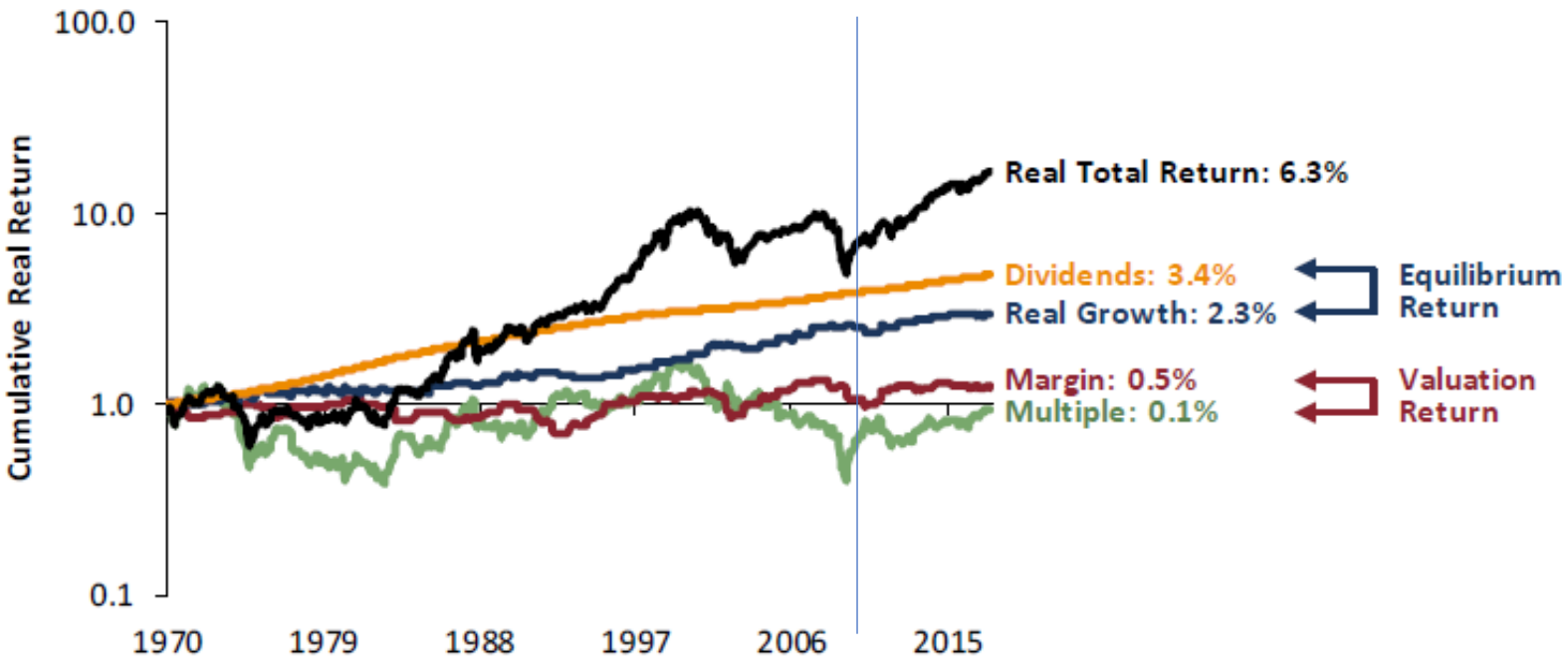
Equity Return decomposition : the case of S&P 500

Decomposing historical equity market returns, 1900–2009



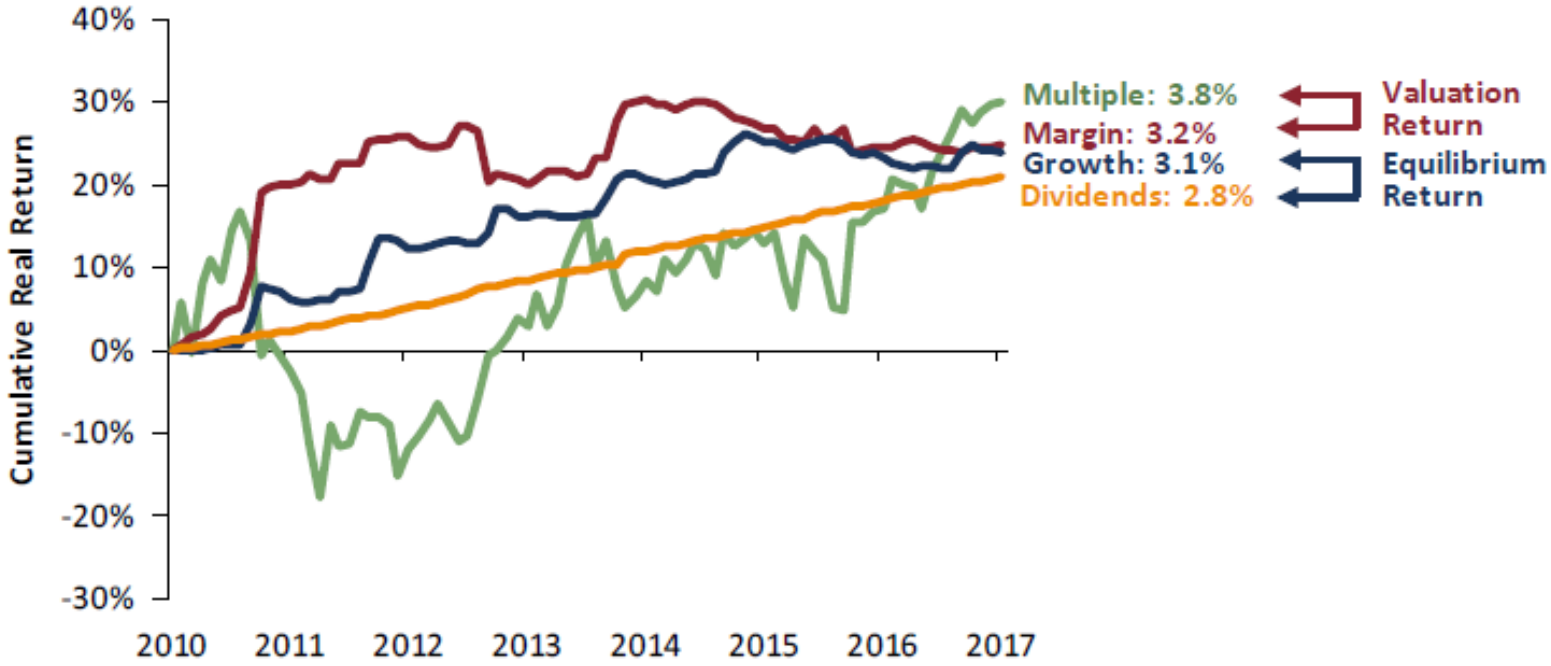
Repricing effect : P/E ratio increased by 75% from 12.5 to 21.9
Could weight in the other direction now (mean reversion)

S&P 500 Return decomposition 1970-2017



As of 6/30/17
Source: GMO, Worldscope, Compustat, MSCI

S&P 500 Return Decomposition—Total Real Return of 13.6% for the Last 7 Years



As of 6/30/17

Source: GMO, Worldscope, Compustat, MSCI

Do Stocks Outperform Treasury Bills?

Are investors paid for holding equities? A puzzling study on the 26k US stocks from 1926 to 2015

Do Stocks Outperform Treasury Bills?

- **58% of CRSP common stocks have lifetime holding period returns less** than those on one-month Treasuries.
- **The entire net gain in the U.S. stock market since 1926 is attributable to the best-performing 4%** of listed stocks, as the other 96% collectively matched 1-month Treasury bills.
- These results highlight the important role of **positive skewness** in the cross-sectional distribution of stock returns. The skewness arises both because monthly returns are positively skewed and because compounding returns induces skewness.
- The results help to explain why active strategies, which tend to be poorly diversified, most often underperform.
- Of all monthly common stock returns contained in the CRSP database from 1926 to 2015, only 47.7% are larger than the one-month Treasury rate. In fact, **less than half of monthly CRSP common stock returns are positive.**
- It also explain why the **lottery-ticket bias** is so significant

Do Stocks Outperform Treasury Bills?

- When focusing on lifetime returns (from the beginning of sample or first appearance in CRSP through the end of sample or delisting from CRSP),
  - Just 42.1% of common stocks have a holding period return, inclusive of reinvested dividends, that exceeds the return to holding one month Treasury Bills over the same horizon,
  - More than 50% deliver negative lifetime returns.
  - The single most frequent outcome (when returns are rounded to the nearest 5%) observed for individual common stocks over their full lifetimes is a loss of 100%.

- Individual common stocks tend to have rather short lives. The median time that a stock is listed on the CRSP database between 1926 and 2015 is just over 7 years.

- the **single stock strategy** (random selection process) underperformed the value weighted market in 96% of the simulations and underperformed the equal-weighed market in 99% of the simulations.

- The single-stock strategy outperformed the one-month Treasury bill over the 1926 to 2015 period in only 28% of the simulations.

Do Stocks Outperform Treasury Bills?

- The fact that the overall stock market generates puzzling high long term returns while the majority of individual stocks fail to even match T-bills can be attributed to the fact that the cross sectional distribution of stock returns is positively skewed.
  - very large positive returns to a few stocks offset the negative returns to more typical stocks.
  - The importance of positive skewness in the cross-sectional return distribution increases for longer holding periods, due to the effects of compounding.

- approximately 26,000 stocks that have appeared in the CRSP database since 1926 are collectively responsible for lifetime shareholder wealth creation of nearly $32 trillion dollars, measured as of December 2015 (current market cap =26 T).
  - However, the 86 top performing stocks (0,3% of the total) collectively account for over 50% of the wealth creation.

- The 1,000 top performing stocks, less than 4% of the total, account for all of the wealth creation. That is, the other 96% of stocks that have appeared on CRSP collectively generated lifetime dollar returns that match the one-month Treasury bill.

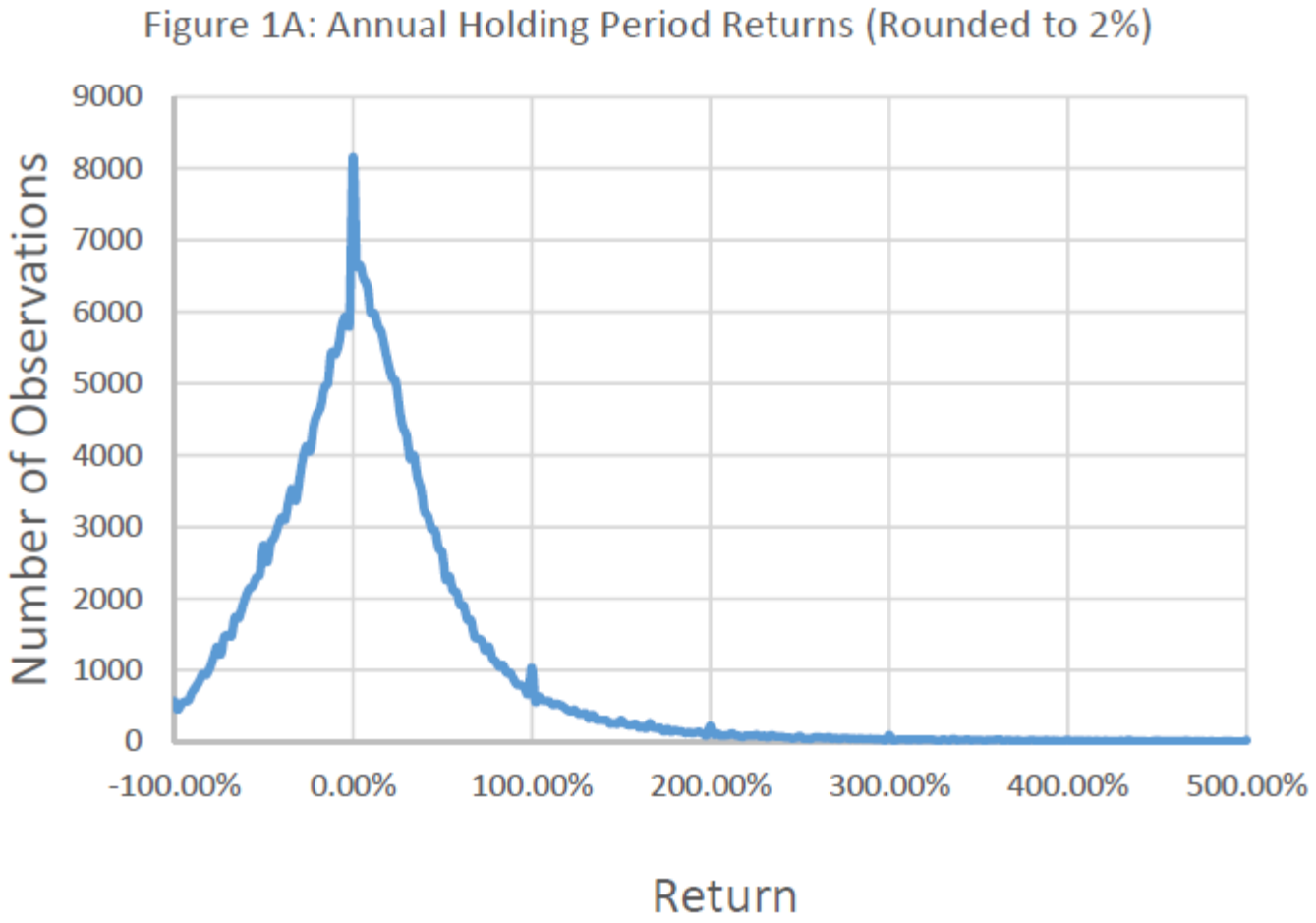
Do Stocks Outperform Treasury Bills?

- The evidence reported here is indeed at odds with the CAPM
  - 1/ **presumption that investors to be risk averse**, since those models imply a positive anticipated return premium
  - 2/ the majority of common stock returns are less than the treasury rate reveals that **the *median* excess return is negative**

- Not only does diversification reduce the variance of portfolio returns, but non-diversified stock portfolios are subject to the risk that they will fail to include the relatively few stocks that, ex post, generate large cumulative returns.

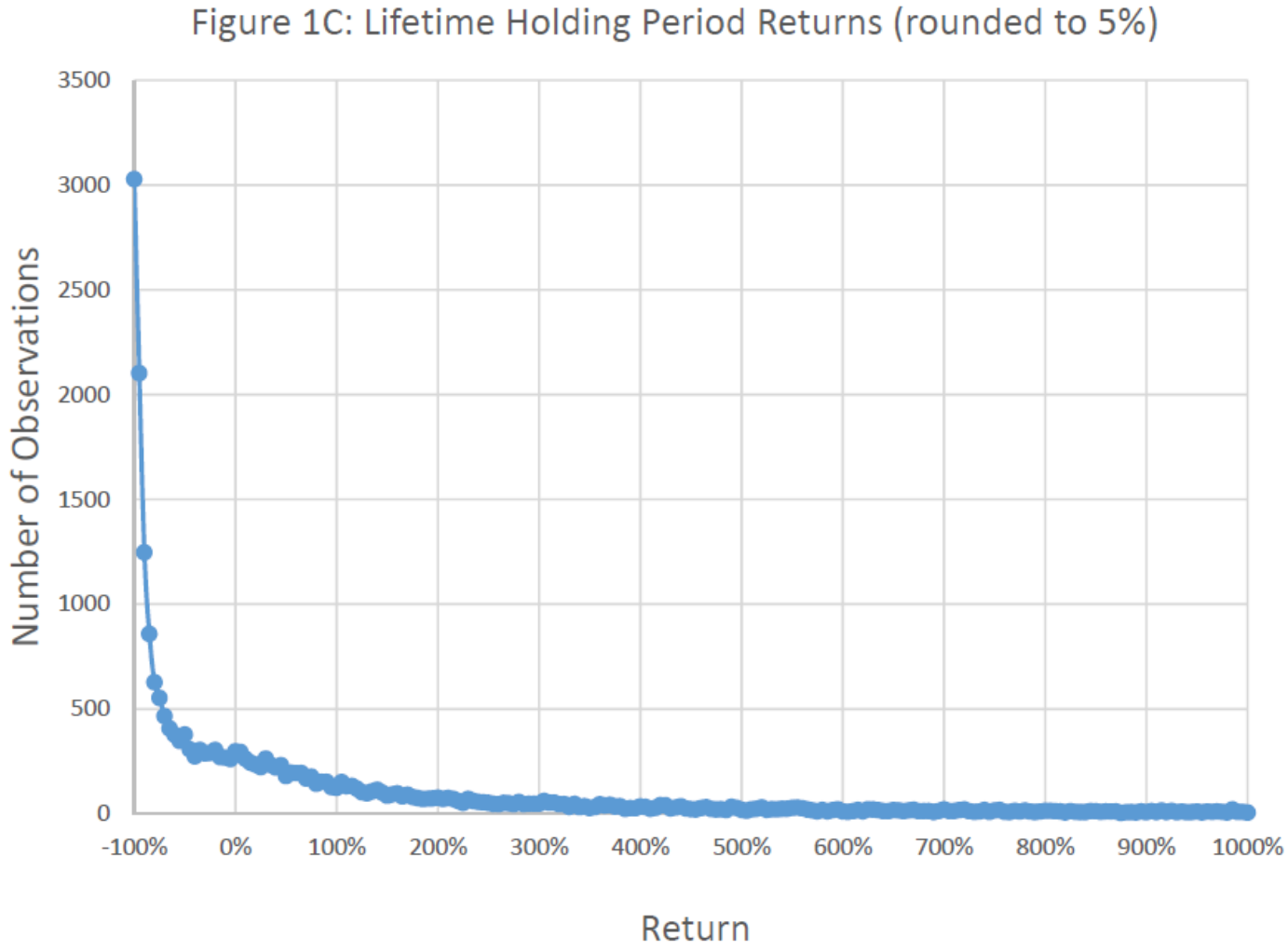
- the evidence supports the interpretation that **“lottery-like” payoffs** comprise a fundamental feature of investing in entrepreneurial ventures in a market economy.

The Distribution of Holding Period Returns



Displayed are frequencies of holding period returns, to a maximum of 500%. The data includes all CRSP common stocks from 1926 to 2015. In cases where stocks list or delist with a calendar period the return is computed for portion of the period where data is available.

Lifetime holding period returns



Cumulative % wealth creation

Figure 2A: Cumulative Percent Wealth Creation, All Stocks

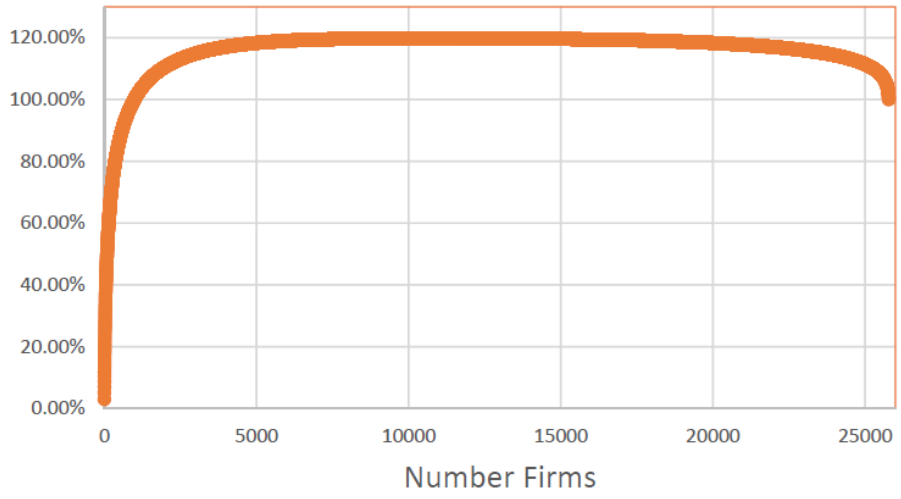
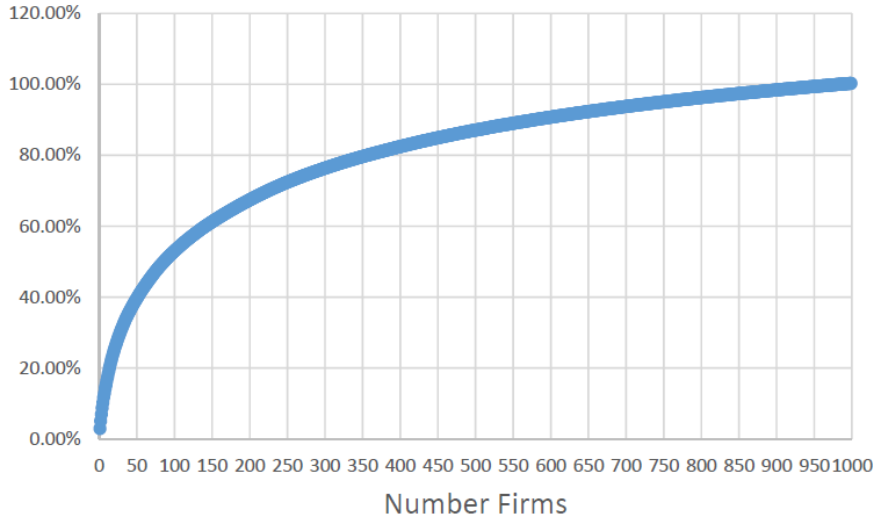


Figure 2B: Cumulative Percent Wealth Creation, Top 1000 stocks



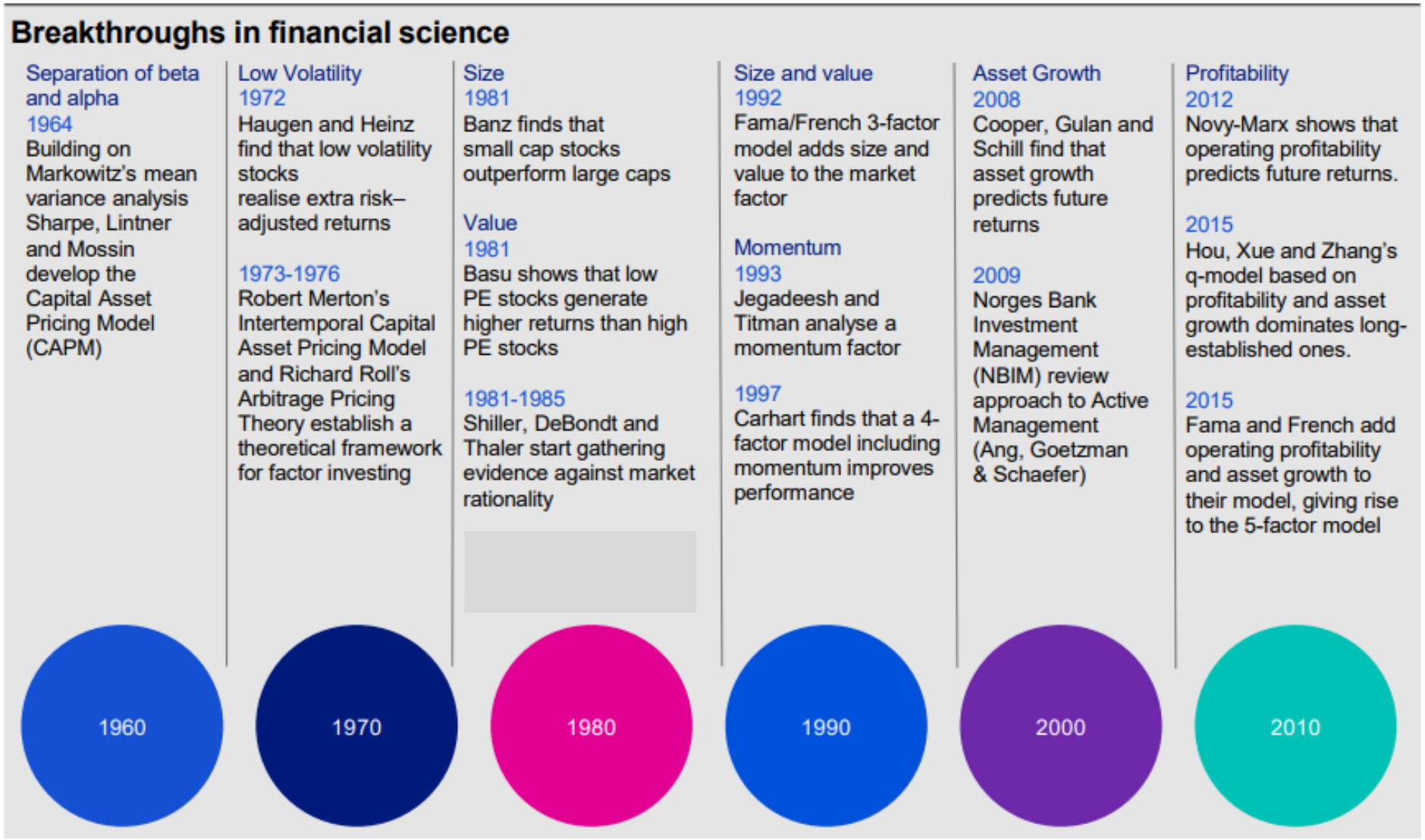
Fama & French 3 factors model

Fator models theory and CAPM

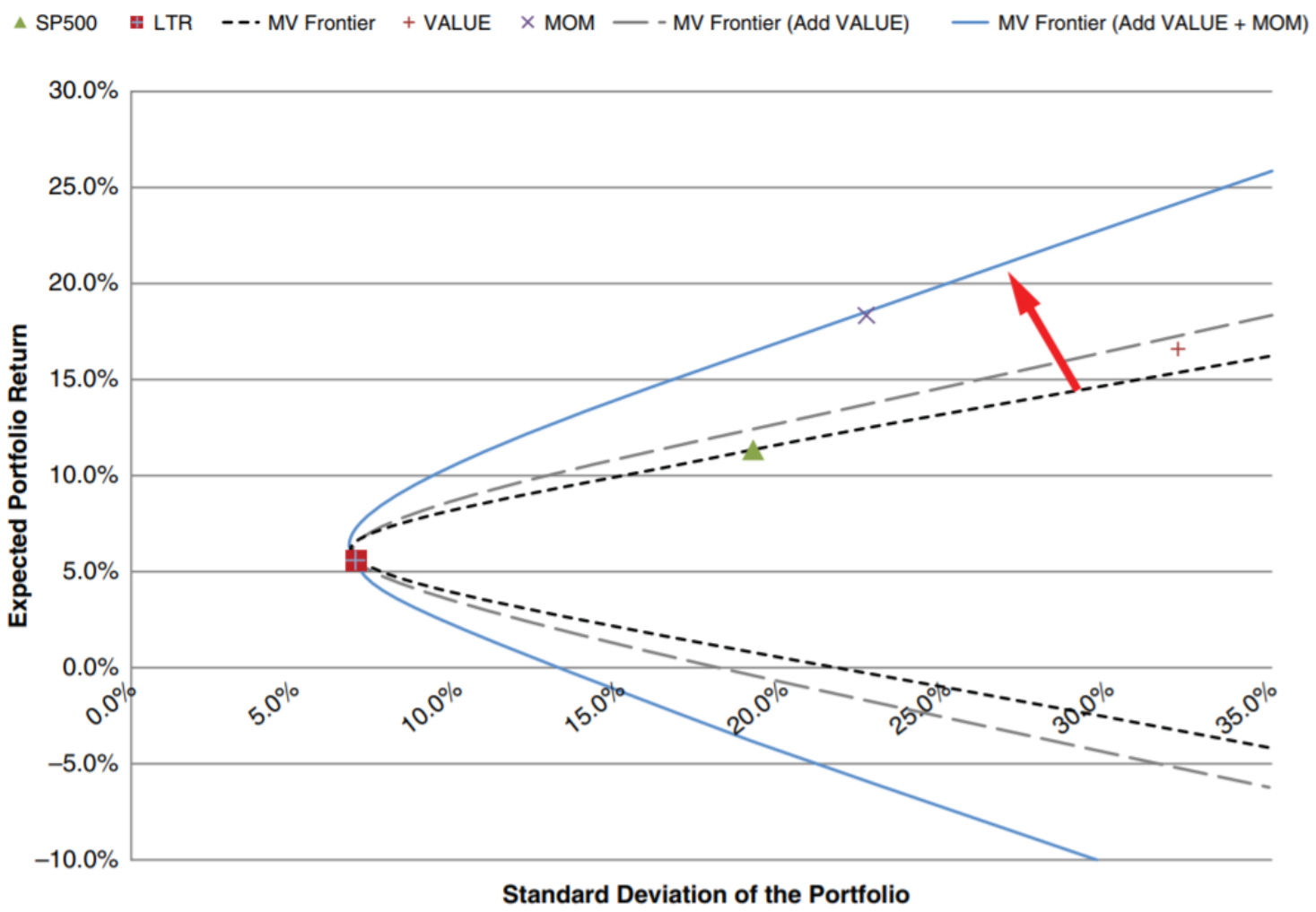
$$r_i = R_F + \beta_i^{\text{mkt}}\text{RMRF} + \beta_i^{\text{size}}\text{SMB} + \beta_i^{\text{value}}\text{HML}$$

Fama E., French K. (1992), "The Cross-Section of Expected Stock Returns", Journal of Finance
Fama E., French K. (1993), "Common Risk Factors in the Returns on Stocks and Bonds", Journal of Financial Economics.
Fama E., French K. (1996), "Multifactor Explanations of Asset Pricing Anomalies", Journal of Finance
Fama E., French K. (2012), "Size, value, and momentum in international stock returns", Journal of Financial Economics

Breakthrough in financial science



Modern Portfolio Theory with Value and Momentum: Equity Style Factors help to outperform traditional portfolios



Factors

"Factor" is the risk that fundamentally explains the existence of the risk premium.

- The **Term premium** is justified by the fact that bond investors are exposed to **inflation risk**, especially for longer-maturity bonds. Inflation is the factor and the term premium is the associated risk premium.
- Investors in corporate bonds receive a credit risk premium in exchange for being exposed to the default risk of the bond issuer (the factor).
- **Equity premium** rewards investor for being exposed to **economic growth cycles** and to **market stress**
- Most traditional risk premia are exposed, in varying degrees, to key macro and market risk factors: **growth, inflation, default risk, various market stress**…

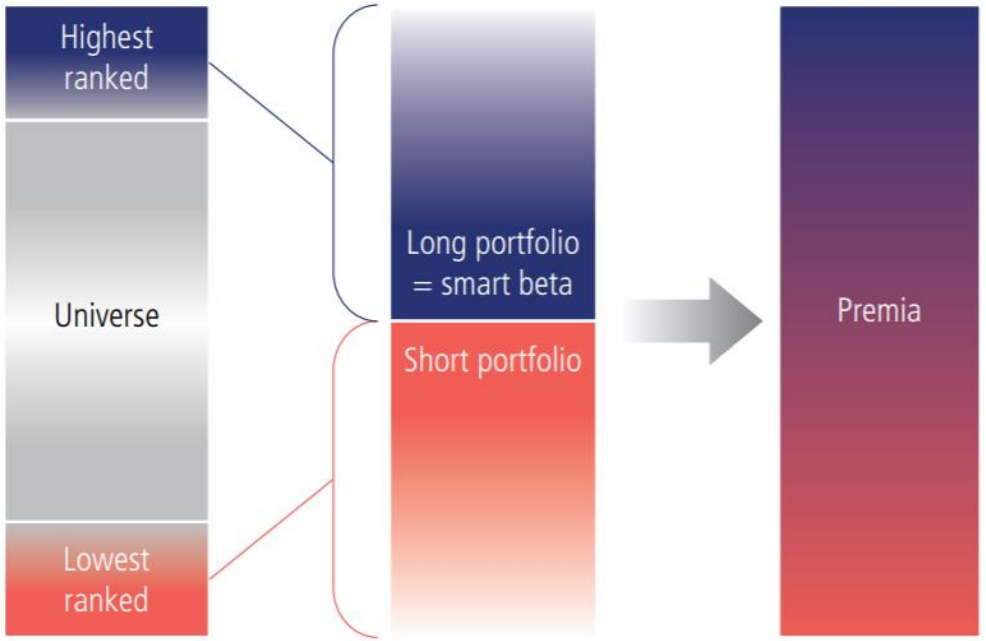
Risk factors, why?

- Factors principle emerged in 1993 after the publication of the seminal article on the three factors model by Fama and French. **Factors help to better explain portfolio return**.
  - a portfolio return can be better explained by looking not only at market performance but also at the performance of size and value factors. Creating a multi-factor model for asset pricing
  - Fama & French found a very smart solution to CAPM criticisms: they added new beta considerations to explain market anomalies… A good way to answer to behavioral criticisms and to keep CAPM alive!

- Investors **receive a risk premium for holding a risk factor** in their portfolio. RP are numerous and are replicable. Among them, we can distinguish :
  - Traditionnal risk premia (equity, bonds, credit emerging…): the original beta
  - Alternative risk premia (value, size, momentum, carry, low risk…): the new beta
  - Hedge funds and illiquid RP (merger arbitrage, illiquidity…): cannot be easily replicated

- Risk factors model apparently jeopardized the EMH conclusions but strengthened it in reality
  - **If all market anomalies can be explained by a beta exposure, there is no more alpha**, just a variety of beta which helps to enhance and strengthen modern finance

Risk Premia Construction:
Long/Short = Risk Premia while Long Only = Smart Beta



Academic Premia –

The most common premia, including:

- Value,
- Momentum,
- Carry,
- Low risk,
- Quality
- Liquidity strategies

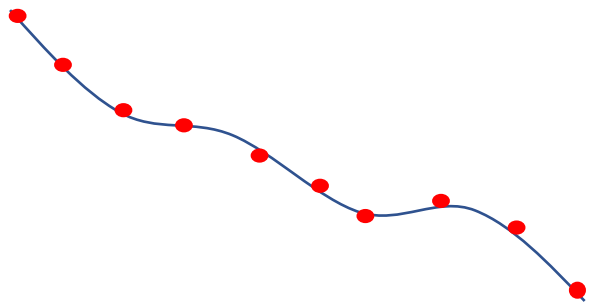
Implied Premia are created by asymmetries in risk and return and specific flows linked to certain investor patterns, hedging by banks or insurance companies and regulatory constraints.

- Volatility,
- Correlation,
- Dispersion and dividends etc…

Consequences on market implementations

Long/Short

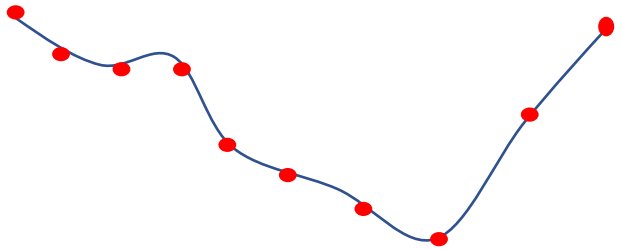
Needs a progressive underperformance decile by decile with a significant risk on the last decile (especially during short covering periods)



D1 D2 D3 D4 D5 D6 D7 D8 D9 D10

Long Only / Smart Beta

Needs the first deciles to outperform the others (Less risk on the short side) and is therefore less demanding



D1 D2 D3 D4 D5 D6 D7 D8 D9 D10

Investment Style Premia or Factor investing

- The traditional risk premia are not the only ones that investors can exploit. Style Premia is a very important one

- academic research has identified a number of other sources of systematic returns that can be elicited from single stocks or from major asset classes
    - **Value**: on average, value stocks outperform growth stocks
    - **Size**: on average, small caps outperform large caps
    - **Momentum**: on average, stocks that have performed well in the past outperform stocks that have performed poorly.
    - **Carry** : Because of their implied risk (skewness in bad times), high carry assets deliver significant risk premia and perform well over time.
    - **Low Beta** stocks out-perform High Beta stocks
    - **Quality**: a quality-minus-junk (QMJ) factor that goes long high-quality stocks and shorts low-quality stocks earns significant risk-adjusted returns

- Factor investing strategies use a long only equity portfolio implementation of investment style

Factor investing and ARP

Strategy	Equities	Rates	Credit	Currencies	Commodities
Carry	Dividend futures High dividend yield	Forward rate bias Term structure slope Cross-term-structure	Forward rate bias	Forward rate bias	Forward rate bias Term structure slope Cross-term-structure
Event	Buyback Merger arbitrage				
Growth	Growth				
Liquidity	Amihud liquidity	Turn-of-the-month	Turn-of-the-month		Turn-of-the-month
Low beta	Low beta Low volatility				
Momentum	Cross-section Time-series	Cross-section Time-series	Time-series	Cross-section Time-series	Cross-section Time-series
Quality	Quality				
Reversal	Time-series Variance	Time-series		Time-series	Time-series
Size	Size				
Value	Value	Value	Value	PPP Economic model	Value
Volatility	Carry Term structure	Carry		Carry	Carry

Factors performance over years :
No predominant factor means low correlation

Faktor-Diversifikation in der Praxis

Rang	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1.	5.0	4.0	27.7	11.6	-1.5	28.0	4.2	10.3	16.1	23.0	2.0	3.3	17.5	1.1	10.9
2.	2.3	2.3	25.0	11.3	-2.4	20.7	2.9	8.5	11.8	22.6	-2.2	2.1	15.1	0.9	10.5
3.	-0.2	1.3	20.9	9.8	-7.0	16.9	2.2	5.8	9.4	22.3	-4.4	0.1	8.3	-0.2	8.9
4.	-0.9	0.7	18.9	6.2	-8.2	10.6	-0.4	0.6	5.2	14.4	-11.2	-0.6	6.9	-1.2	6.5
5.	-5.5	0.3	17.2	4.2	-9.2	9.9	-3.4	0.4	3.8	9.7	-11.2	-1.6	4.1	-1.3	3.5
6.	-5.6	-0.5	9.8	0.7	-9.2	9.3	-4.6	-0.8	-0.7	8.5	-11.8	-2.2	0.7	-2.2	1.0
7.	-7.7	-1.6	1.1	-2.1	-12.5	7.7	-4.7	-7.1	-4.2	7.5	-16.8	-4.0	-2.3	-3.2	-0.2

Value | Size | Mom. | Res. Mom. | Reversal | Low Risk | Quality

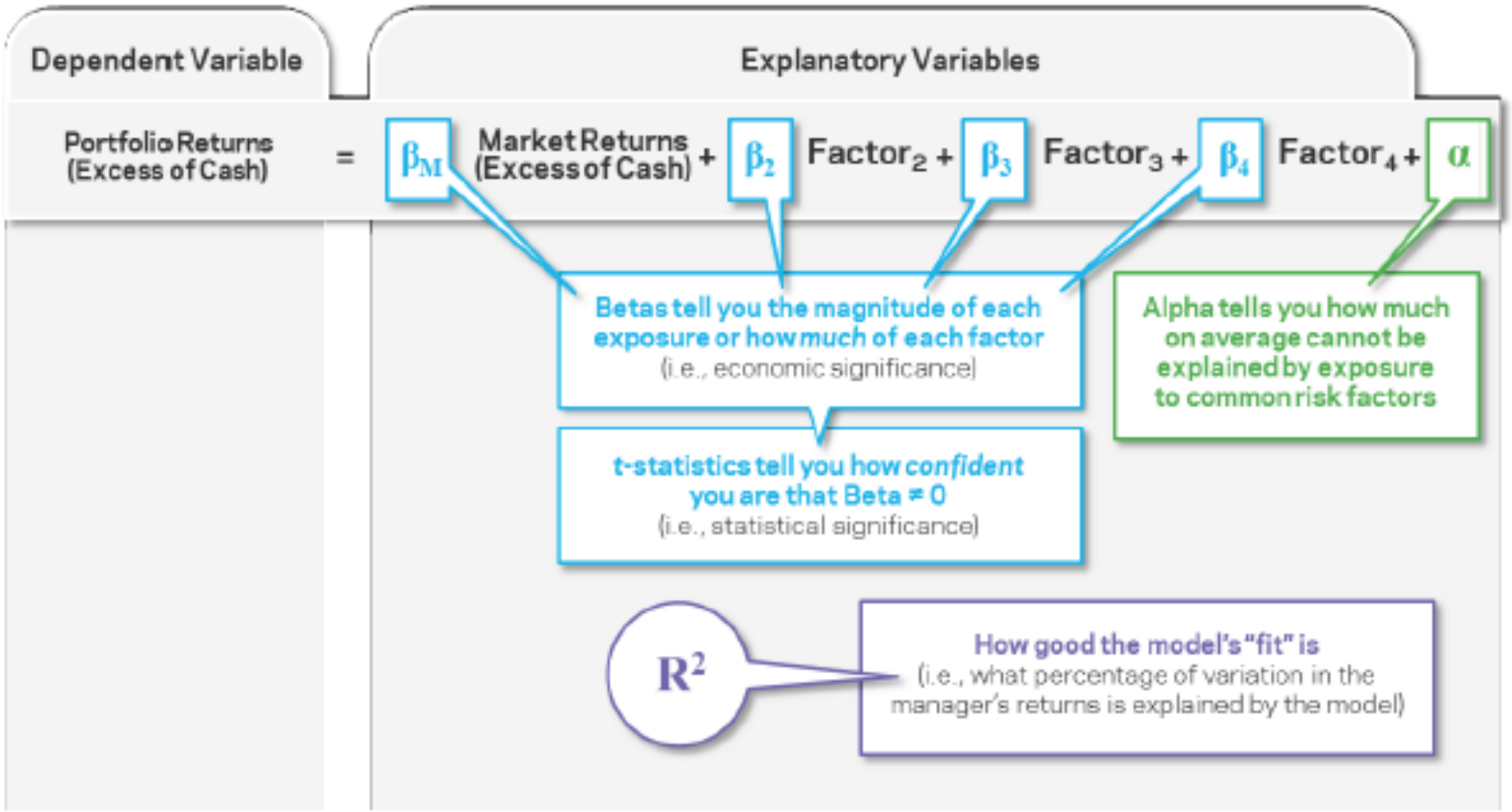
Ränge der Renditen der SPI Multi Premia® Faktorportfolios gegenüber dem SPI. Zeitraum: 01/2001 – 12/2015. Finreon Analyse.
Mom. = Total Return Momentum; Res. Mom. = Residual Momentum

Die Performance von Einzel-Faktor-Strategien **variiert stark** von Jahr zu Jahr. Die **tiefen Korrelationen** zwischen den Strategien eröffnen ein **starkes Diversifikationspotential**.

Measuring Factor Exposures

A framework for measuring factor exposures

Regression Approach:



Measuring factor exposures :

First regression model is the CAPM with the market as the only factor :

$$(R_i - R_f) = \alpha + \beta_{MKT}(R_{MKT} - R_f) + \varepsilon \qquad (1)$$

Or roughly,

Portfolio returns in excess of cash
= Alpha + Beta × Market risk premium[13]

And the factor beta can be determined as follow :

$$\beta_{i,m} = \rho_{i,m}(\sigma_i/\sigma_m)$$

$$\text{Factor beta} = \text{Factor correlation with portfolio} \times \left(\frac{\text{Portfolio volatility}}{\text{Factor volatility}}\right)$$

Measuring factor exposures :

The same framework can be applied for multiple risk factors :
Below the regression adds the value factor :

$$(R_i - R_f) = \alpha + \beta_{MKT}(R_{MKT} - R_f) + \beta_{HML}(R_{HML}) + \varepsilon$$

The momentum factor can then be added :

$$(R_i - R_f) = \alpha + \beta_{MKT}(R_{MKT} - R_f) + \beta_{HML}(R_{HML}) + \beta_{UMD}(R_{UMD}) + \varepsilon$$

Anf then, the size factor :

$$(R_i - R_f) = \alpha + \beta_{MKT}(R_{MKT} - R_f) + \beta_{HML}(R_{HML}) + \beta_{UMD}(R_{UMD}) + \beta_{SMB}(R_{SMB}) + \varepsilon$$

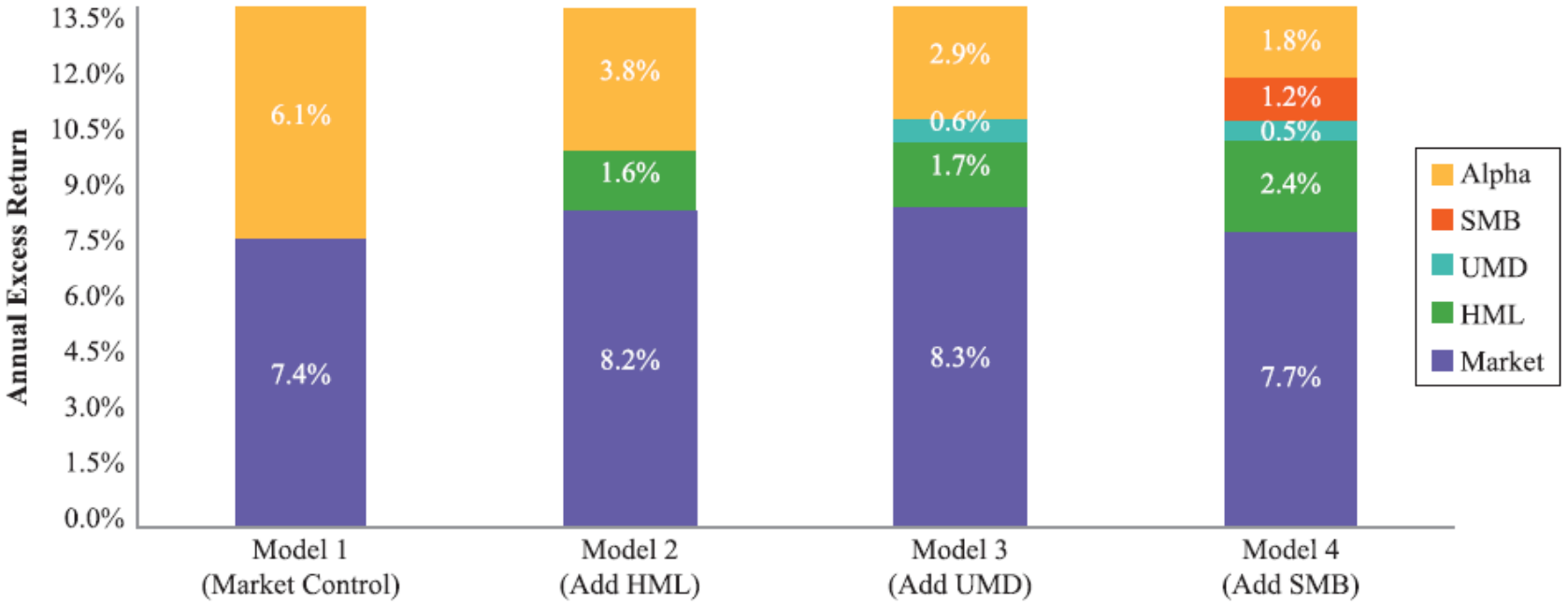
Exemple of application : Decomposing hypothetical portfolio returns by factors (jan 1980- dec 2014)

	Portfolio	Market	Value (HML)	Momentum (UMD)	Size (SMB)
Annual Excess Returns	13.5%	7.8%	3.6%	7.3%	1.6%
Volatility	17.8%	15.6%	10.5%	15.8%	10.6%
Correlation with Portfolio		0.84	–0.06	–0.08	0.53

Panel A: Regression Results

	Model 1 (Market Control)	Model 2 (Add HML)	Model 3 (Add UMD)	Model 4 (Add SMB)
Alpha (ann.)	**6.1%**	**3.8%**	**2.9%**	**1.8%**
t-statistic	3.6	2.5	1.9	2.2
Market Beta	**0.96**	**1.05**	**1.07**	**0.99**
t-statistic	31.1	35.7	36.0	61.5
HML Beta		**0.43**	**0.46**	**0.65**
t-statistic		9.8	10.3	26.4
UMD Beta			**0.09**	**0.07**
t-statistic			3.0	4.6
SMB Beta				**0.74**
t-statistic				32.2
R^2	0.70	0.75	0.76	0.93

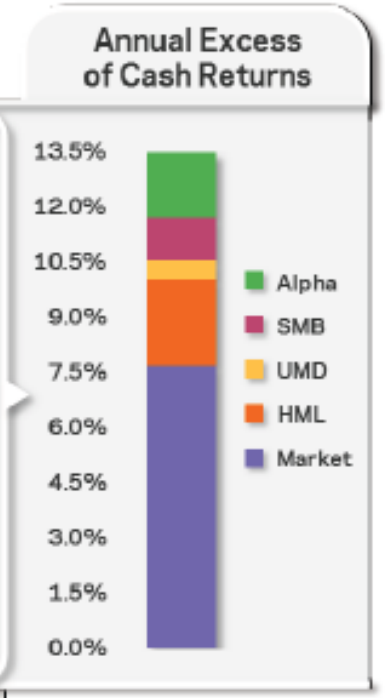
Portfolio return decomposition



Decomposing Hypothetical Portfolio Returns by Factors

Hypothetical Results
January 1980–December 2014

Regression Output			Risk Premium		Return Contribution
Alpha (annual)	1.8%				1.8%
t-statistic	(2.2)				
SMB Beta	0.74	✖	1.6%	=	1.2%
t-statistic	(32.2)				
UMD Beta	0.07	✖	7.3%	=	0.5%
t-statistic	(4.6)				
HML Beta	0.65	✖	3.6%	=	2.4%
t-statistic	(26.4)				
Market Beta	0.99	✖	7.8%	=	7.7%
t-statistic	(61.5)				
R^2	0.93		Annual Excess Return	=	13.5%



It's important that investors are able to distinguish whether a manager is actually providing alpha above and beyond their factor exposures. But doing so requires using the correct model.

Portfolio risk contribution

Betas from regression analysis can be used in portfolio risk contribution.

- The market factor dominates the risk profile of the portfolio :

$$\left(\sqrt{\text{market beta}^2 \times \text{market volatility}^2} = \sqrt{0.96^2 \times 15.6\%^2}\right) = 14.98\%$$

- Given that overall portfolio risk is 17.8%, we can estimate the proportion of variance driven by market exposure :

$$\left\{\frac{\text{Market variance contribution}}{\text{Portfolio variance}}\right\} = \left\{\frac{14.9\%^2}{17.8\%^2}\right\} = 0.70.$$

- 70% of portfolio variance can be attributed to the market risk factor which is the value of R2

Factor differences : academic vs practitioneers

- Implementability : academic factors do not account transaction and frictions costs
- Investment universe : academics use the CSRP universe (5k stocks) vs the Russell 3000
- Factor weighting : for HML, the factors are formed by giving equal capital weight to each universe (cheap / expensive) – unlike professionals who use a signal weighting
- Industries
- Risk targeting : portfolio risk remain stable for professionals
- Multiple measures of styles : instead of one factor (B/P), professionnals use up to 5 measures (earnings, cash flows, sales with a price normalization)

Introduction to Style Factors

Size

Value

Profitability

Quality

Conservative minus Aggressive (CMA) or Investment factor

Momentum

Low Volatility

Style Factors Implementation

Building Multi-factor Portfolios

The agnostic view: Application to an equity portfolio harvesting several equity risk premia

Implementing convictions: Style selection depending of macro & market views

Acronym list of Equity Style Factors

5-Factor model (Fama & French 2015)

- **SML** or SMB: Small Minus Large / Big or **Size** factor
- **HML**: High (book-to-mkt) Minus Low, or **Value** vs Growth
- **RMW** : Robust Minus Weak or **Profitability** factor
- **CMA**: Conservative Minus Agressive or **Investment** factor

Other recognized academic factors

- **QMJ: Quality** Minus Junk
- **BAB**: **Beta** Against Beta
- **VOL**: Low minus High **Vol**
- **UMD: Momentum** (Up Minus Down)
- iMOM: Idiosyncratic Momentum

Methodology to consider and validate Style Premia consistancy

Risk Premia: Factors Which Earn Persistent Premium Over Long Periods. A factor needs to be:

- Persistent over time
- Pervasive (multizones and multiasset if applicable)
- Robust — It holds for various definitions (for example, there is a value premium whether it is measured by price-to-book, earnings, cash flow, or sales).
- Investable (no liquidity or historical issues)
- Intuitive: risk based + behavioral explanations
  - “systematic”risk : factors earn excess returns because there is “systematic risk” attached to them.
  - Systematic errors: Investors exhibit behavioral biases due to cognitive or emotional weaknesses. Examples include chasing winners, over-reacting, overconfidence, preferring “familiar” investments (“home bias”), and myopic loss aversion
- Understanding specificities and anomalies

Size

SML or SMB: Small Minus Large / Big or **Size** factor

Fama & French, The three-factors model, 1993

Size

- Principle: Return of small cap stocks minus Large cap stocks

  (6-10 deciles of CRSP index – 1-5 deciles of the CRSP index)

  from 1927 to 2015, Size premium = +3,3%

  However, volatility of small = 30% vs 20% for Large

- Persistance

	1-YEAR	3-YEAR	5-YEAR	10-YEAR	20-YEAR
SIZE	59	66	70	77	86

* Investable: same analysis with investable funds confirms such overperformance

Why does size generate a Premia ?

- Greater leverage
- Smaller capital base (lower ability to deal with economic adversity)
- Greater vulnerability in variations of credit conditions
- Higher volatility of earnings
- Lower levels of profitability
- Greater uncertainty of cash flow
- Less depth of management
- Lower liquidity of stocks (more expensive to trade)
- Less proven track record for the business model and management capabilities
- Much higher volatility
- Poor performance in bad times
  - Economic risk (bankruptcy risk) + Liquidity risk
  - Compensated by a faster growth in good economic times (1)

(1) Kim and Burnie « The Firm size effect and the economic cycle » 2002

The small-cap growth anomaly

CRSP 1927-2015	Small-Cap stocks	Large-cap stocks	Small-cap growth stocks
Performance over the period	11,8%	9,8%	8,7%

Behavioral explanation:

- Preference for « lottery tickets » (1): preference for stocks that exhibit positive skewness on the right. Investors find this small possibility attractive. Therefore, positively skewed securities tend to be overpriced delivering a negative premia

- After controlling for quality, a significant size premium emerges (2)

  Premium stable through time, not concentrated in microcaps, less liquidity risk

  monotonic relationship between size deciles and excess return

Small-cap stocks have low exposure to profitability factor and to the investment factor

(1) Barberis and Ming: « Stocks as Lotteries: The implications of Probability weighting for security prices » 2008

(2) Asness, Frazzini, Israel, Moskowitz, Pedersen : « Size matters, if you control for junk »

Value

HML: High (book-to-mkt) Minus Low, or **Value** vs Growth

Fama & French, The three-factors model, 1993

Three ways of defining Value :

* Price reversion
* Investor Preferences (flows)
* Fundamental Rationale

Value

- From 1927 to 2015, the average Value premium has been +4,8% for US and +4,9% for Europe (1982-2014)

- Emerging mkts (1989-2015): 13% vs 9,3%

Odds of outperformance	1 y	3 y	5 y	10 y	20 y
Value	63%	72%	78%	86%	94%

(1) Asness, Moskowitz, Pedersen : « Value and Momentum everywhere » - 2013

Is value premium risk-based or behavioral-based?

Risk-based explanation:

- **Distress risk factor** (Chen, Zhang « Risk and Return of Value Stocks » - 1998
- Intuitive measures of distress present in Value stocks : cutting dividends by at least 25%, high ratio of debt to equity and a high standard deviation of earnings. Those criteria have a high correlation with Book-to-market levels.
- Value stocks are cheap because they tend to be firms in distress, providing higher returns. They have poorer earnings and profitability than growth stocks
- They are low duration vs high duration for growth stocks

- Strong relation between **BtM and leverage**. Academics found a relation with macro economic data like Industrial production, money supply, interest rates or inflation (Black, Mao, McMillan « the value premium and economic activity: Long run evidence from United-States »

- Zhang « The Value Premium » - 2005 explains the value premium by its **asymetric risk**. Very risky in bad times compared to growth stocks and marginally less risky than growth stocks in good times.
  - Investment is irreversible: Value stocks carry more non productive capicity. Very difficult to adjust especially in bad times with a direct impact on earnings and dividends.
  - In good times, this weakness becomes an advantage : growth stocks find it harder to increase capacity

Is value premium risk-based or behavioral-based?

Behavioral explanations:

- **Mispricing:** Investors are too optimistic with growth stocks and too pessimistic with value stocks. Confusion effect between familiarity and safety.
- Preference for growth stocks: very popular / glamour- vs value –neither popular nor glamour.
- See Piotroski, So « Identifying expectation errors in value/glamour strategies: a fundamental analysis approach » 2011

  Value strategies are successful if prices don't reflect the future cash flow implications of historical information

  Fscore (9 financial signals 0 or 1). Fscore is positively correlated with future earnings growth and future profitability levels.

- **Anchoring**: glamour stocks investors anchor on the high P/E value of growth shares, while ignoring the high likelihood that this P/E ratio will change in the future.

- **Loss aversion**: A loss that comes after prior gains is less painful than usual, because it is cushioned by those earlier gains. Risk aversion decreases because the investor is now playing with the house's money. But a loss that comes after other losses is more painful than usual: After being burned by the first loss, people become more sensitive to additional setbacks.

- Preference for "**lottery ticket**" investments that provide the small chance of a huge payoff.

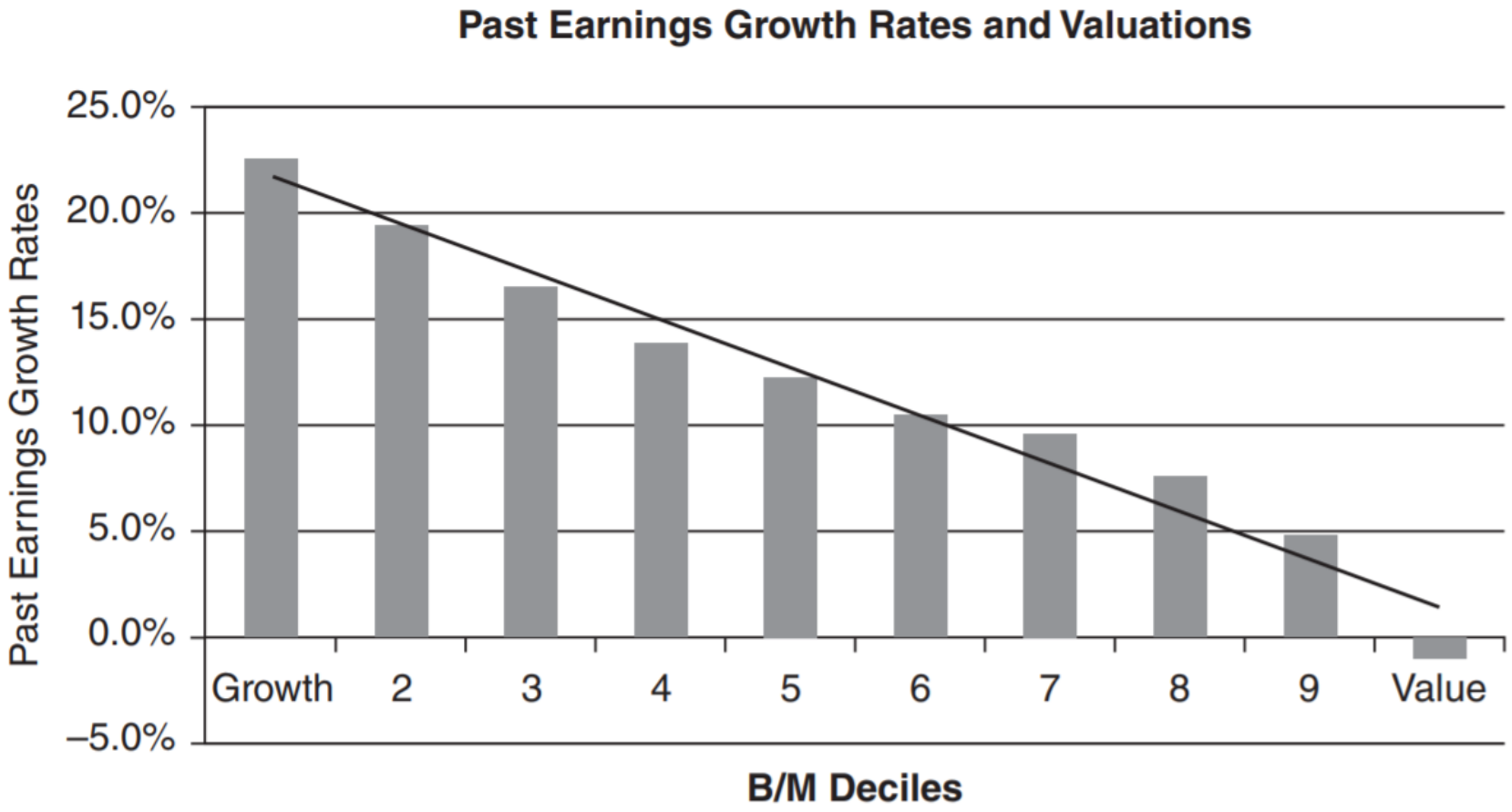
ROBUST TO VARIOUS DEFINITIONS

- In United States for the period from 1952 through 2015, the annualized value premium as measured by :
  - 4.1% (t-stat3 = 2.4) for B/M
  - 4.7% (t-stat = 2.9) for cash flow-to-price ratio, and
  - 6.3% (t-stat = 3.4) for the earnings-to-price ratio.

  - Robustness of the value premium is confirmed in the research report “Value vs. Glamour: A Long-Term Worldwide Perspective” by The Brandes Institute, which covered developed markets for the period from January 1980 through June 2014, found a similar value premium no matter the metric used. (respectively 6.1%, 8% and 7.3%)

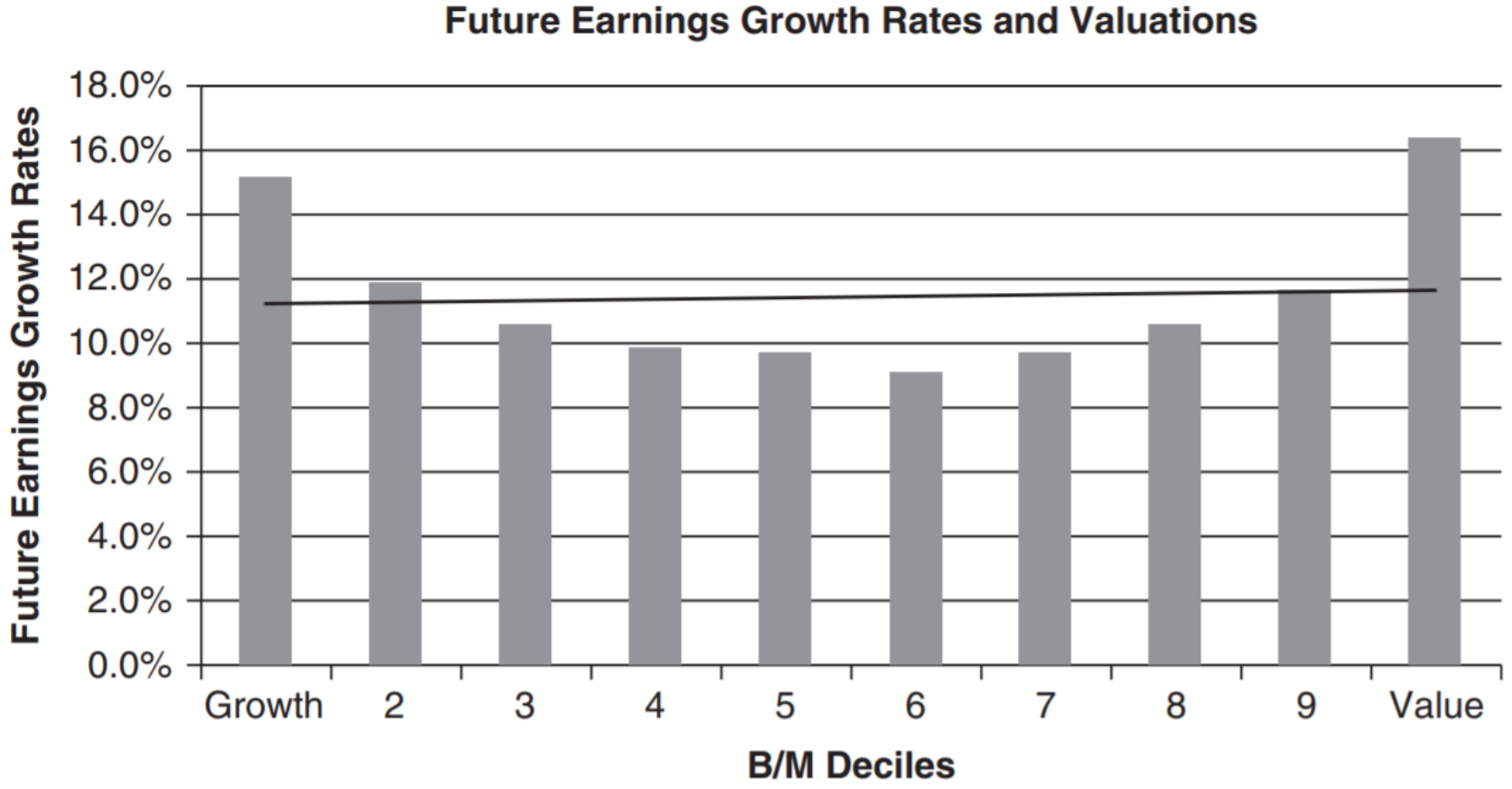
  - The bottom line is that the value factor clearly meets all of the robustness criteria

B/M deciles and earnings growth over the preceding five years.



➔ B/M is a good proxy for past growth

Previous B/M deciles and earnings growth over the next five years



Value stocks outperform earnings growth expectations and growth stocks underperform their expectations, systematically

Value investing these recent years…
and the problem of the zombie companies

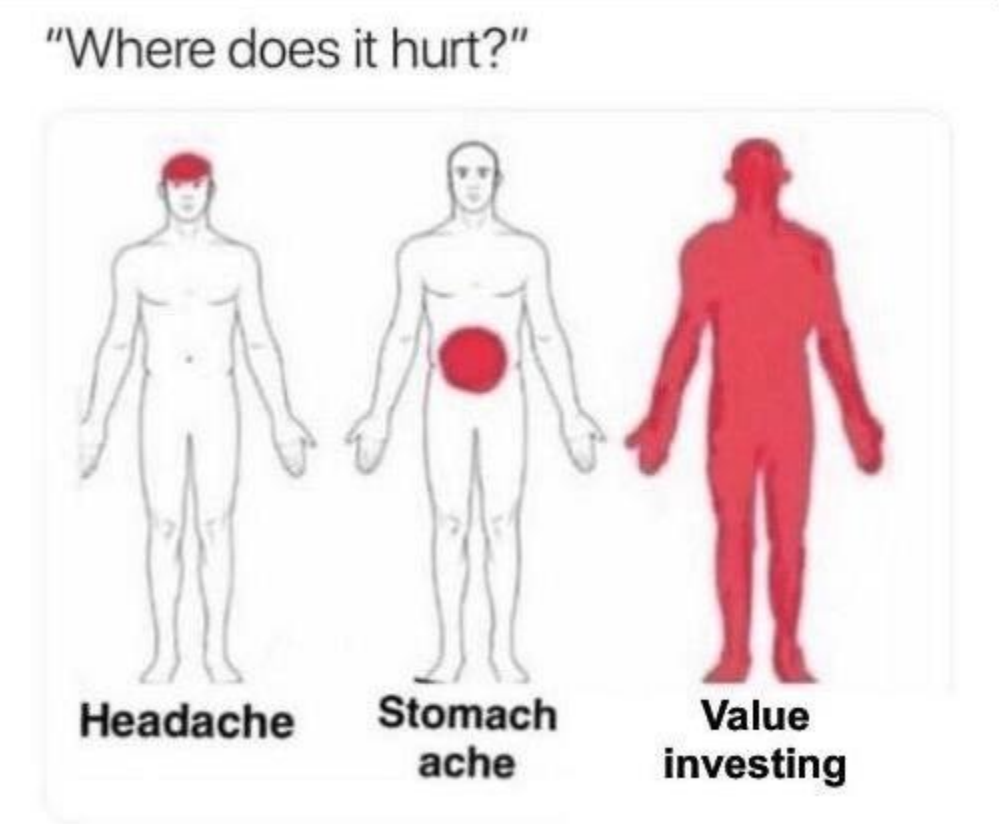
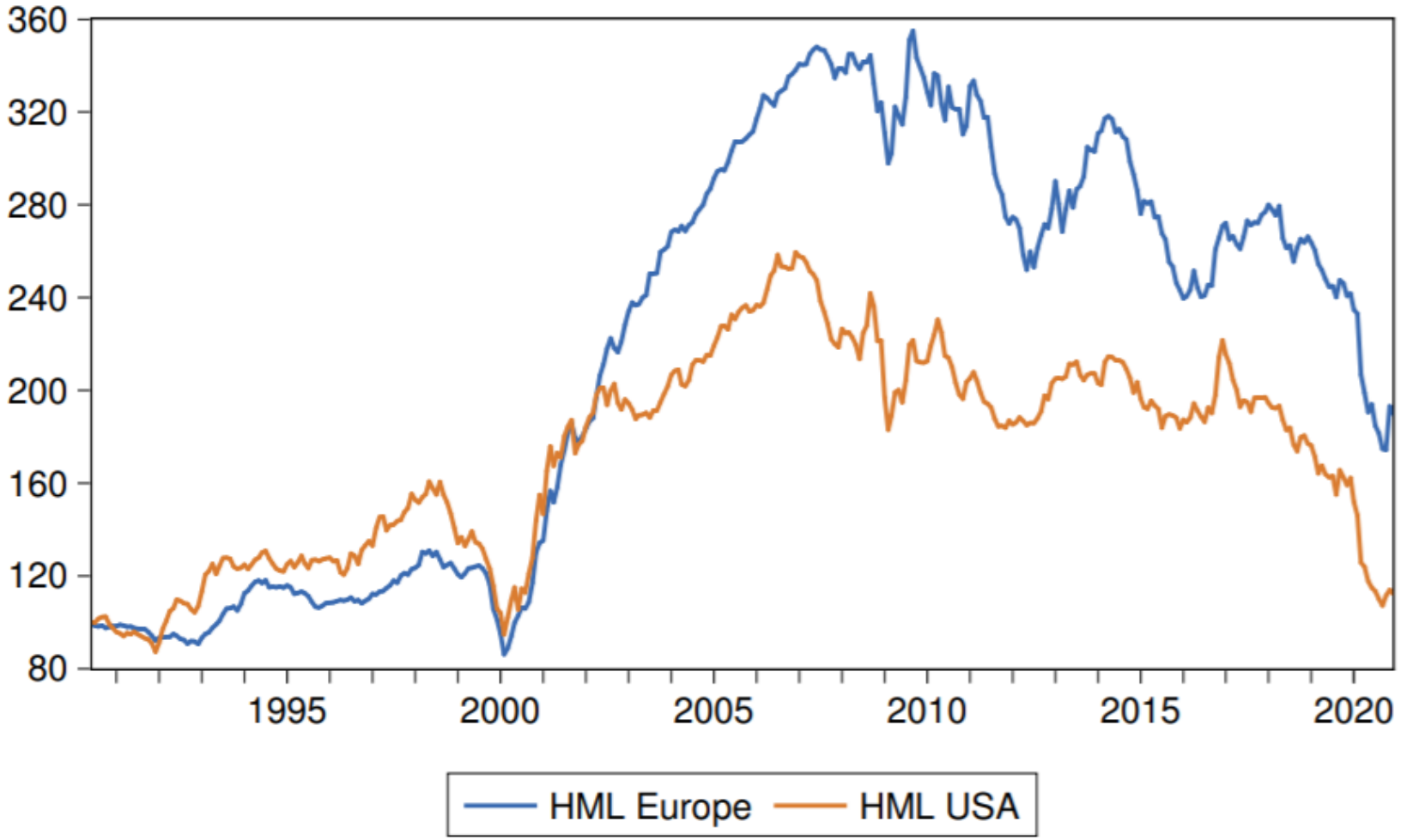


Figure 1: Cumulative performance of the HML factor (long value, short growth)



Quality

QMJ, or Quality Minus Junk

Quality to Gross Profitability (Novy-Marx 2013);
Return on Invested Capital (Greenblatt 2010);
combination of various profitability, earnings quality and leverage metrics (Grantham 2004)

Value & Quality:
Opposition or complementarity?

- Benjamin Graham, an early pioneer of value investing, believed that **quality and value** went hand in hand (Graham 1973).

- Graham's strategy is to identify undervalued and underappreciated stocks that meet certain criteria for quality.

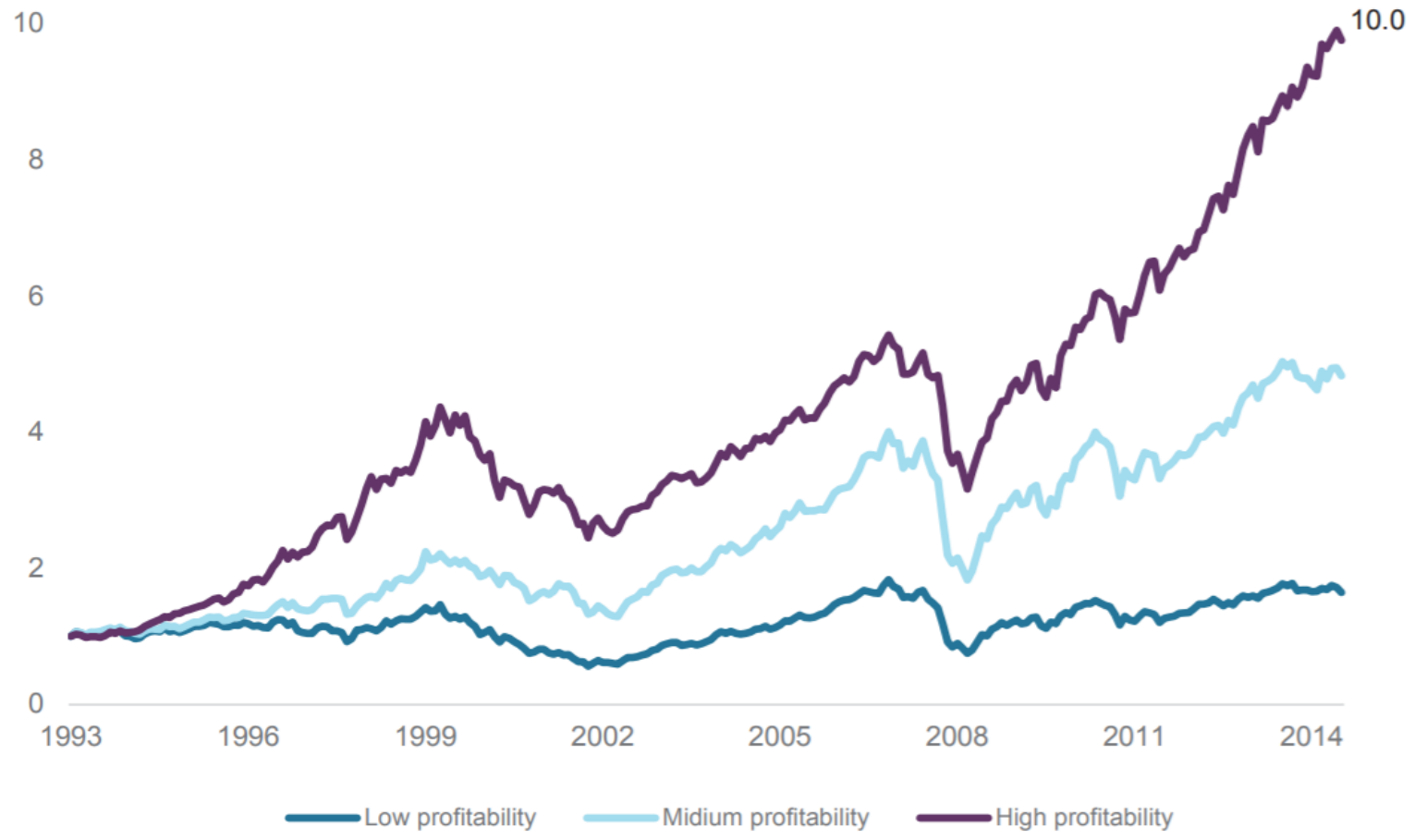
- Graham considered metrics such as **debt ratios, earnings stability, past earnings and dividend growth** to be as important as value metrics such as **price-to earnings** and **price-to-book** ratios for selecting stocks.

- Identifying mispriced high-quality assets is still central to fundamental stock analysis and underlies much of the asset management industry

Metrics

- The most commonly used quality metrics fall into three categories:
    - (1) **profitability** measured by gross profits over assets, operating profit, **ROA, ROE or ROIC**;
    - (2) **safety** measured by a variety of solvency metrics such as **debt/assets**; and
    - (3) **earnings quality** measured by differences between cash and accounting items (**accruals**). A quality company is one that is profitable and safe and makes most of its earnings in cash.
- The outperformance of high-quality stocks over low-quality stocks is well-documented in financial research. The empirical evidence for the **existence of a profitability premium is especially strong**.
- Quality performs well during market downturns and may offer some downside protection in bear markets.

Performances



Source: FTSE; FactSet; NBIM calculations

Main definitions for Quality : **low leverage and stable earnings**.

Author/Practioner	Quality defnition
Novy-Marx (2013)	Gross profits / assets
Fama and French (2014)	Operating income before depreciation and amortisation minus interest expense scaled by assets
Greenblatt (2010)	Return on invested capital (ROIC)
Sloan (1996)	Difference between cash and accounting earnings scaled by assets (earnings quality)
Piotroski (2000)	(1) Return on assets, (2) Operating income, (3) Cash flow, (4) Quality of earnings, (5) Net income, (6) Leverage, (7) Liquidity equity issuance, (8) Gross margins, (9) Asset turnover
Asness, Frazzini and Pedersen (2014)	Z-scores based on: • profitability: gross profits over assets, return on equity, return on assets, cash flow over assets, gross margin, low accruals • growth: 5-year prior growth of profitability • safety: low beta, low idiosyncratic volatility, low leverage, low bankruptcy risk, low ROE volatility • payout: equity and debt issuance and total net payout over profits
GMO white paper (2004)	• ROE • Leverage • Profit volatility
Graham (1973)	Adequate size of enterprise, sufficiently strong financial position, earnings stability, dividend record, earnings growth, moderate P/E and P/B ratios
FTSE Quality indices	• Return on assets • Accruals • Operating cash flow to debt"

Profitability

= Gross Profits / Assets

with Gross profits = sales - cost of goods sold

- Robert Novy-Marx 2013 :

  “The Other Side of Value: The Gross Profitability Premium”

  - new insights into the cross-section of stock returns
  - explained some of Warren Buffett’s superior performance.

High-quality firms are often described as profitable firms.

- Profitability refers to a company's ability to generate earnings as compared to its expenses.
- Accounting ratios such as:
  - **gross profits over assets and operating profits over assets**, which indicate how well a company is managing its expenses,
  - **operating cash flows over assets**
  - various net profit-based measures such as **Return on Equity (ROE), Return on Assets (ROA**). These ratios indicate how well the company is deploying its capital to generate returns.
  - **return on invested capital (ROIC)** or return on capital employed (ROCE).
  - Novy-Marx (2013) argues that gross profit is the cleanest accounting measure of true economic profitability because this measure is relatively unaffected by accounting estimates for accruals and non-cash expenses such as depreciation and amortisation.

Profitability

- **Profitable firms generated significantly higher returns** than unprofitable firms, despite having significantly **higher price-to-book ratios**

- Profitable firms tend to be growth firms, meaning they expand comparatively quickly. Gross profitability is a powerful predictor of future growth as well as of earnings, free cash flow, and payouts.

- The most profitable firms earn **returns 0.31% / month** higher than the least profitable firms.

- Gross profitability is a much better predictor than earnings-based measures of profitability. It means that **high gross margins** are the distinguishing characteristic of “good growth” stocks.

- **Gross profits-to-assets and book-to-market ratios are highly persistent** reducing the turnover

Accruals accounting

- There are two accounting method:

  Accrual accounting measures the performance and position of a company by recognizing economic events regardless of when cash transactions occur.

  Cash Accounting applies the matching principle. This method allows the current cash inflows or outflows to be combined with future expected cash inflows or outflows to give a more accurate picture of a company's current financial position

- **The cash-flow component of earnings is a superior and better forecaster of future earnings**, if we would compare it with the accrual component of earnings.

  Therefore, investors who are not able to distinct between true earnings and accruals can become overly optimistic about the future prospects of firms with high accruals.

  Moreover, they can become even overly pessimistic about the future prospect of firms with low accruals.

- **Profitability includes accruals** which, when added to cash flows, provide a better measure of current-period performance.

Accruals anomaly

- There is a **strong negative relationship between accruals and the cross-section of expected returns**. This relationship is known as the "accrual anomaly."

The basic idea behind this "**accruals anomaly**" is that stocks with high and increasing **accruals** tend to have low earnings quality while stocks with low and decreasing **accruals** tend to have high earnings quality.

- Sloan (1996) shows that portfolios of US firms with low accruals earn positive abnormal returns in the following year. A portfolio that is long the 10 percent of firms with the "cleanest" earnings (low accruals) and short the 10 percent of firms with the largest accruals, earns an average return of **10% per year**.

- Ball, Gerakos, Linnainmaa, and Nikolaev, 2016 "Accruals, Cash Flows, and Operating Profitability in the Cross Section of Stock Returns," covers the period from July 1963 through December 2013.

They observed that profitability includes accruals which, when added to cash flows, provide a better measure of current-period performance.

Firms with high accruals today earn lower future returns because they are less profitable on a cash basis."

The risk-based Premium explanation

- Quality strategies are found to have a **positive skewness and a very small propensity to crash**.

  Indeed, Profitable firms are less prone to distress and have lower operating leverage than unprofitable firms. These characteristics suggest that **they are less risky**.

  Liu, 2015 “Profitability Premium: Risk or Mispricing?” found that the worst one-year drawdown for the least profitable firms was -74%, nearly 30% worse than that of the most profitable firms…

- On the other hand, more profitable firms tend to be growth firms, which have more of their cash flow in the distant future. **More distant cash flows are more uncertain and should require a risk premium**.

- Another risk-based explanation is that higher profitability should attract **more competition, threatening profit margins** (and thus making future cash flows less certain). And that, too, creates more risk and should require a risk premium.

The behavioral explanation: the mispricing hypothesis

- Liu worked on the **difference between earnings forecasted by sell-side analysts and actual earnings realized across profitability-sorted portfolios**. He found a **monotonically decreasing relationship** across the 10 deciles of profitability from low to high. The expectation error was not only larger for unprofitable firms, but it was persistent for up to five years

- Another study confirms that analysts as a whole are overly optimistic. However, the greater the profitability of a firm, the less optimistic analysts become. They found that **analysts are clearly under-weighting operating cash-flows**; in fact they even seem to be putting a slightly negative weight on that variable, even though it is a strong positive predictor of future returns. These last results strongly suggest that **the quality anomaly is likely due to a significant underweighting of quality in price forecasts**.

- Conclusion: i**nvestors expect the performance of profitable firms to mean-revert faster than they actually do**, and they are willing to bet on the revival of the unprofitable firms despite low net income and poor current performance.

Quality companies are often described as **safe and stable**

- Excessive leverage may jeopardise a company's ability to service its debt and ultimately lead to financial distress.

- Safety is typically associated with a strong balance sheet
  - low leverage (e.g. low debt-to-assets ratio),
  - high current ratios (current assets to current liabilities),
  - high interest coverage ratios
  - high credit ratings from debt rating agencies.

  - In addition to the level, the change in these ratios can also be used as safety indicators (Asness et al. 2014).
  - Some researchers also use return-based measures of safety such as stock volatility and market beta (Asness et al. 2014).

Quality of earnings:

- Quality of earnings can refer to both **earnings persistence (stability) and "accounting" quality.**

- Earnings stability can be measured by
  - the volatility of earnings per share (EPS) or EPS growth
  - the volatility of various profitability metrics such as ROE, ROA and ROIC.
  - A stable and persistent stream of earnings can indicate that a company has a competitive advantage, above-average management and a dominant market position.
  - Earnings stability can vary by industry and company age: Younger companies will typically have higher earnings volatility than older and more-established ones.
  - A high-quality company is also one that derives **most of its earnings from cash transactions rather than from accruals**, as the latter are less likely to persist, and the company is more likely to suffer subsequent earnings disappointments (Sloan 1996).

Corporate governance can also be an additional Quality indicator (level of shareholders rights…)

Quality Premium anomaly

- Return premiums for low leverage and low distress are significant in **raw returns** and even stronger in **risk-adjusted returns**.

- Penman, Richardson and Tuna (2007) decompose the book-to-market ratio into asset and leverage components and show that **the leverage component is negatively related to stock returns**.

- Haugen and Baker (1996) find no statistically **significant relationship between past volatility of earnings and returns**

Main Quality metrics

(1) Profitability

$$GP\ to\ Assets = \frac{Sales - COGS}{Total\ assets}$$

$$CF\ to\ Assets = \frac{Cash\ flows\ from\ operations}{Total\ assets}$$

(2) Safety

$$Leverage = \frac{Total\ debt}{Total\ assets}$$

$$\Delta\ Net\ debt = \frac{\Delta\ Total\ debt - \Delta Cash}{Total\ assets}$$

(3) Earnings stability/quality

$$EPS\ stability = StdDev(EPS)\ over\ 5\ years$$

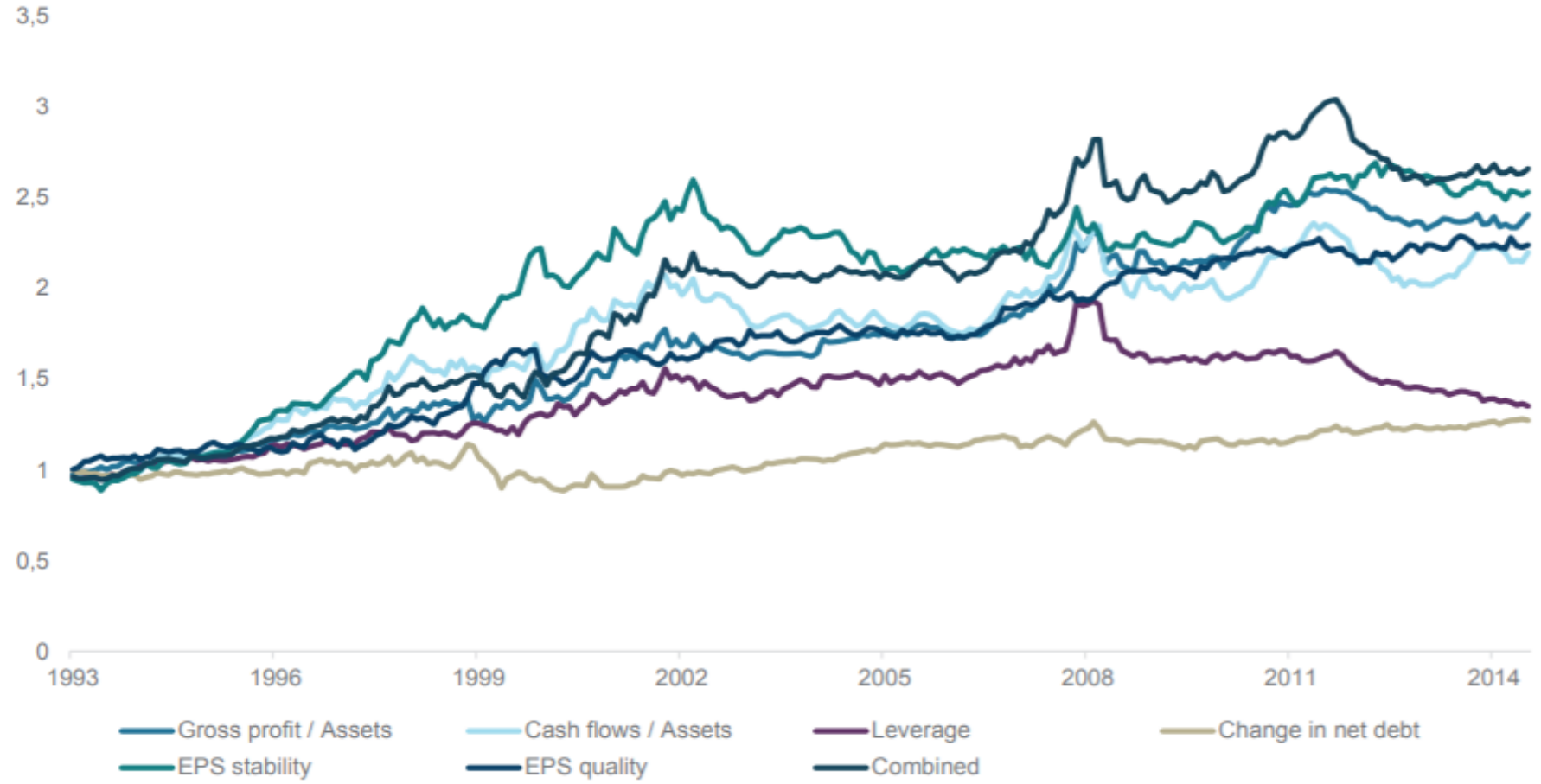
$$EPS\ accruals = \frac{(Cash\ flow\ from\ operations - Net\ profit)}{Abs\ (Net\ profit)}$$

	Gross profit / Assets	Cash flows / Assets	Lever-age	Change in net debt	EPS stabil-ity	EPS quality	Com-bined
Global, unadjusted							
Average	8.37	7.02	2.06	2.87	7.16	5.32	8.94
Std dev	9.26	9.46	10.29	7.65	12.59	8.22	9.37
Sharpe	0.90	0.74	0.20	0.37	0.57	0.65	0.95
Min monthly	-7.79	-10.80	-15.68	-10.49	-10.63	-9.37	-8.77
Max monthly	8.84	9.30	11.06	10.53	10.98	11.24	8.64
Correlations							
Gross profit / Assets	1.00						
Cash flows / Assets	0.59	1.00					
Leverage	0.35	0.07	1.00				
Change in net debt	0.25	0.08	0.65	1.00			
EPS stability	0.31	0.36	0.29	-0.01	1.00		
EPS quality	0.19	0.17	0.53	0.43	0.16	1.00	
Combined	0.71	0.63	0.65	0.47	0.57	0.41	1.00
Region and sector neutral							
Average	4.29	3.93	1.60	1.30	4.56	3.89	4.77
Std dev	6.50	7.44	6.36	6.00	7.06	5.43	6.72
Sharpe	0.66	0.53	0.25	0.22	0.65	0.72	0.71
Min monthly	-7.82	-10.46	-9.69	-7.90	-6.90	-7.92	-9.00
Max monthly	8.48	6.67	9.55	7.06	7.93	5.78	7.51
Correlations							
Gross profit / Assets	1.00						
Cash flows / Assets	0.57	1.00					
Leverage	0.54	0.35	1.00				
Change in net debt	0.26	0.26	0.27	1.00			
EPS stability	0.39	0.50	0.31	0.03	1.00		
EPS quality	0.02	0.22	-0.04	0.29	-0.09	1.00	
Combined	0.68	0.75	0.60	0.41	0.53	0.17	1.00

Source: FTSE; FactSet; NBIM calculations

Quality metrics performances

Chart 3: Performance of quality portfolios (region and sector neutral)



Source: FTSE; FactSet; NBIM calculations

Persistence of Quality

Table 8: Transition probabilities, gross profitability

		One year later				
		Most profitable	2	3	4	Least profitable
Now	Most profitable	80 %	17 %	3 %	1 %	0 %
	2	16 %	64 %	17 %	2 %	1 %
	3	3 %	17 %	64 %	16 %	1 %
	4	1 %	3 %	15 %	71 %	11 %
	Least profitable	0 %	0 %		11 %	87 %

		Three years later				
		Most profitable	2	3	4	Least profitable
Now	Most profitable	68 %	22 %	6 %	2 %	1 %
	2	20 %	51 %	22 %	5 %	1 %
	3	6 %	21 %	49 %	21 %	2 %
	4	2 %	5 %	20 %	57 %	16 %
	Least profitable	1 %	1 %	3 %	16 %	79 %

Source: FTSE; FactSet; NBIM calculations

Quality Premium explanations

- Statistical explanations and measurement errors
  - Accruals mispricings
- Risk-based explanations
  - Cf Profitability explanations
- Behavioural explanations
  - Investors may have irrational preferences for volatile and skewed investments due to **lottery preferences** or overconfidence. Kumar (2009) argues that various socioeconomic and psychological factors lead to excess investments in lottery-type stocks
  - Leverage-constrained investors who seek maximum returns from beta risk must invest in high-beta stocks directly as opposed to a levered portfolio of low-beta stocks (Frazzini and Pedersen 2013).
  - When accruals are too high, it is less likely that the full value of the accrual will be realised, thereby leading to lower profitability for the firm. Richardson et al. (2005) provide evidence for this hypothesis by linking **accrual reliability to earnings persistence**

Conservative minus Aggressive (CMA) or Investment factor

- Conservative minus Aggressive (CMA) stands for the difference in returns between firms with low and high investment policies.
- Conservative firms are those that have low investment policies whereas aggressive firms show a higher degree of investment.
- The investment factor corresponds to the annual change in gross property, plant, and equipment plus the annual change in inventories all divided by the book value of total assets.

Fama & French 5-factors model: Low Vol and Momentum still missing!

- After the the 3-factor model (1993), F&F decided to create a 5-factor model in 2015, adding two additional quality factors, namely profitability and investment.

- IF Profitability factor is well accepted in terms of robustness, it's less the case of investment factor. But there are two main issues with this F&F 5f-model:

1- The 5-factor model keeps the CAPM relationship between risk and return and EMH, which implies that a higher market beta should result in a higher expected return. This assumption refutes the existence of a low beta or low-volatility premium, despite a wide body of literature showing otherwise.

  - On this specific matter, Fama and French have argued that the low-beta anomaly is fully accounted for in their 5-factor model. But their conclusion seems premature, since they fail to provide direct evidence that a higher market beta exposure is rewarded with higher returns.

2- The 5-factors model remains unable to explain the momentum premium which is a major contradiction to EMH. Yet, because momentum is too pervasive and important to ignore, most studies also look at 4-factor beta, based on the 3-factor model augmented with the momentum factor.

Momentum

UMD: Up Minus Down

Jegadeesh, Titman : « Returns to buying winners and selling losers: implication for stock market efficiency » - 1993

Momentum UMD (Up Minus Down)

- Last 12 months return excluding the most recent month (1 or 2)
- From 1927 to 2015, the average Momentum premium has been +9,6% (larger than the equity premium itself @ +8,3%)
- Cross-sectional momentum: measures relative performance of assets within the same asset class
- Time-series momentum: measures the trend of an asset with respect of its own performance (ie, absolute performance). Buying (selling) assets with rising (losing) values

	1-YEAR	3-YEAR	5-YEAR	10-YEAR	20-YEAR
MOMENTUM	73	86	91	97	100

(1) Jegadeesh, Titman : « Returns to buying winners and selling losers: implication for stock market efficiency » - 1993

The momentum anomaly

- From an EMH perspective, for all intents and purposes, evidence on the performance of relative strength strategies was an impossibility

- Price momentum had nothing to do with fundamentals, so even a halfwit could pursue a successful strategy focused solely on relative price performance. This finding conflicted with the weakest form of EMH.

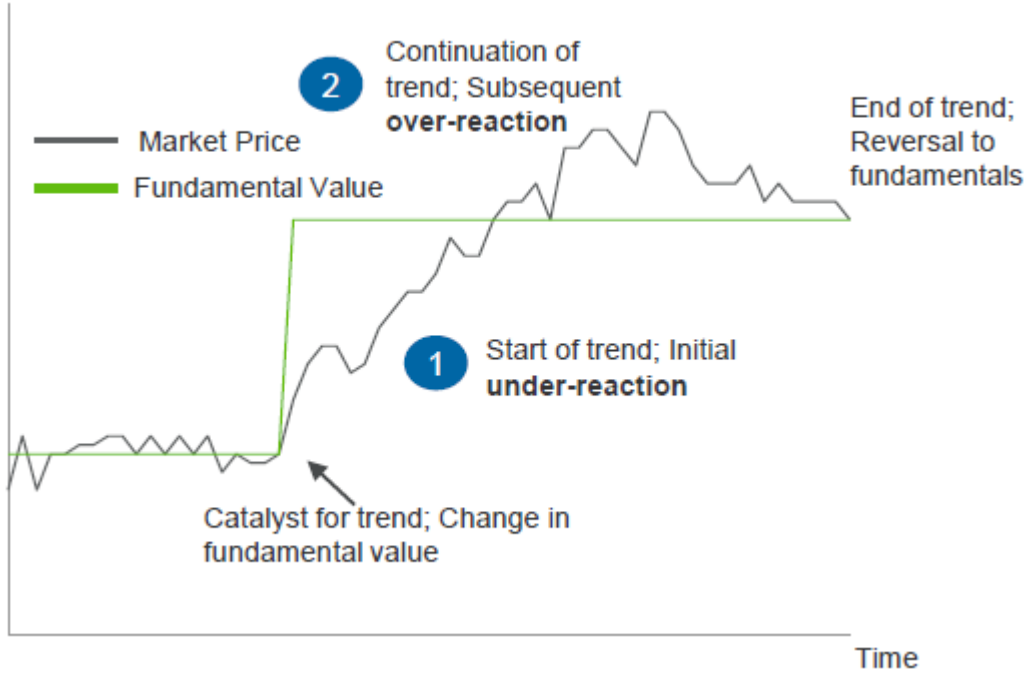
- **Behavioral finance** theorists explain momentum
  - Barberis and al. published a theoretical model on investor sentiment, which described the possibility that behavioral biases drive underreaction and overreaction, which lead to value and momentum effects. **Value is essentially an overreaction to bad news; momentum is an underreaction to good news**.
  - Novy-Marx finds that price momentum is a manifestation of the earnings momentum anomaly. The **momentum anomaly works because investors systematically underreact to earnings surprises**. After controlling for earnings momentum, price-based momentum is no longer "anomalous."
  - According to Novy-Marx's analysis, price momentum doesn't matter—earnings momentum does

Explainations of trend following

Explanations of Trend following:

1. **The under-reaction of the market price to a change in the fundamental value of an asset has been linked to a number of market characteristics and behavioural tendencies:**
   - Information dissemination
   - Anchor-and-insufficient-adjustment
   - Disposition effect

2. **A number of other explanations exist for why a trend may tend to extend to a level of over-reaction:**
   - Crowding / Herding effect
   - Confirmation bias
   - Institutional bureaucracy
   - Risk management



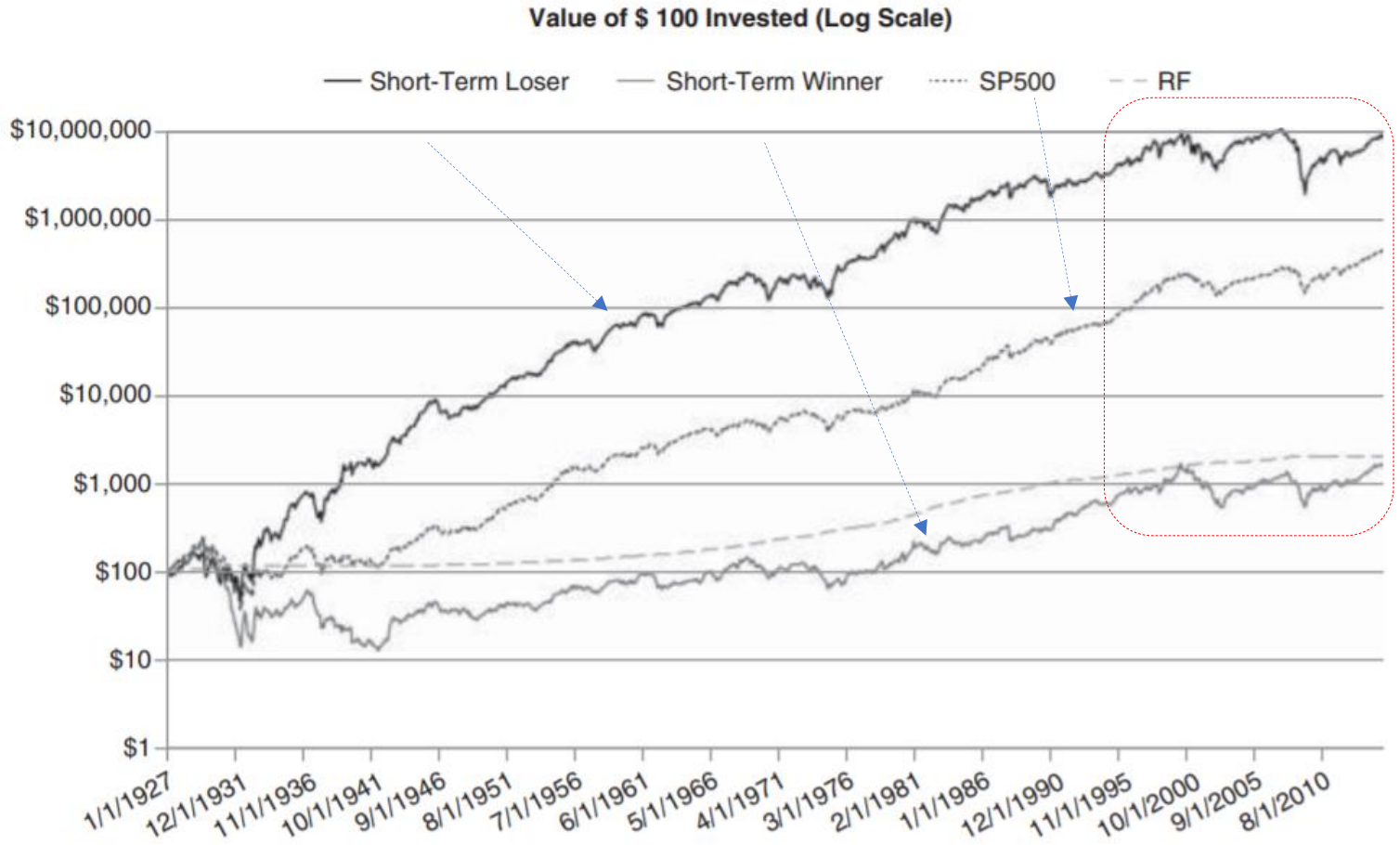
Short term mean reverting effect

- Bruce Lehman investigates how stock returns using a **one-week look-back affect the next week's returns** over his sample period from 1962 to 1986 : "Fads, Martingales, and Market Efficiency," finds that portfolios of securities that had positive returns (winners) in the prior week typically had negative returns in the next week (–0.35% to –0.55% per week on average).
- Jegadeesh, examines the returns of stocks from month to month sample period between 1934 and 1987 : "Evidence of Predictable Behavior of Security Returns," finds a similar reversal in returns: **Last month's winners are next month's losers, and vice versa**. And the effect is large and significant. The prior month's winners have an average future return (next month) return of –1.38 percent, while the prior month's losers have an average future return (next month) of 1.11%. This 2.4% spread in the two portfolios is difficult to reconcile with the EMH theory.

TABLE 5.2 Short-Term Momentum Portfolio Returns (1927–2014)

	Short-Term Loser	Short-Term Winner	SP500	Risk Free
CAGR	13.46%	3.21%	9.95%	3.46%
Standard Deviation	29.60%	24.18%	19.09%	0.88%
Downside Deviation	20.36%	16.83%	14.22%	0.48%
Sharpe Ratio	0.46	0.11	0.41	0.00
Sortino Ratio (MAR = 5%)	0.59	0.06	0.45	−3.34
Worst Drawdown	−81.48%	−94.31%	−84.59%	−0.09%
Worst Month Return	−32.66%	−31.27%	−28.73%	−0.06%
Best Month Return	55.85%	63.65%	41.65%	1.35%
Profitable Months	60.13%	56.06%	61.74%	98.01%

Short Term Momentum

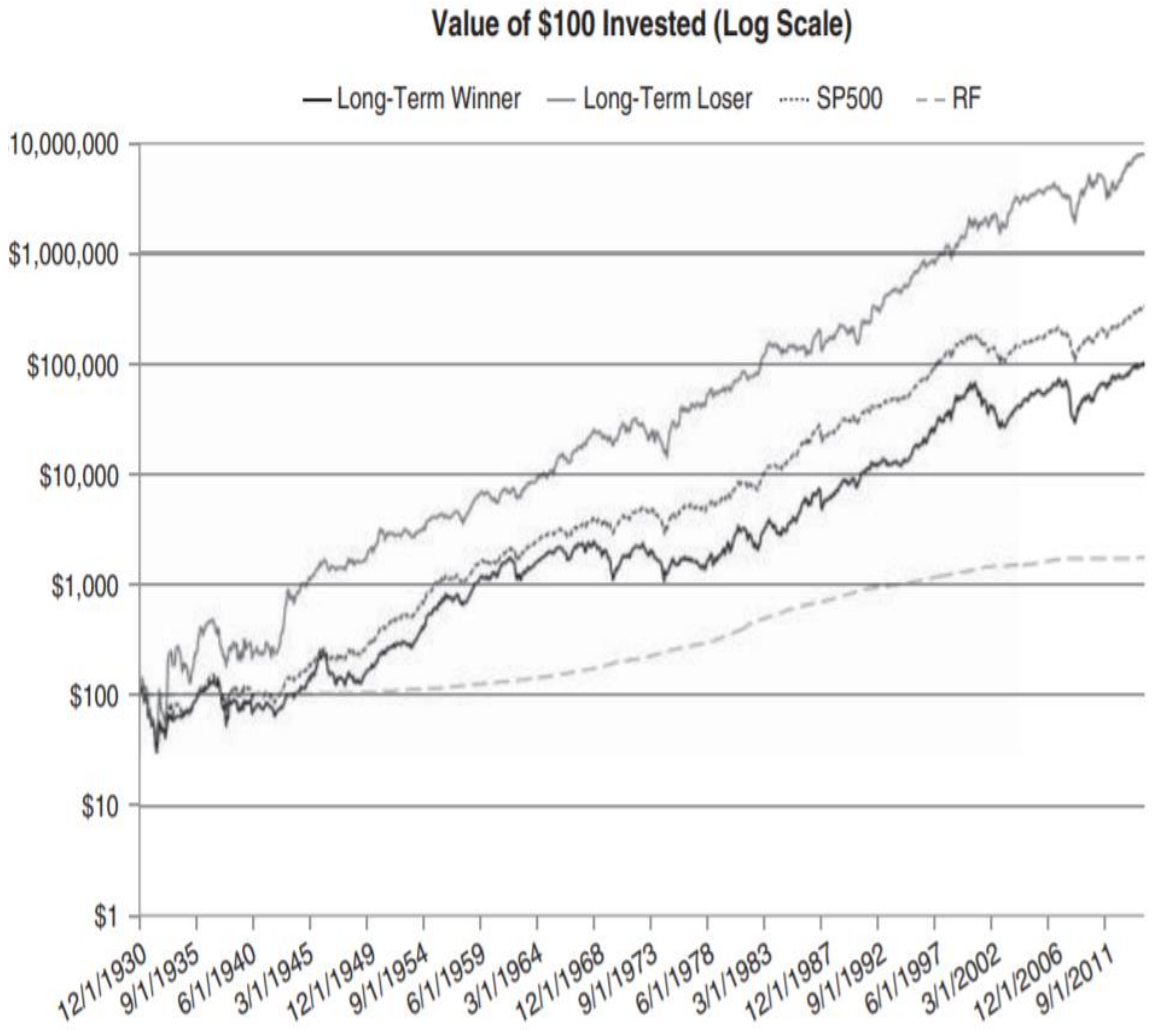


… Be careful with very LT charts: the mean-reverting strategy have been impressive from 1927 till 1980 but is underperforming since then…

Long term (5y) momentum: same mean-reverting effect

TABLE 5.3 Long-Term Momentum Portfolio Returns (1931–2014)

	Long-Term Loser	Long-Term Winner	SP500	Risk Free
CAGR	14.30%	8.59%	10.13%	3.46%
Standard Deviation	30.37%	21.95%	18.92%	0.90%
Downside Deviation	17.98%	16.23%	13.91%	0.47%
Sharpe Ratio	0.47	0.33	0.43	0.00
Sortino Ratio (MAR = 5%)	0.70	0.35	0.46	3.35
Worst Drawdown	−71.24%	−72.80%	−74.48%	−0.09%
Worst Month Return	−40.77%	−34.10%	−28.73%	−0.06%
Best Month Return	91.98%	30.74%	41.65%	1.35%
Profitable Months	58.04%	58.83%	61.71%	97.92%



Jegadeesh and Titman, 1993 “Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency.”

- If a stock has done relatively well in the past, it will continue to do well in the future. There is a continuation in returns when using intermediate-term momentum. The best strategy (in their paper) is **selecting stocks based on past 12 months’ performance and holding the position for 3 months**.
- The intermediate-term momentum effect may occur if the market underreacts to information about the short-term prospects (such as earning announcement) of firms but eventually overreacts to information about the long-term prospects.
- They identify that the holding period, or the rebalance frequency, dramatically affects a momentum portfolio’s performance. As a general rule, **the more frequent a portfolio is rebalanced, the better the performance**

TABLE 5.4 Intermediate-Term Momentum Portfolio Returns (1927–2014)

	Intermediate-Term Winner	Intermediate-Term Loser	SP500	Risk Free
CAGR	16.86%	−1.48%	9.95%	3.46%
Standard Deviation	22.61%	33.92%	19.09%	0.88%
Downside Deviation	16.71%	21.97%	14.22%	0.48%
Sharpe Ratio	0.66	0.02	0.41	0.00
Sortino Ratio (MAR = 5%)	0.79	−0.05	0.45	−3.34
Worst Drawdown	−76.95%	−96.95%	−84.59%	−0.09%
Worst Month Return	−28.52%	−42.26%	−28.73%	−0.06%
Best Month Return	28.88%	93.98%	41.65%	1.35%
Profitable Months	63.16%	51.42%	61.74%	98.01%

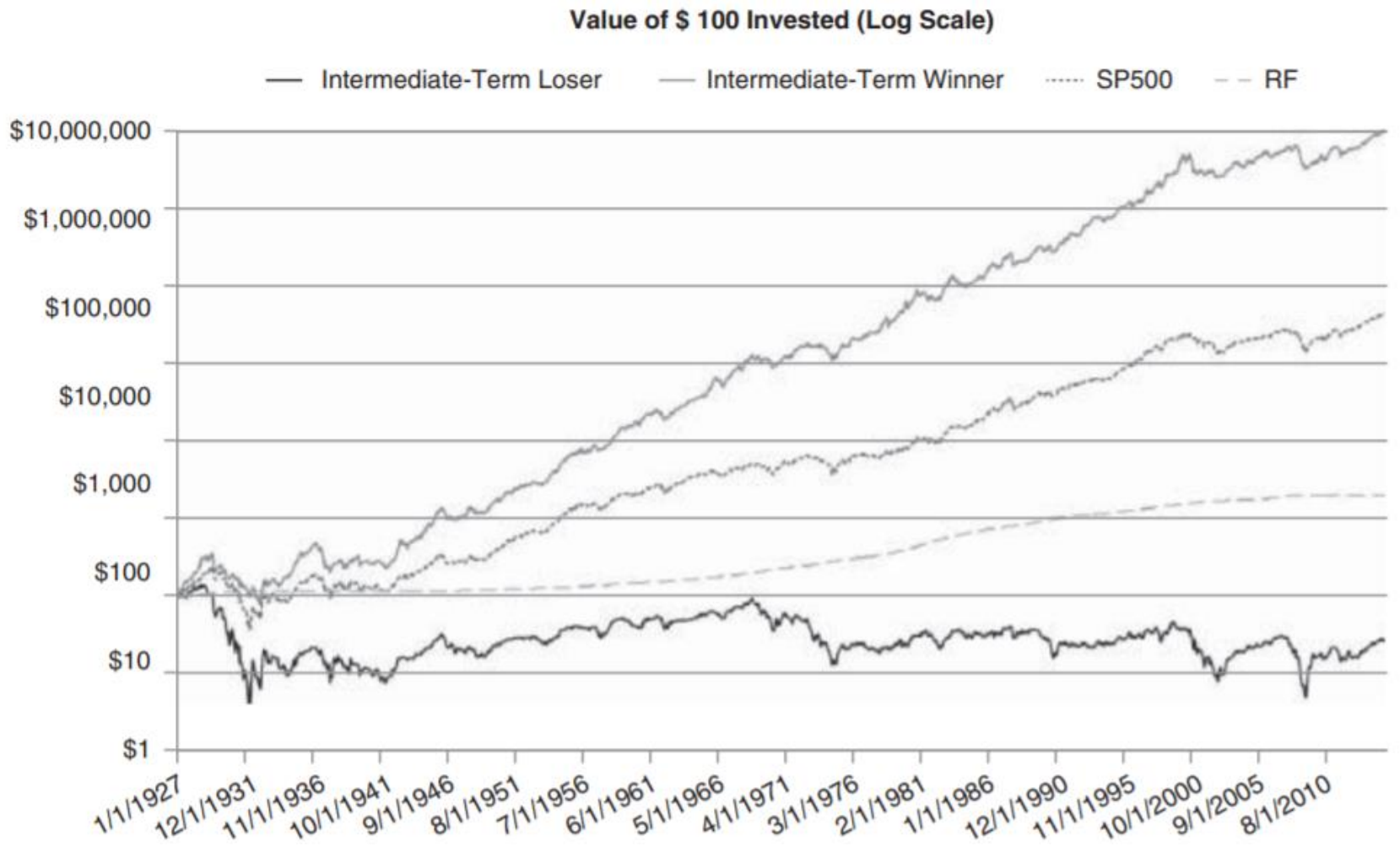
Rebalancing Frequency and Portfolio concentration have a significant impact on final performance

TABLE 5.5 Momentum Portfolio Returns: Varying Holding Period and Number of Firms in the Portfolio (1927–2014)

	50-Stock Portfolio	100-Stock Portfolio	150-Stock Portfolio	200-Stock Portfolio	250-Stock Portfolio	300-Stock Portfolio	Universe (500 Firms)
1-month hold	17.02%	14.40%	13.55%	12.69%	12.07%	11.50%	9.77%
2-month hold	16.05%	14.17%	13.23%	12.59%	11.98%	11.43%	9.77%
3-month hold	15.15%	13.81%	12.93%	12.25%	11.74%	11.23%	9.77%
4-month hold	14.54%	13.53%	12.78%	12.11%	11.63%	11.21%	9.77%
5-month hold	14.37%	13.31%	12.62%	12.04%	11.57%	11.17%	9.77%
6-month hold	13.93%	13.05%	12.37%	11.88%	11.46%	11.10%	9.77%
7-month hold	13.68%	12.80%	12.11%	11.66%	11.33%	10.99%	9.77%
8-month hold	13.38%	12.58%	11.89%	11.48%	11.19%	10.90%	9.77%
9-month hold	12.94%	12.24%	11.60%	11.23%	11.01%	10.77%	9.77%
10-month hold	12.62%	11.93%	11.37%	11.03%	10.85%	10.66%	9.77%
11-month hold	12.21%	11.61%	11.12%	10.81%	10.68%	10.52%	9.77%
12-month hold	11.78%	11.27%	10.83%	10.58%	10.48%	10.36%	9.77%

Holding fewer stocks and rebalancing more frequently leads to higher compound annual growth rates (CAGRs). The ideal portfolio is highly concentrated (e.g., 50 stocks) and rebalanced monthly (e.g., holding period equals one month)

12mths – 1mth momentum applied



Momentum path matters

- “jumpy versus smooth”: compute the percentage of days that have a positive return relative to the percentage of days that have a negative return.

- “smoother” momentum have a higher percentage of positive return days and a lower percentage of negative return days

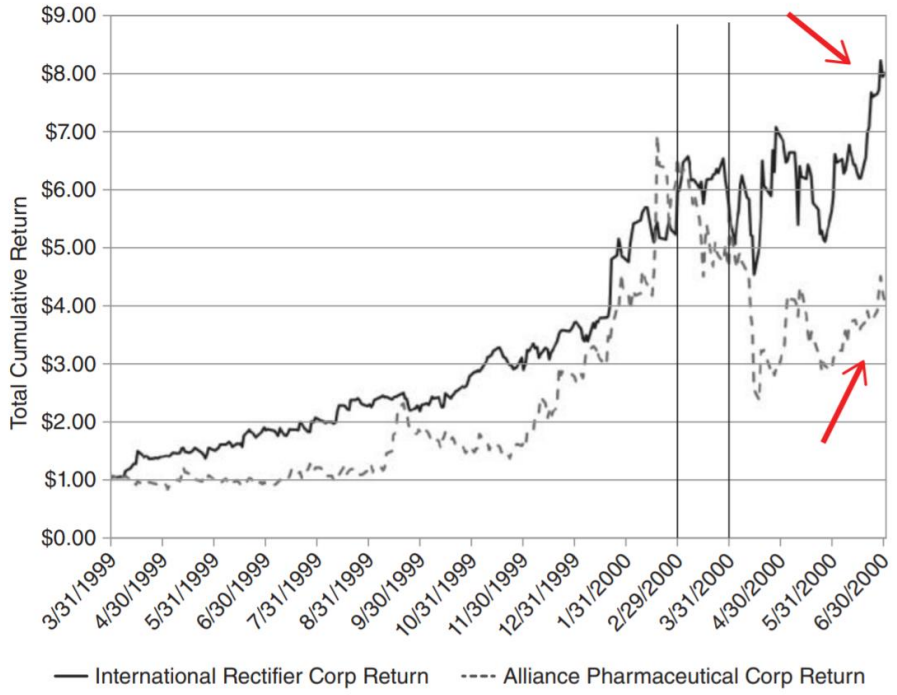
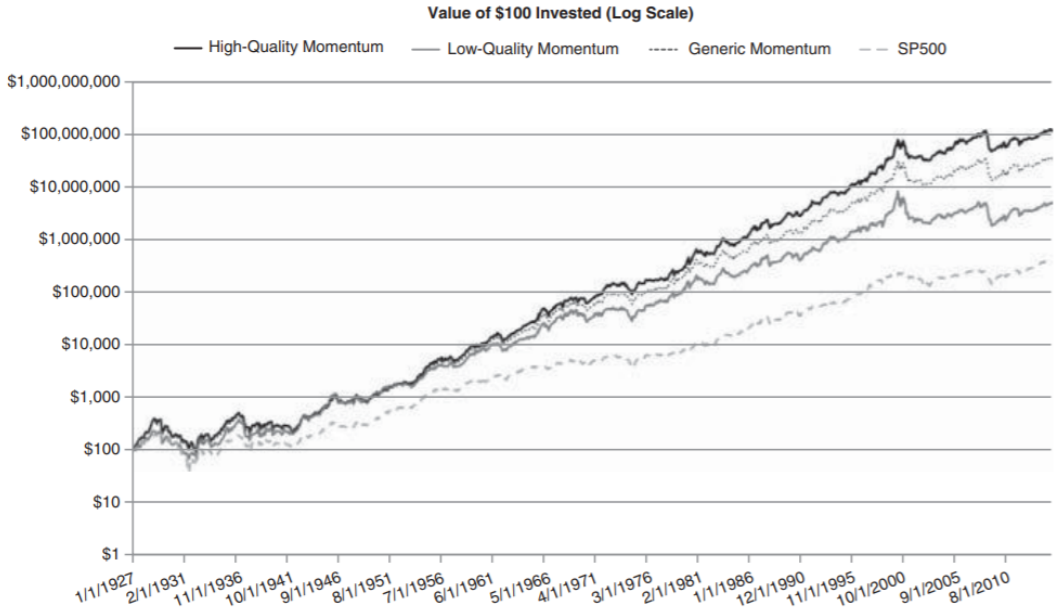


FIGURE 6.2 Alliance and International Rectifier Future Performance

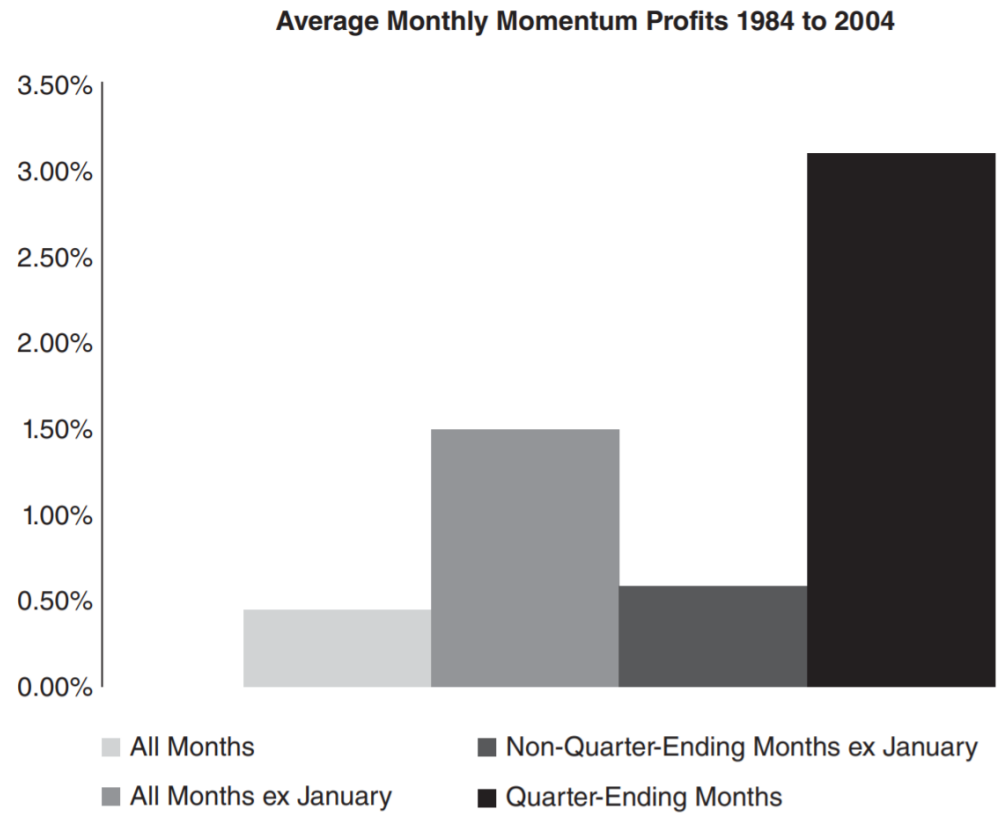
Same kind of results with quality stocks momentum

TABLE 6.4 Quality of Momentum Portfolio Annual Results

	High-Quality Momentum	Low-Quality Momentum	Generic Momentum	SP500
CAGR	17.14%	13.02%	15.56%	9.95%
Standard Deviation	23.45%	25.16%	23.61%	19.09%
Downside Deviation	16.98%	18.71%	17.42%	14.22%
Sharpe Ratio	0.65	0.48	0.59	0.41
Sortino Ratio (MAR = 5%)	0.81	0.56	0.71	0.45
Worst Drawdown	−74.60%	−77.44%	−73.90%	−84.59%
Worst Month Return	−29.23%	−34.71%	−30.00%	−28.73%
Best Month Return	30.63%	37.15%	33.88%	41.65%
Profitable Months	62.50%	61.08%	61.84%	61.74%



Momentum seasonality

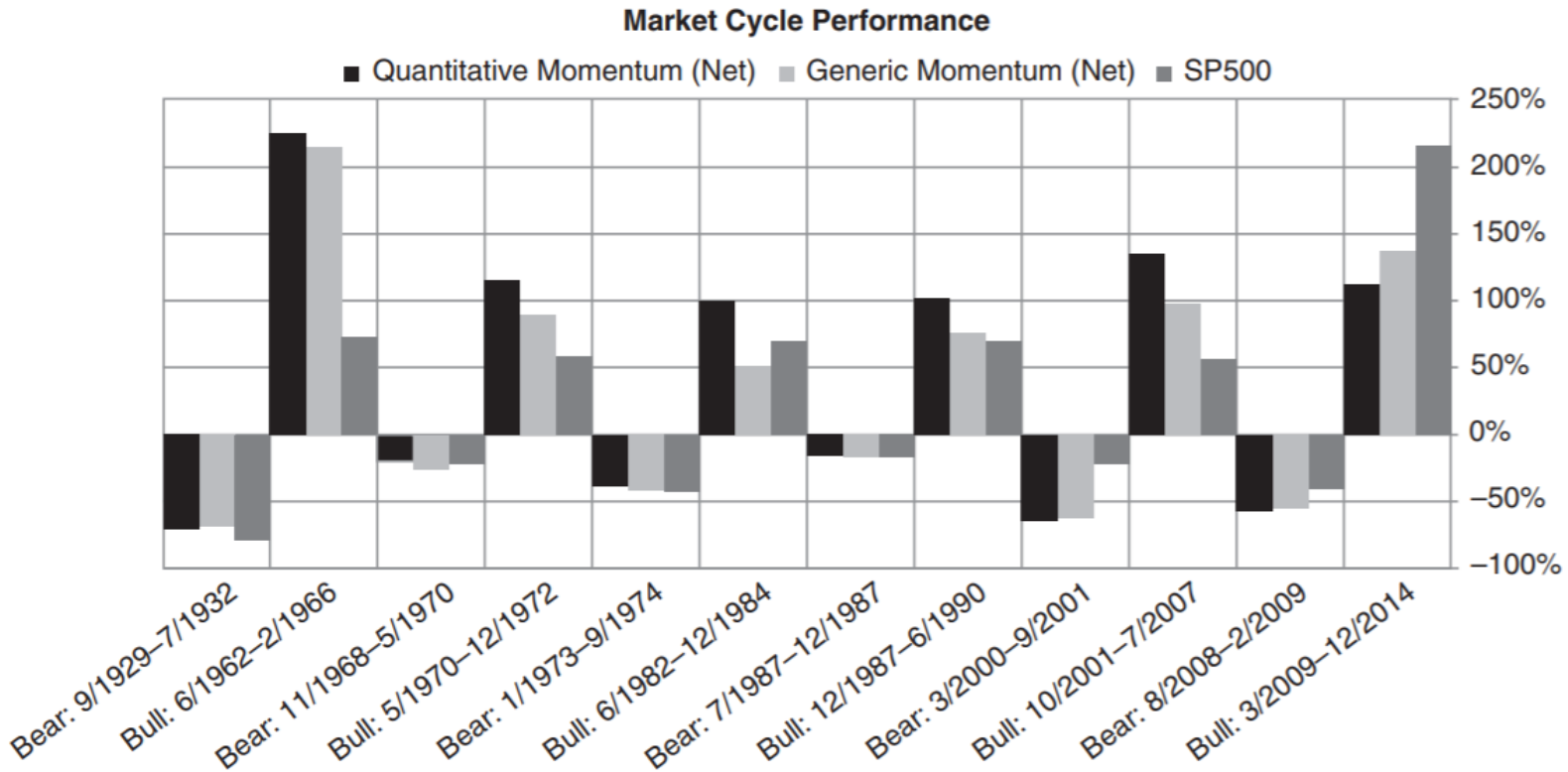


Anyone devising a momentum strategy should incorporate aspects of seasonality, especially due to the window dressing effect. Near the end of a quarter, Managers window dress their portfolios, so winning stocks do well.

Average momentum returns by month (1927-2014)

	Low Momentum	High Momentum	Spread (High – Low)
January	2.91%	1.19%	–1.72%
February	–0.24%	1.65%	1.89%
March	0.13%	1.86%	1.73%
April	1.33%	1.85%	0.53%
May	0.09%	0.82%	0.73%
June	0.01%	1.56%	1.55%
July	1.77%	1.21%	–0.56%
August	1.96%	1.34%	–0.62%
September	–1.63%	–0.20%	1.44%
October	–0.54%	0.75%	1.28%
November	0.67%	2.39%	1.71%
December	0.19%	2.95%	2.76%

Momentum performances and market cycles



the strategy performed similar to the S&P 500 in bear markets and outperformed the S&P 500 in bull markets

Momentum Explains a Bunch Of Equity Factors (Favilukis and Zhang- 2019)

- Favilukis and Zhang “One anomaly to explain them all “ suggest explaining a lot of equity factors with momentum anomaly. They show that very often, up to 50% of the equity factor returns can be linked to returns of momentum strategy. This link is especially prevalent in **short legs of equity factors**

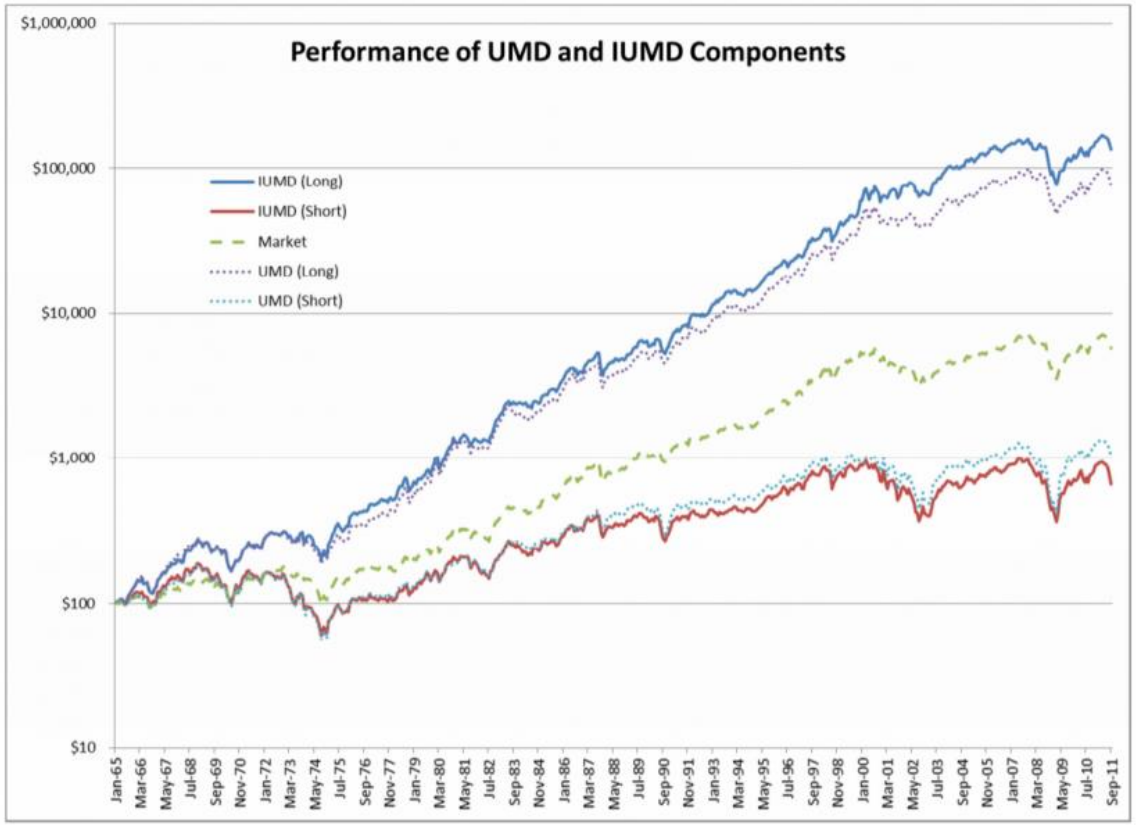
- Portfolios within which momentum trading opportunities (MTOs) -ie buying winners and selling losers- are unprofitable, tend to have significantly higher unconditional average returns than portfolios within which momentum strategies are profitable
  - for exemple firms in the top idiosyncratic volatility decile persistently earn high momentum returns, while firms in the bottom idiosyncratic volatility decile persistently earn low momentum returns
  - The model’s intuition is that active, or speculative traders are more interested in firms which offer active trading opportunities, than those firms that do not. As a result, MTO firms have higher unconditional prices and lower unconditional expected returns, despite offering high returns for traders who follow an active (conditional) strategy.”

- Second key finding is that MTOs tend to be present in the short leg, that is the low buy-and-hold return leg, of many anomalies. For example, high market-to-book, low cash-flow yield, high investment rate, low operating profitability, high idiosyncratic volatility firms all offer great MTOs
  - Controlling for the presence of MTOs, the average long-short anomaly alpha is reduced by between 23% and 47%.

Idiosyncratic Momentum

- Idiosyncratic momentum was first investigated by Roberto C. Gutierrez and Christo A. Prinsky in their study "Momentum, Reversal, and the Trading Behaviors of Institutions,"
- Regression approach helps to **remove the return component due to market betas** and thus produced a new definition of momentum with reduced volatility
- This new version of momentum also works in Japan!

Figure 3 – This chart shows the cumulative performance of $100 invested in January 1965 in each of five portfolios: market, long and short legs of UMD, and long and short legs of IUMD.



Idiosyncratic momentum exhibits a very resilient behavior in markets turmoils

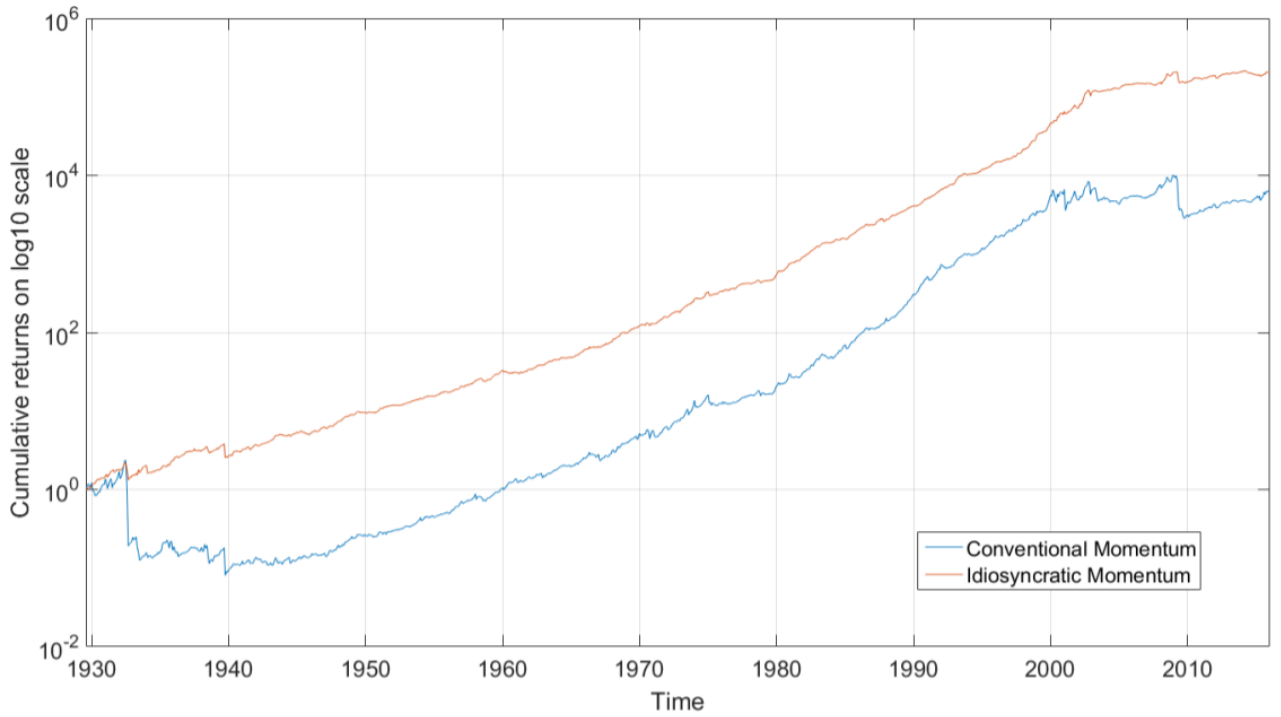


Figure 1: Cumulative Returns

This figure shows cumulative outperformance of the top over the bottom total return and idiosyncratic momentum portfolios. Total return momentum is defined as the 12-2 month total stock return and idiosyncratic momentum is the 12-2 month volatility-scaled idiosyncratic return estimated over past 36 months using the Fama-French (1993) three-factor model. We include all common stocks traded on NYSE, AMEX, and NASDAQ exchanges from July 1963 to December 2015, except those with share price below $1, with valid total return and idiosyncratic momentum scores. Portfolios are equal-weighted and reformed monthly.

Methodology of Gutierrez and Pirinsky (2007) and Blitz et al. (2011)

From CAPM 3 factors model :

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{mkt,i} \cdot (R_{mkt,t} - R_{f,t}) + \beta_{hml,i} \cdot R_{hml,t} + \beta_{smb,i} \cdot R_{smb,t} + \epsilon_{i,t} \qquad (1)$$

idiosyncratic returns

$$e_{i,t} = R_{i,t} - R_{f,t} - \hat{\alpha}_i \iota - \hat{\beta}_{mkt,i} \cdot (R_{mkt,t} - R_{f,t}) - \hat{\beta}_{hml,i} \cdot R_{hml,t} - \hat{\beta}_{smb,i} \cdot R_{smb,t} \qquad (2)$$

$$IdiosyncraticMomentum_{i,t} = \frac{\sum_{t-12}^{t-2} e_{i,t}}{\sqrt{\sum_{t-12}^{t-2} (e_{i,t} - \bar{e}_i)^2}} \qquad (3)$$

The idiosyncratic anomaly

- Idiosyncratic momentum (iMOM) **cannot be explained** by any of the established asset pricing factors, such as market, size, value, operating profitability, and investment, even if the total return momentum factor is included.
- Overconfidence, **overreaction,** and risk-based explanations that arguably explain conventional momentum cannot explain idiosyncratic momentum.
- The existence of idiosyncratic momentum profits is **consistent with the underreaction to news** (slow diffusion of information) hypothesis.

- **Idiosyncratic momentum forecasts high short and long-term excess returns, while conventional momentum forecasts high short-term and negative long-term excess returns.**

- There's a monotonically decreasing pattern in excess returns, Sharpe ratios, and factor adjusted returns (i.e. alphas) going from high (Decile 1) to low (Decile 10) idiosyncratic and total return momentum portfolios. The D1-D10 idiosyncratic momentum portfolio generates a monthly return of 1.39 percent, somewhat lower than that of total return momentum (1.54 percent), but with a substantially lower volatility. The Sharpe ratio of the idiosyncratic momentum strategy is 0.48 per month, almost double that of conventional momentum (0.25).

- A portfolio that is long idiosyncratic momentum winners and short losers within past conventional momentum winners generates high returns continually over the next five years.
- Idiosyncratic momentum shows robust performance in international equity markets, including the one market where conventional momentum is known to be ineffective — Japan.

- Importantly, idiosyncratic momentum is significantly less affected by market dynamics (bull vs. bear markets) and, thus, to crash risk — the return in up months following bear markets, particularly hurtful for conventional momentum, is -0.18 percent and statistically indistinguishable from zero (t-stat = -0.39).

The low risk anomaly

Betting against Beta (BAB) : the low beta factor, Frazzini and Petersen (2010)
Volatility Factor (VOL, Low minus High Vol), Ang

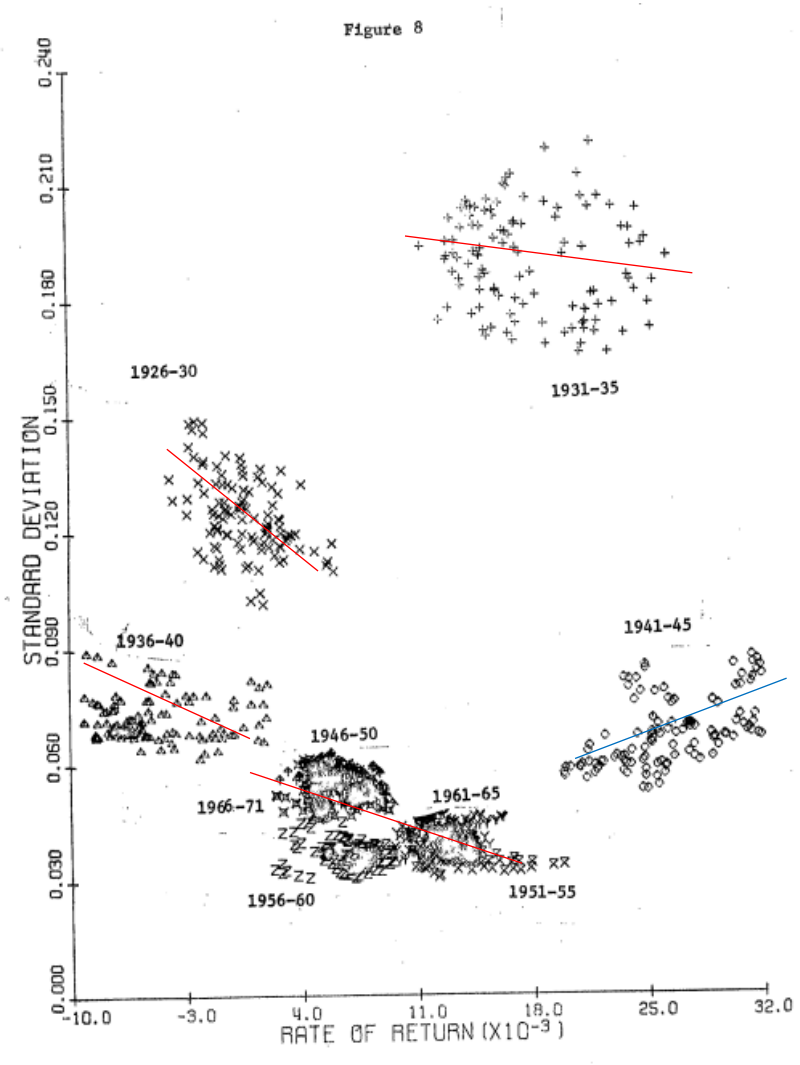
The low-risk anomaly

- Haugen and Heins (1975) using data from 1926 to 1971 concluded that the conventional hypothesis that risk generates a special reward was wrong : « over the long run, portfolios with lesser variance in monthly returns have experienced greater average returns than riskier counterparts. »

- The low-risk anomaly is a combination of 3 effects :
  - Volatility is negatively related to future returns
  - Realized beta is negatively related to future returns
  - Minimum variance portfolios do better than the market

- One explanation for the relatively low return of high beta would be
  - the leverage constraints (high beta stocks are more expensive because they **deliver a free leverage**)
  - while the low beta stocks are removed from portfolios for TE reasons (which can explain why they are cheap).

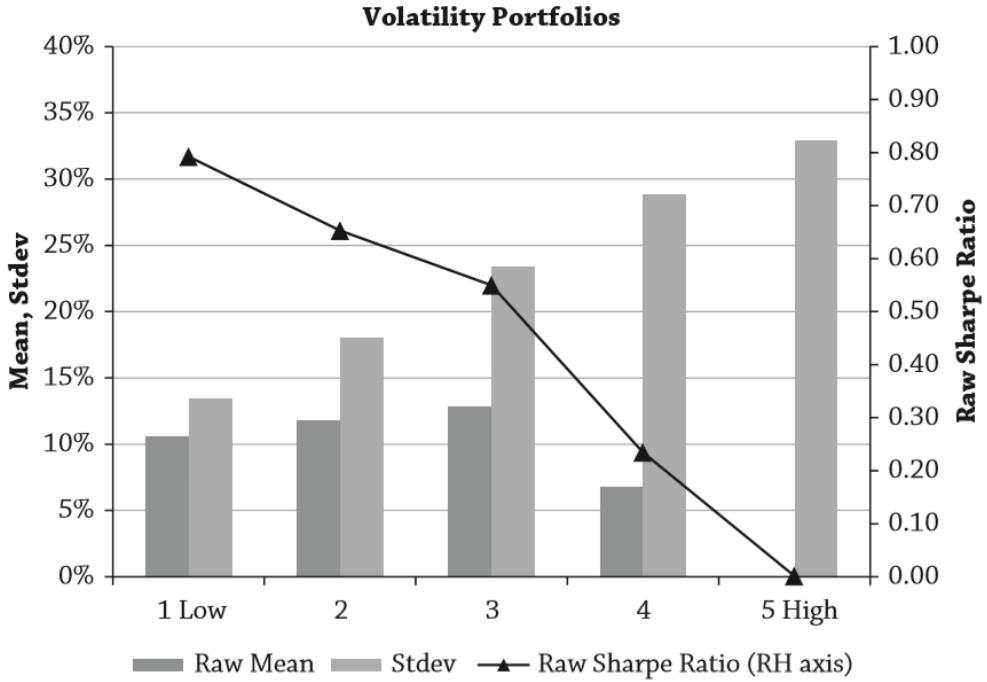
Haugen & Hines (72) challenge the hypothesis that risk (volatility) generates a special reward



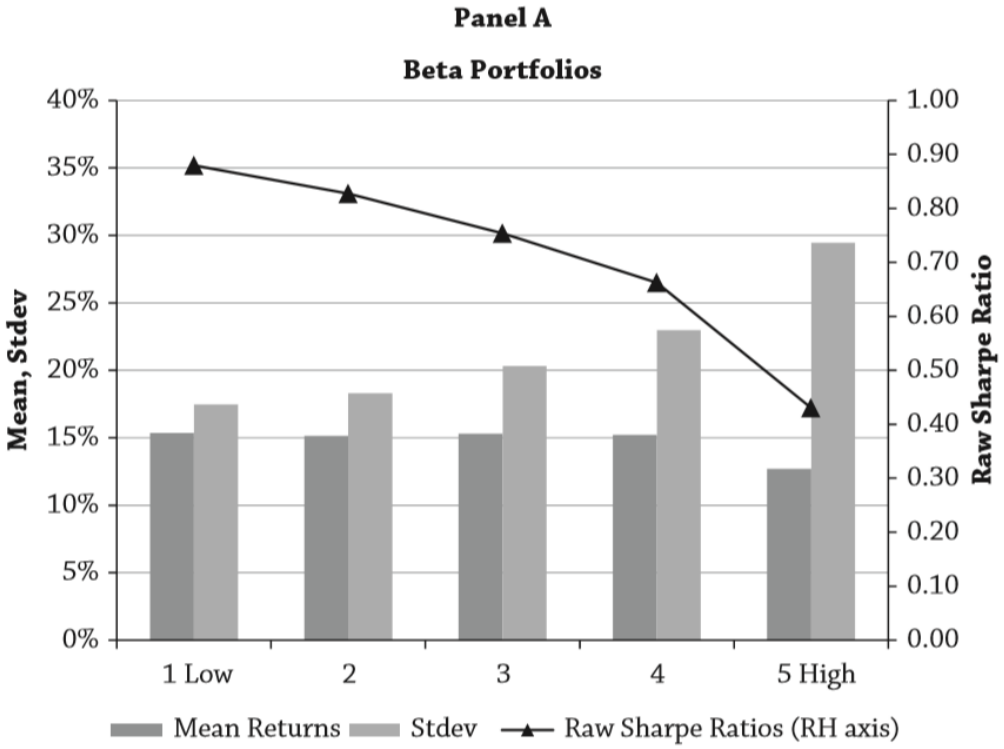
The volatility anomaly

- Ang (2006) results show a negative relation between both idiosyncratic and total volatility with returns.

- Portfolios are sorted on idiosyncratic volatility (Fama & French 93) and rebalanced quaterly



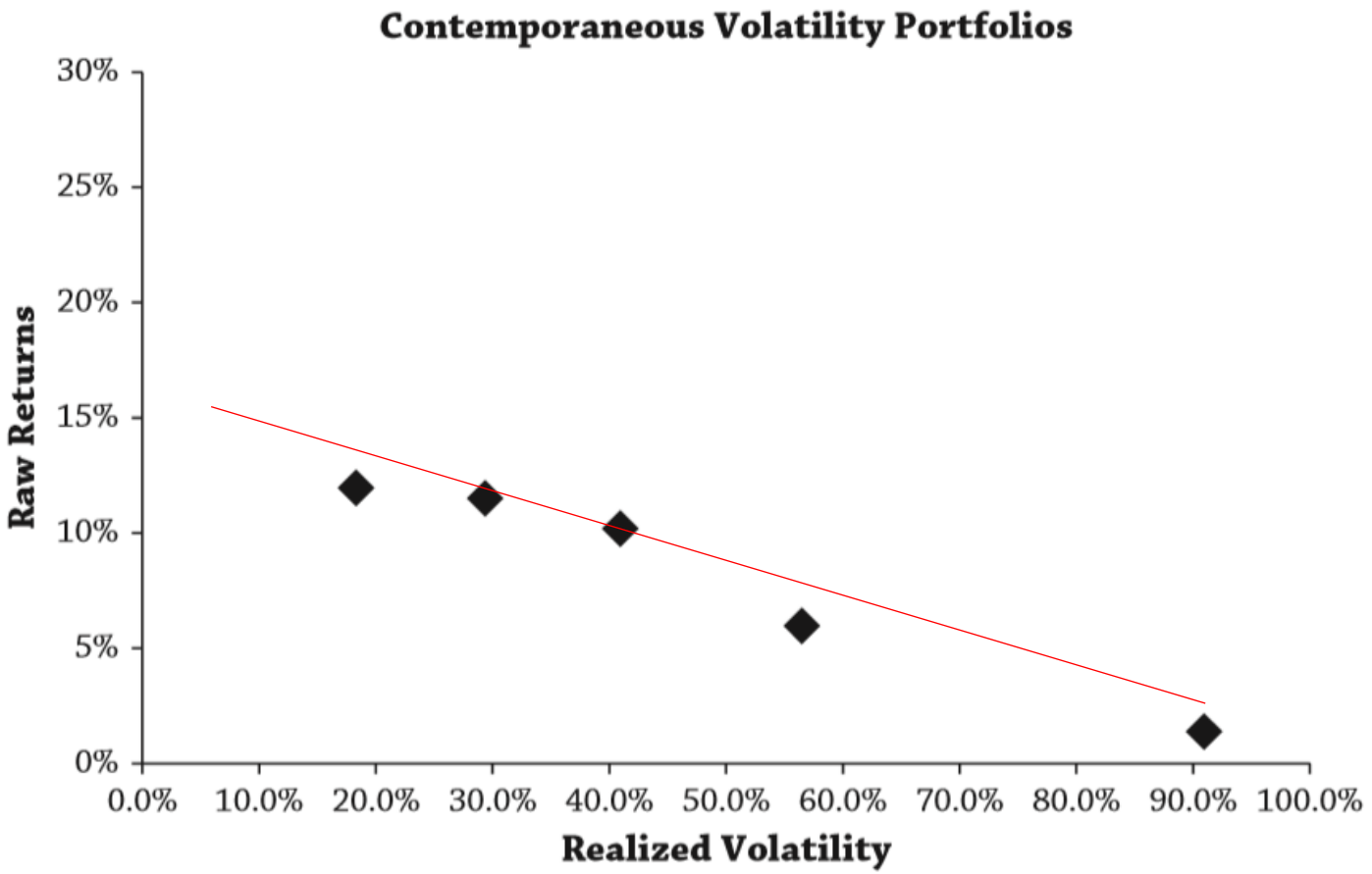
Beta anomaly



- Quintile portfolios (equal weighted) rebalancing every quarter based on the betas estimated over the previous quarter using daily returns

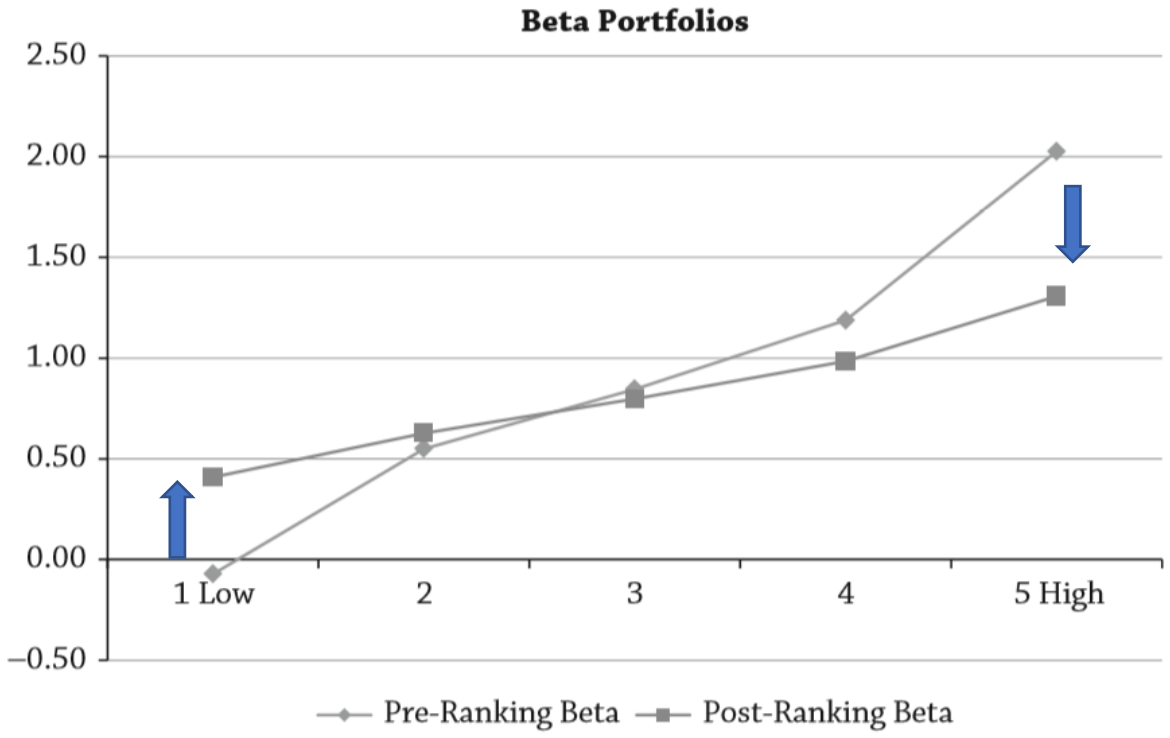
- The beta anomaly isn't that high beta have low returns, it is that high beta stocks have high volatilities

The relation between realized beta and returns does exist…



But beta prediction is uncertain

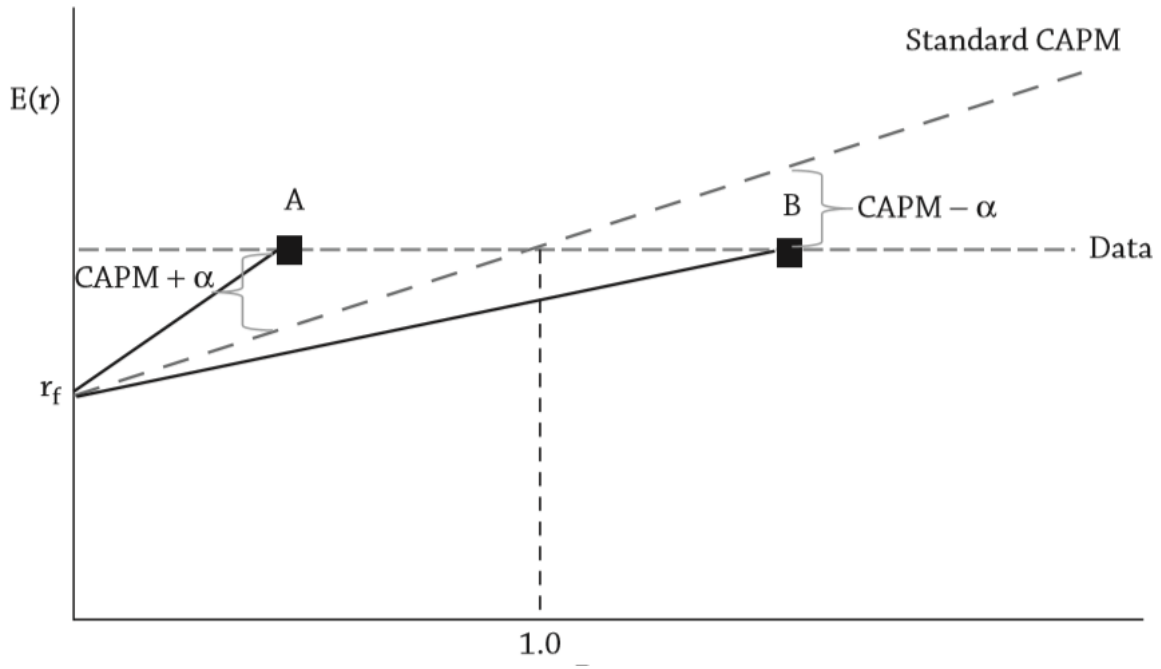
- It is hard to predict beta : past beta hardly predict future beta.



The Low Beta anomaly

- Many institutional managers can't or won't play the risk anomaly.
- In particular, the use of market-cap weighted benchmarks itself may lead to the low volatility anomaly

- Theoretically, stock A, has positive alpha, and B, has negative alpha. The arbitrage is very attractive but needs leverage to be financed

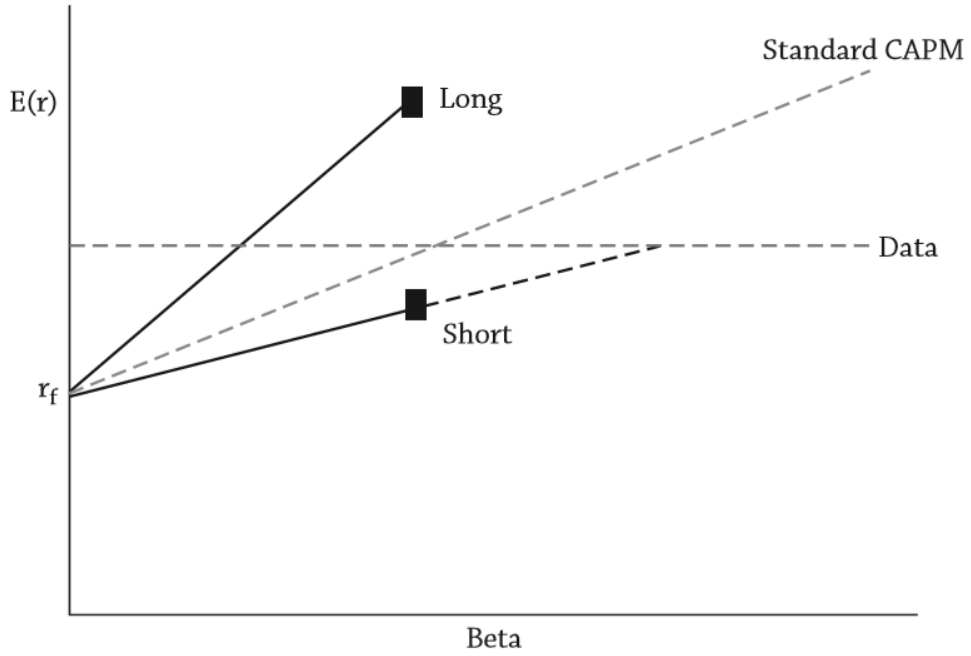


Betting against Beta (BAB) : The low beta factor Frazzini and Petersen (2010)

- BAB : long low beta stocks / short high-beta stocks

$$BAB_{t+1} = \frac{r_{L,t+1} - r_f}{\beta_{L,t}} - \frac{r_{H,t+1} - r_f}{\beta_{H,t}},$$

- The low beta portfolio is levered. Given the very low beta of several stocks, they just use 2 beta portfolios (quintile segmentation is almost impossible)

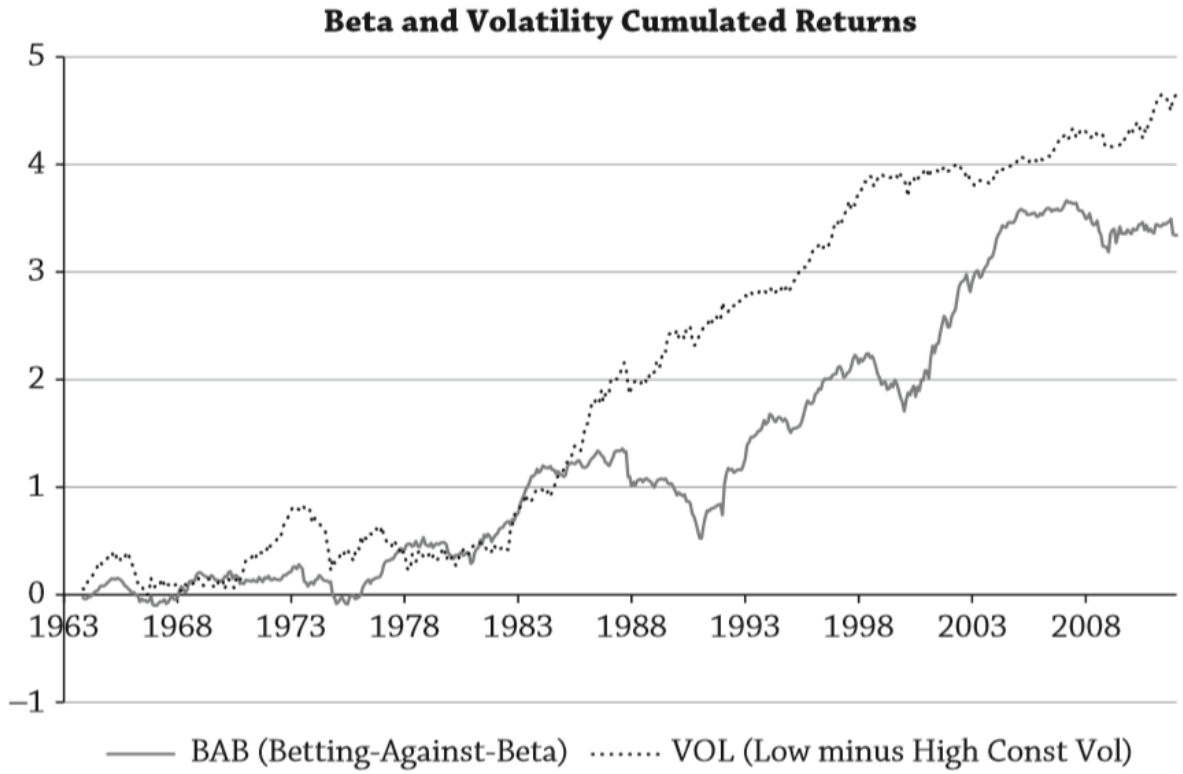


The Volatility factor (Ang)

- Same portfolio construction than BAB but using volatility parameters

$$VOL_{t+1} = \sigma_{\text{target}} \times \left(\frac{r_{L,t+1} - r_f}{\sigma_{L,t}} - \frac{r_{H,t+1} - r_f}{\sigma_{H,t}} \right),$$

	BAB Factor		VOL Factor	
	Coeff	T-stat	Coeff	T-stat
Alpha	0.33%	1.89	0.42%	4.37
MKT Loading	–0.17	–4.13	0.87	38.8
SMB Loading	0.29	5.20	–0.63	–20.3
HML Loading	0.48	7.85	0.20	5.73
UMD Loading	0.09	2.35	0.13	6.00



Defensive Style: Buy Low-Risk Assets

- Risk has been rewarded across stocks/bonds/cash in the long run but not *within* asset classes

- Poor long-run performance of the speculative segment in many asset classes may be due to leverage constraints and/or lottery preferences: **People overpay for embedded leverage and for lottery tickets.**

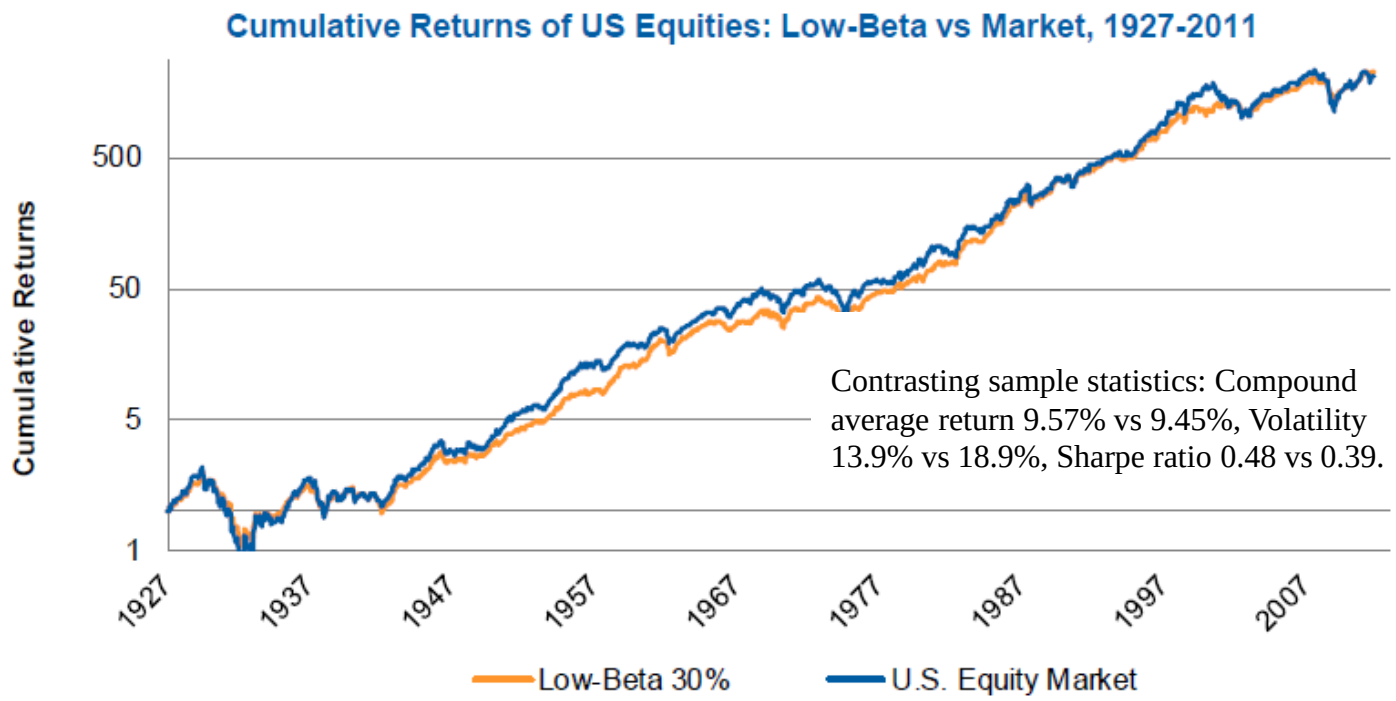


Exhibit 2: S&P 500 and S&P 500 Low Volatility Returns Breakdowns

	Feb. 1972 - May 2019		Before Dec. 1990		Since Dec. 1990	
	S&P 500 Low Volatility	S&P 500	S&P 500 Low Volatility	S&P 500	S&P 500 Low Volatility	S&P 500
Average Return	1.03%	0.92%	1.18%	0.96%	0.93%	0.89%
Average Return (Up)	2.73%	3.42%	3.58%	3.99%	2.25%	3.10%
Average Return (Down)	-1.85%	-3.33%	-1.98%	-3.03%	-1.74%	-3.60%
Upside Capture	79.82%		89.72%		72.69%	
Downside Capture	55.49%		65.46%		48.27%	
Hit Rate (Up)	35.29%		39.84%		32.75%	
Hit Rate (Down)	80.95%		79.38%		82.30%	
Beta	0.68		0.80		0.58	

Source: S&P Dow Jones Indices. Table based on monthly total returns between Feb. 1972 and May 2019. Capture ratios are computed by dividing the low volatility index's average up and down monthly returns by the corresponding S&P 500 total return. Past performance is no guarantee of future results. Table is provided for illustrative purposes only.

The volatility has various components and methodologies

- Volatility of returns (from 1 year to 3 years)

- Idiosyncratic volatility
  - returns on stock i: ri,t = $\alpha_i + \beta_i r_{m,t} + \epsilon_{i,t}$,
  - which implies stock-level variance is: $\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{\epsilon,i}^2$.
  - Thus, volatility at the firm level has a common component $(\beta_i^2 \sigma_m^2)$ as well as an idiosyncratic component $(\sigma_{\epsilon,i}^2)$

- Fundamental volatility
  - For instance, sales growth, cash-flow growth, earnings growth, analysts forecasts

Style Factors Implementation

Implementation of Style Factors
« The devil is in the detail »

- Implementation is crucial to make a strategy efficient:
- In the meantime, if all participants share the same implementation, the risk premia could vanish (overcrowding effect) while alternative implementations could still receive a premium

  - Top vs bottom Quintile, Decile 1,2,3 ? Keeping the extreme Z-scores or not (winsorizing) … How many stocks in portfolios?
  - For L/S, how to manage the short side? Idem for Long Only, how to compensate the lack of short side?
  - Rebalancing (Monthly / Quaterly…) with which maximum turnover (cost)
  - Sector neutral or sector agnostic?
  - TE budget?
  - What type of portfolio construction? EW, market cap, RW, Factor weighted…
  - Which metric? A single one (like pure 12 months momentum) or a combination (earnings momentum or ‘less the previous month’). How to choose?
  - Which parameter? The academic one (12 months) or another one more efficient with the benchmark (like 9 months?) or a sliding parameter dependant on past performance ?

Which metrics for a factor? Which parameters?

- Asset managers are very dependant from academic papers and theoretical definitions
- The 12 month Momentum is very enlightning: The industry is still using the definition of Jegadeesh and Titman's paper wrote in 1993… without any additional input!
- Puzzling given that the way academics consider factors is often very far away from markets considerations
- There are a lot of additional metrics to consider and to backtest. There are a lot of subtilities to add given the level of correlation among the metrics universe and their specific risk features.
- Additionally, parameters can be improved: both in a static way and ideally on a flexible way. For instance, the 12 month momentum could be modified according to market environment.
- Technical analysis tools could be used to have a better metric than the simple momentum
- The portfolio construction is a significant part of potential improvement.
- IA is a very attractive way to consider all these issues.

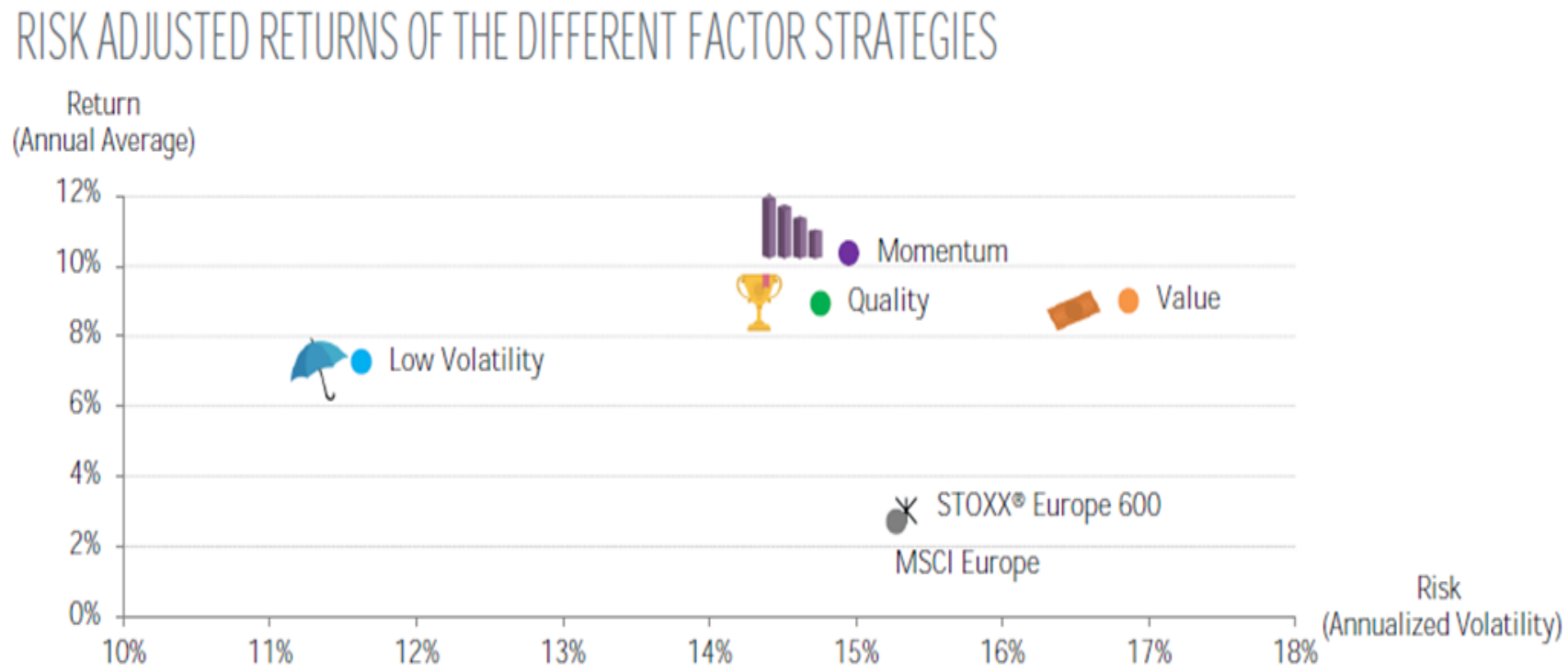
Trading within Style Premia Portfolio

- A style Premia Portfolio needs to match with academic Style Factors but should first target good performances over time.

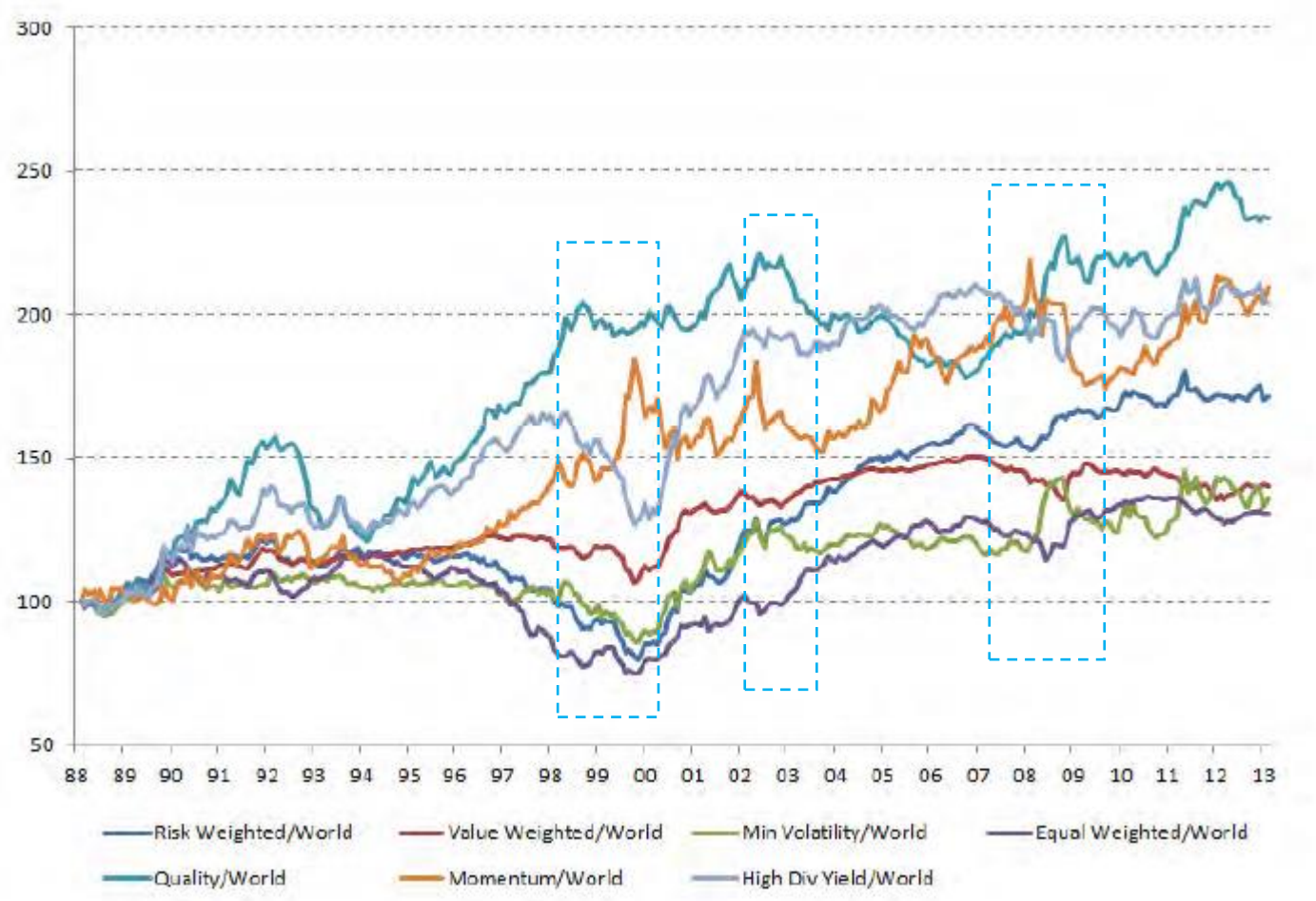
- To achieve this goal, various issues need to be clarified:
  - Metrics to watch and Metrics parameters
  - Various implementation features
  - Portfolio construction
  - Risk management:
    - portfolio construction depending from Style Factor characteristics
      - EW, RW, Min-Var, Max-Div…
    - Risk control: avoiding falling knifes
      - Implement momentum strategies to avoid loosing stocks or lottery-tickets stocks
    - Money management: mean-reverting strategies
      - For specific Style Factor strategies, mean-reverting strategies make sense (ie. Buy Low and Sell High)
    - Using Behavioral bias like saisonnality

Building Multi-factor Portfolios

Risk Adjusted returns of factor strategies



Factors performance over time



Correlation matrix and statistics

Exhibit 5: Correlations of Relative Monthly Returns (June 1988 to June 2013, USD Gross Returns)

	MSCI World Risk Weighted	MSCI World Value Weighted	MSCI World Minimum Volatility	MSCI World Equal Weighted	MSCI World Quality	MSCI World Momentum	MSCI World High Div. Yield
MSCI World Risk Weighted	1.00						
MSCI World Value Weighted	0.61	1.00					
MSCI World Minimum Volatility	0.65	0.14	1.00				
MSCI World Equal Weighted	0.75	0.63	0.12	1.00			
MSCI World Quality	0.07	0.00	0.24	-0.26	1.00		
MSCI World Momentum	0.04	-0.26	0.16	-0.20	0.38	1.00	
MSCI World High Div. Yield	0.62	0.71	0.51	0.26	0.35	0.04	1.00

Exhibit 6: Combining Multiple Factors Offers Substantial Diversification Effects (May 1999 to September 2013)

	World Standard	MSCI World Quality Index	MSCI World Risk Weighted Index	MSCI World Value Weighted Index	MSCI World Momentum Index	**Multi Factor Index**
Total Return* (%)	4.2	5.3	8.6	5.5	6.9	**6.7**
Total Risk* (%)	16.3	14.3	14.6	17.2	16.7	**14.9**
Sharpe Ratio	0.18	0.26	0.47	0.25	0.33	**0.34**
Annualized Active Return (bps)		110	440	120	270	**250**
Tracking Error* (%)		4.5	5.6	3.6	9.0	**3.0**
Information Ratio		0.25	0.79	0.35	0.30	**0.83**
Max Rel. Drawdown (Active Returns) (%)		20.5	16.0	10.7	21.6	**5.7**
Max Rel. Drawdown Period (Active Returns) (in Months)		52	10	9	19	**2**

* Annualized in USD for the 05/31/1999 to 09/30/2013 period
** Annualized one-way index turnover for the 05/31/1999 to 09/30/2013 period

Correlations of the 5-factors model in Europe

- Correlations between Mkt -RF, SMB, HML, RMW and CMA for Europe. Data period for returns is from January 2001 to December 2016

	Mkt-RF	*SMB*	*HML*	*RMW*	*CMA*
Mkt-RF	1	-0.104	0.199	-0.405	-0.294
SMB	-0.104	1	-0.067	0.051	-0.160
HML	0.199	-0.067	1	-0.527	0.591
RMW	-0.405	0.051	-0.527	1	-0.148
CMA	-0.294	-0.160	0.591	-0.148	1

- The highest correlation is between HML and CMA : firms with high book to market value tend to be firms with a conservative investment strategy.
- Most value firms have a low book to market value because of their financial difficulties which prevents them to engage in an aggressive investment strategy
- The correlation of the value factor with the profitability factor is significantly negative : non-profitable firms are likely to be value oriented. Benjamin Graham already explained this correlation in his book Securities Analysis where he talks about deep value investing
- The size factor is only positively correlated with the profitability factor : idea that small and medium sized firms are generally the most profitable.

The agnostic view:
Application to an equity portfolio harvesting several equity risk premia

Complementarity of styles sounds more performing than any tactical timing

- Value timing is difficult : changes in style valuations are often driven by changes in portfolio positions or fundamentals rather than changes in prices
- Beta is very unstable and timing unstable variables proved to be unefficient
- Timing Momentum can offer better results but mean reverting signals are difficult to capture
- Research suggest the approach of sticking to a well diversified portfolio of uncorrelated factors with proven ability to perform is more appropriate than seeking tactical adjustments

Multi- factor portfolio construction: The agnostic view

- Several ways to implement an agnostic view:
  - Equally weighted, Risk-based approach, ERC…

- Two ways of implementations:
  - Top-down construction consisting in the addition of x RP portfolios (Value + Low Vol + Momentum + Quality…)
    - Too many stocks in the portfolio creates inefficiencies
  - Bottom-Up approach: selecting the stocks which have the best average scores to selected factors

Investment process : the case of LOIM Factor enhanced

1 Robust factor selection

- Select factors that are representative of recognised and persistent risk premia

2 Dynamic factor weighting

- Dynamically adjust factor weighting to market conditions

3 Rigorous stock selection

- Select stocks with best overall exposure to selected factors

4 Diversified portfolio construction

- Properly balance portfolio risks in terms of sectors and stocks

1 – Robust factor selection

- select factors that are
  - Simple and intuitive
  - Justified by academic research and backed by economic and behavioural rationale
  - Deliver significant performance that is expected to persist
  - Provide diversification and improve the performance of the overall portfolio

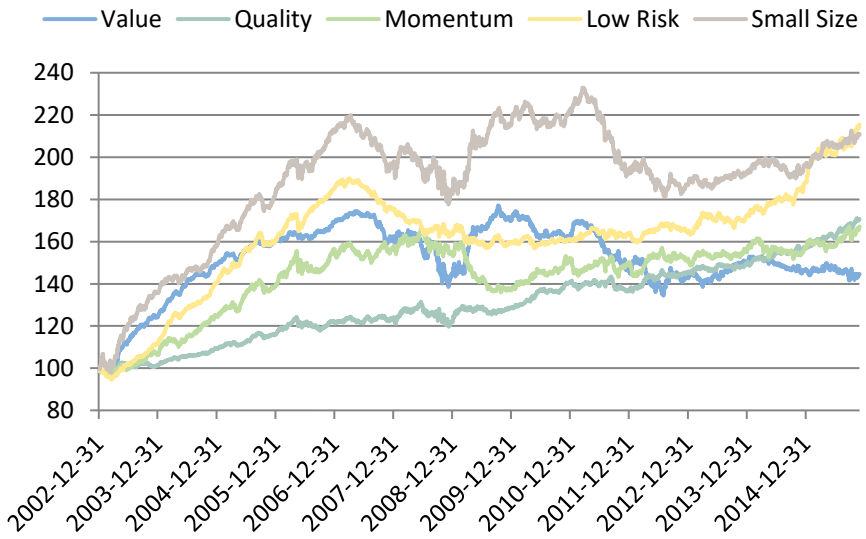
SELECTED FACTORS

Value	Quality	Momentum	Low risk	Small size
Undervalued companies	Sound companies	Companies with strong recent price appreciation	Stable companies considered overlooked	Potential for future growth
Lowest P/E and P/B ratios	Highest ROE and lowest leverage	Best performance over one year	Low beta versus market	Lowest market cap

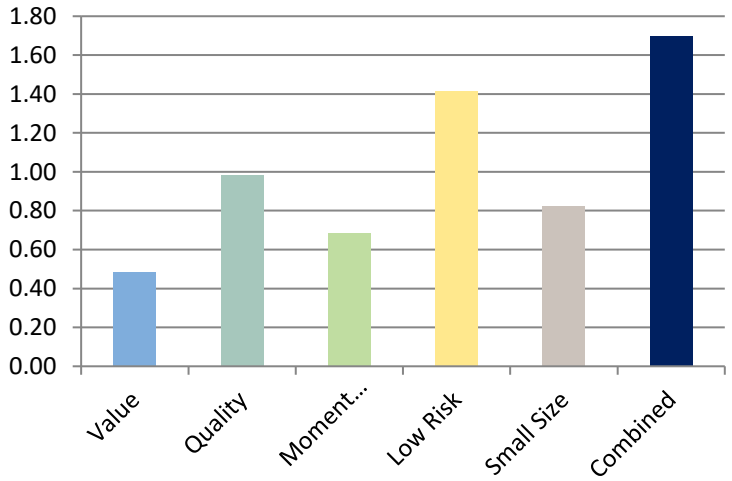
Value: Standardised average between P/E and P/BV (IBES FY1median estimates).
Quality: Standardised average between Total liabilities to Equity and Return on Equity (Based on the last reported earnings).
Momentum: 12 month market performance of stocks.
Low risk: Beta versus market, proprietary risk model.
Small size: MSCI float adjusted market capitalisation.

1 – Robust factor selection

LONG TERM EXCESS RETURNS OF FACTORS



INFORMATION RATIO

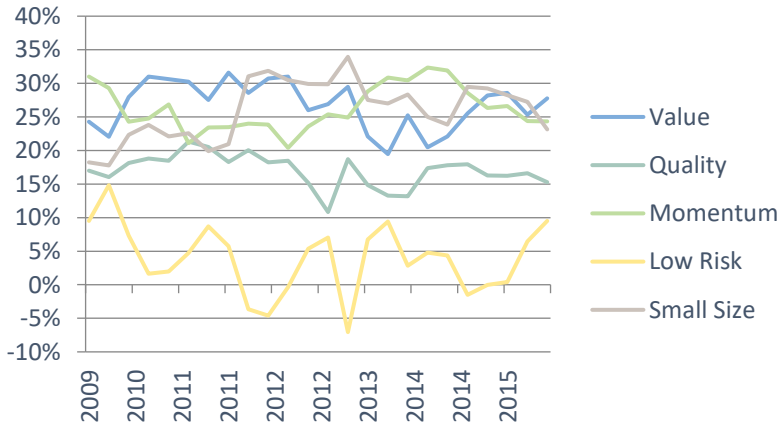


Excess performance of european equity portfolios composed of 20% best stocks as measured by factor metrics above MSCI Europe, monthly rebalancing, performance is gross of fees in EUR, net of dividends.
Past performance is not a guarantee of future results. These performance results are back tested based on an analysis of past market data with the benefit of hindsight,
do not reflect the performance of any LOIM product and are being shown for informational purposes only.
Source LOIM, MSCI

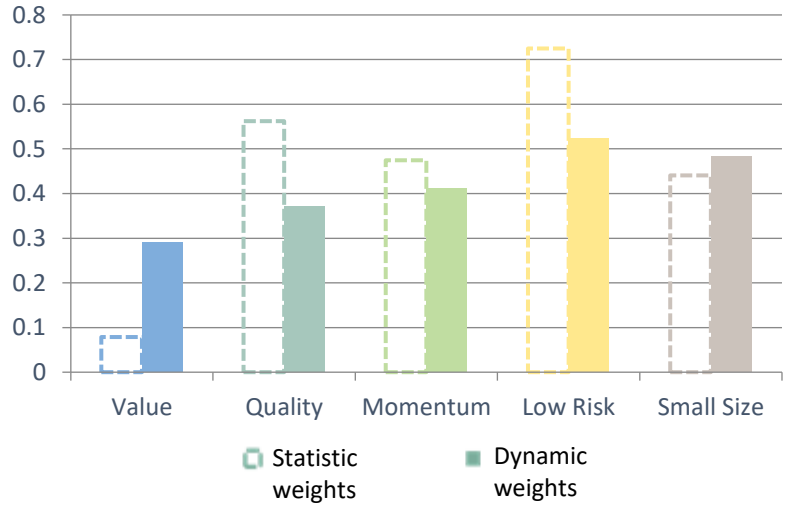
2 – Dynamic factor weighting – LOIM solution

- Interaction between factors must be accounted for in order to achieve a balanced factor exposure and deliver more stable performance
- We measure factors correlations, and adjust weights accordingly :
  - Under-represented factors receive higher allocation
  - A factor with lower (resp. higher) correlations to other factor receive higher (resp. lower) weight in the composite score
- Market beta is controlled to maintain proper market risk premia exposure
- Quarterly rebalancing

DYNAMIC FACTOR WEIGHTING…



… ACHIEVES A MORE BALANCED EXPOSURE



Data as at 30 September 2015. For illustrative purposes only. Allocations are subject to change.
Source: LOIM

3 – Rigorous stock selection

- don't combine factor portfolios, select stocks with outstanding average scores across different factors
  - Stocks are scored within each sector according to their factor exposure
  - For each stock, individual factor scores are averaged
  - The best scoring stocks are selected (80% of investment universe)

ILLUSTRATION: RANKING AND SELECTION OF STOCKS WITHIN THE TELECOM SERVICES SECTOR

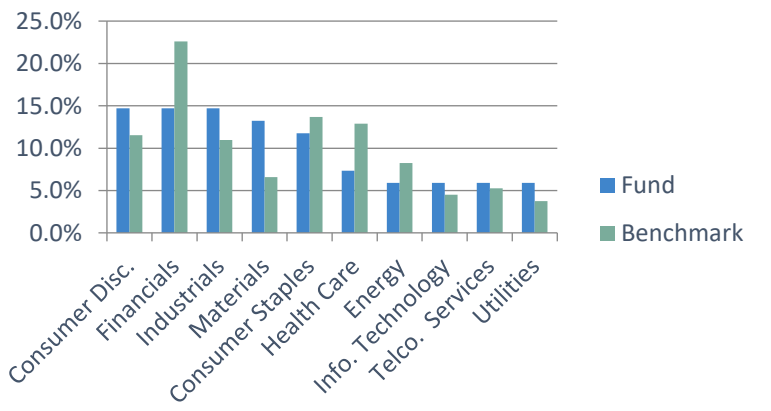
		Value (27%)	Quality (23%)	Momentum (18%)	Low risk (12%)	Small size (20%)	Composite score
TDC		1.94	0.41	-1.94	1.41	1.41	0.65
ELISA		-0.64	1.01	1.41	0.72	1.12	0.56
PROXIMUS		-0.13	1.41	0.00	0.90	0.27	0.36
TELE2 'B'		0.27	0.20	-0.90	0.55	1.94	0.29
TELIASONERA		1.41	0.72	-1.41	0.13	-0.41	0.21
ORANGE		1.12	0.00	0.13	-0.72	-0.72	0.19
TELECOM ITALIA RSP		0.90	-1.27	0.55	-1.41	0.90	0.16
ILIAD		-0.90	1.01	-0.27	1.94	0.13	0.09
SWISSCOM 'R'		-0.27	1.94	-0.41	1.12	-1.94	-0.01
INMARSAT		-1.94	0.20	1.94	0.00	0.55	-0.06

This example is for illustrative purpose only. Holdings and/or allocations are subject to change. Any reference to a specific company or security does not constitute a recommendation to buy, sell, hold
or directly invest in the company or securities. It should not be assumed that the recommendations made in the future will be profitable or will equal the performance of the securities discussed in this document.
Source: LOIM. Data as at 30 September 2014, investment universe MSCI Europe. For illustrative purposes only. Rankings are subject to change.

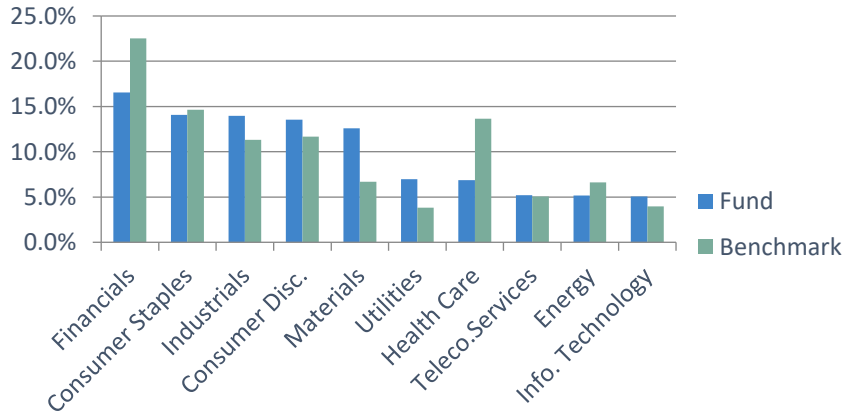
4 – Diversified portfolio construction

- **Sector risk is an important driver of portfolio performance. An optimal portfolio should diversify sector risk and stock-specific risk**
  - Avoid concentration of risk in a given sector or stock seen in market-cap indices for improved risk-reward
  - An equal risk budget is assigned to each sector within the portfolio and to each stock within each sector
  - Risk budget is reduced in sectors with less than 50 stocks

TARGET RISK BUDGET BY SECTOR…



SECTOR WEIGHTINGS….

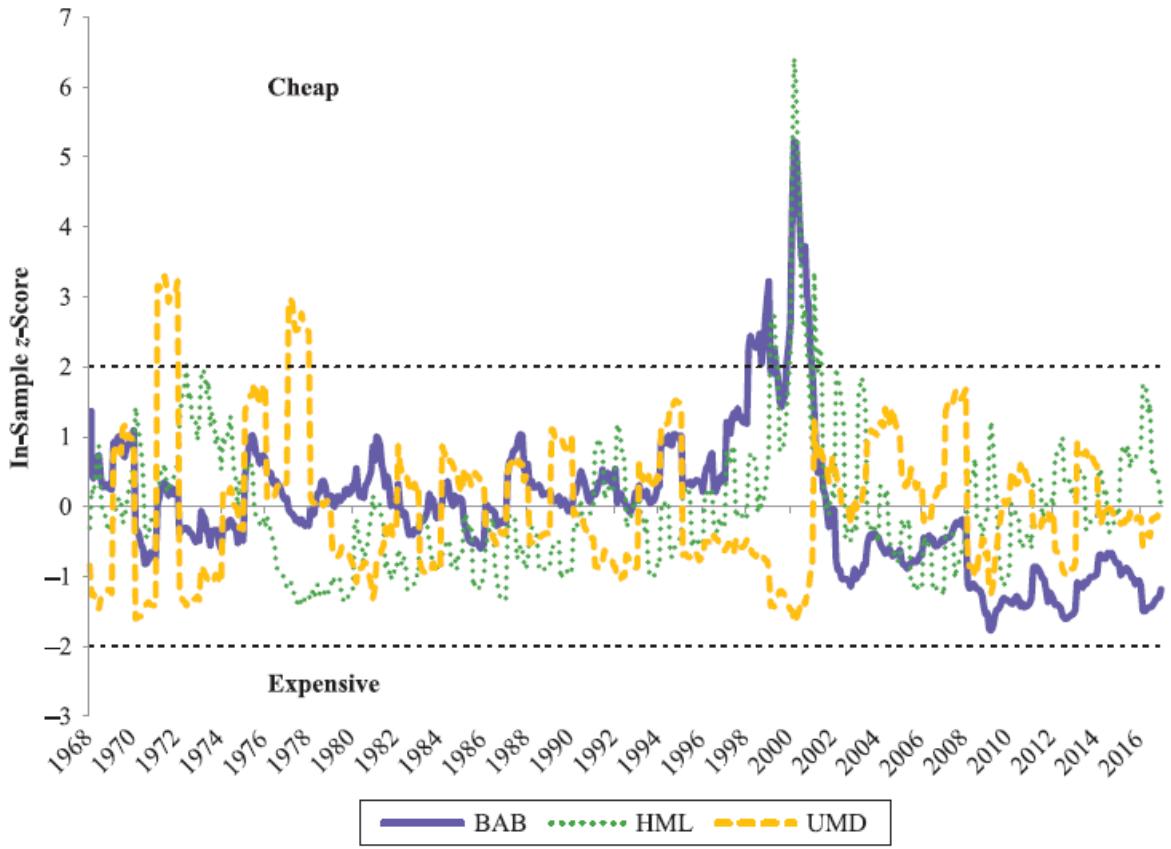


Data as at 30 November2015. For illustrative purposes only. Allocations are subject to change.
Source: LOIM, MSCI.

Implementing convictions:
Style selection depending of macro & market views

Can dynamic allocations improve the performance of a diversified multi-style Pf ?

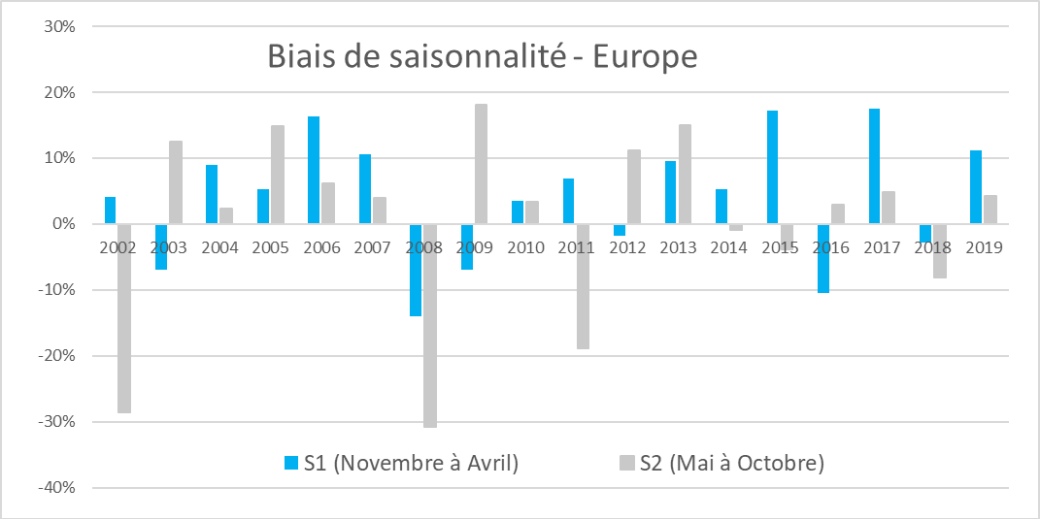
Book-to-Price Spreads of U.S. Large-Capitalization Academic Styles, 1968–2016



Notes: The universe is U.S. large-cap stocks. The book-to-price ratio value spreads are standardized in-sample.

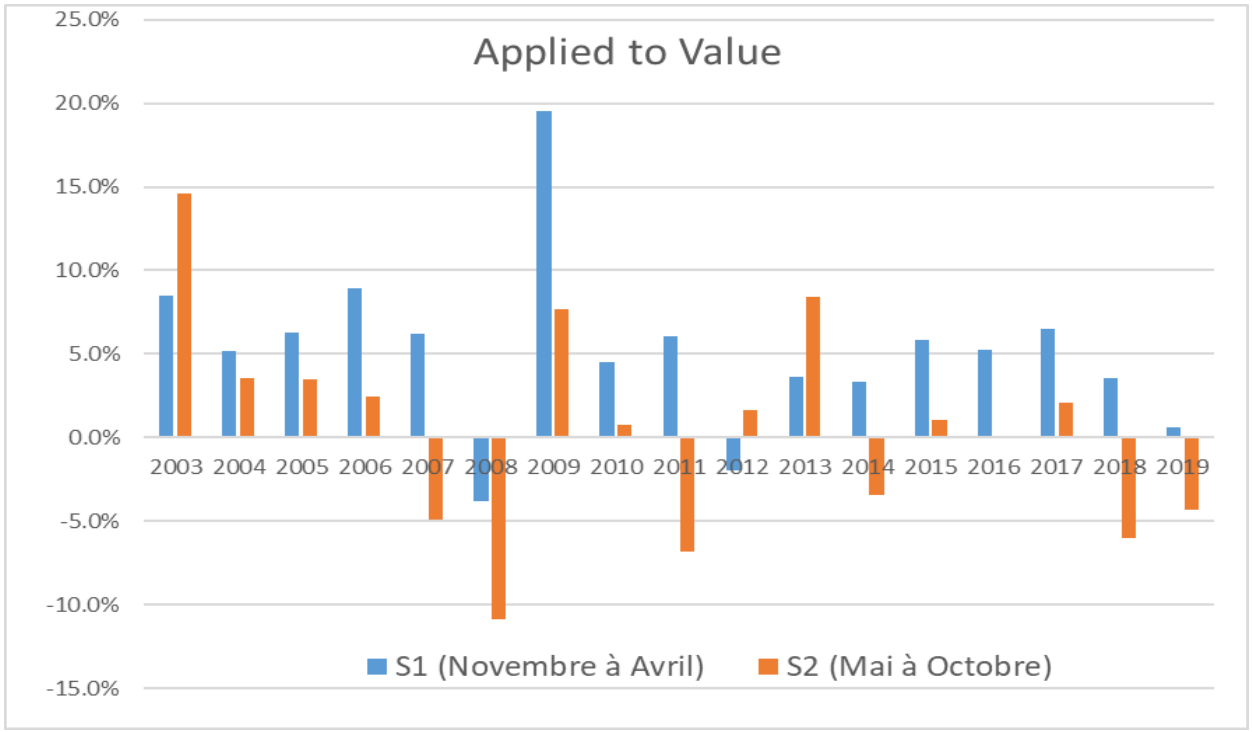
Saisonnality is a behavioral anomaly

- Principle: apply the adage « sell in May and go away… till October ». Basically, the strategy is go flat the market end of April, go long the market in early November till April



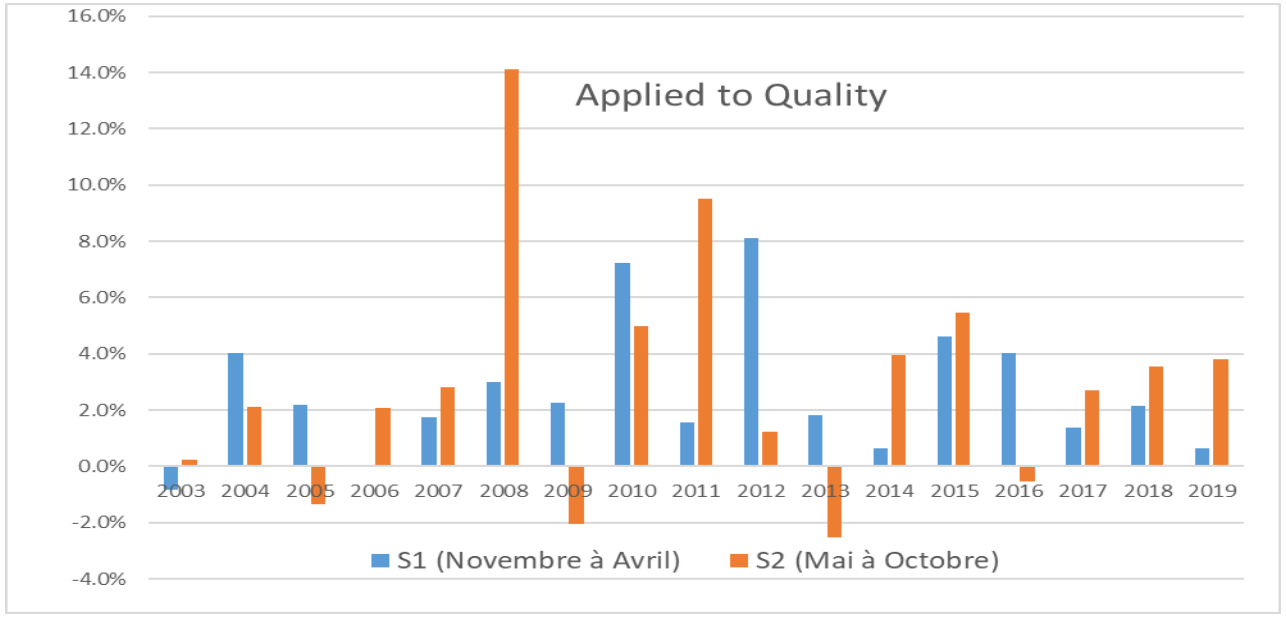
	S2	S1	Global
Performance moyenne	0.49%	4.09%	2.80%
Volatilité historique	14.10%	9.50%	12.70%
Sharpe Ratio	0.03	0.43	0.22

Applying Saisonnality anomaly to Value



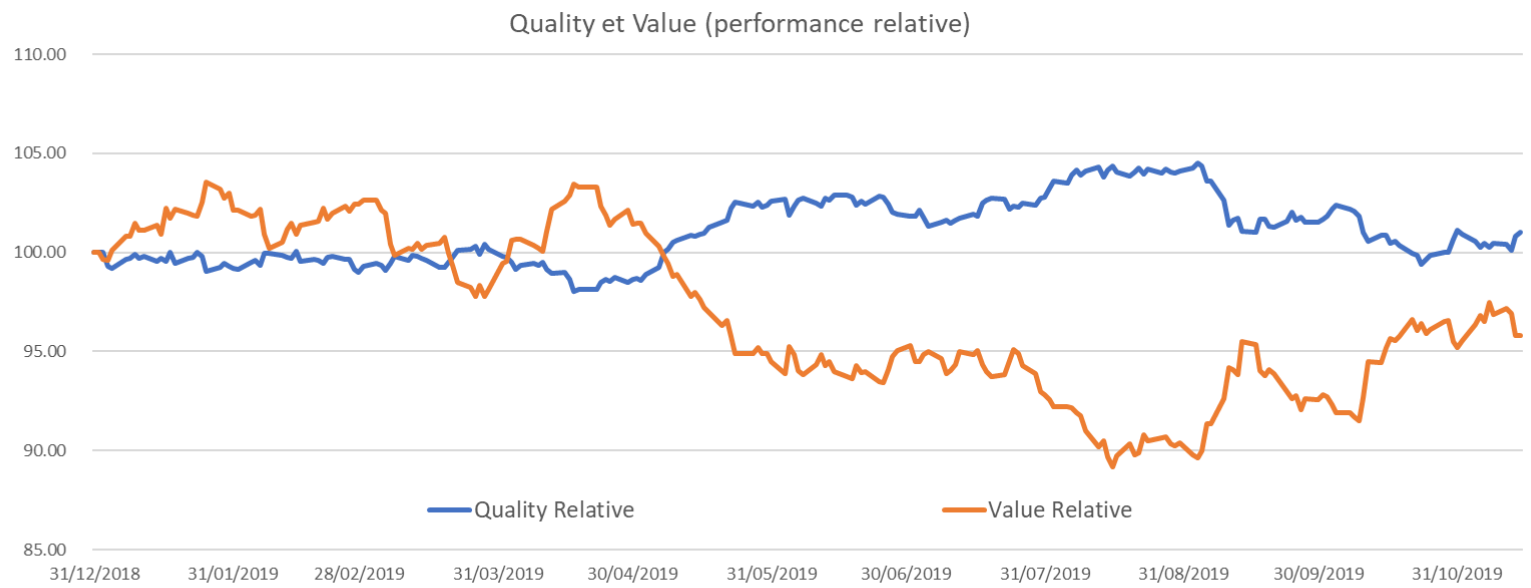
	S2	S1	Global
Performance moyenne	0.73%	5.18%	2.90%
Volatilité historique	6.16%	4.99%	6.79%
Sharpe Ratio	0.12	1.04	0.43
Nbr of years S2>S1	17.6%		

Applying Saisonnality anomaly to Quality

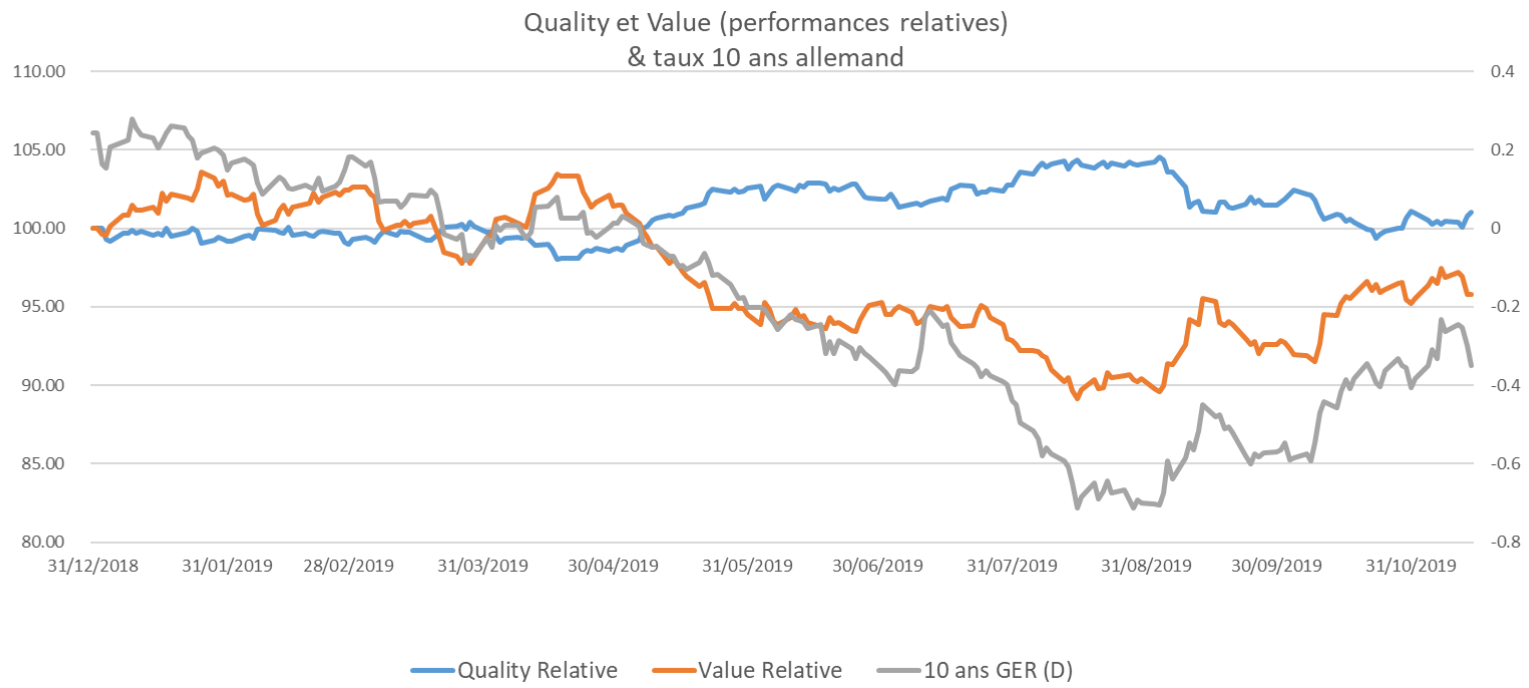


	S2	S1	Global
Performance moyenne	3.27%	2.62%	2.92%
Volatilité historique	4.26%	2.38%	4.54%
Sharpe Ratio	0.77	1.10	0.64
Nbr of years S2>S1	58.8%		

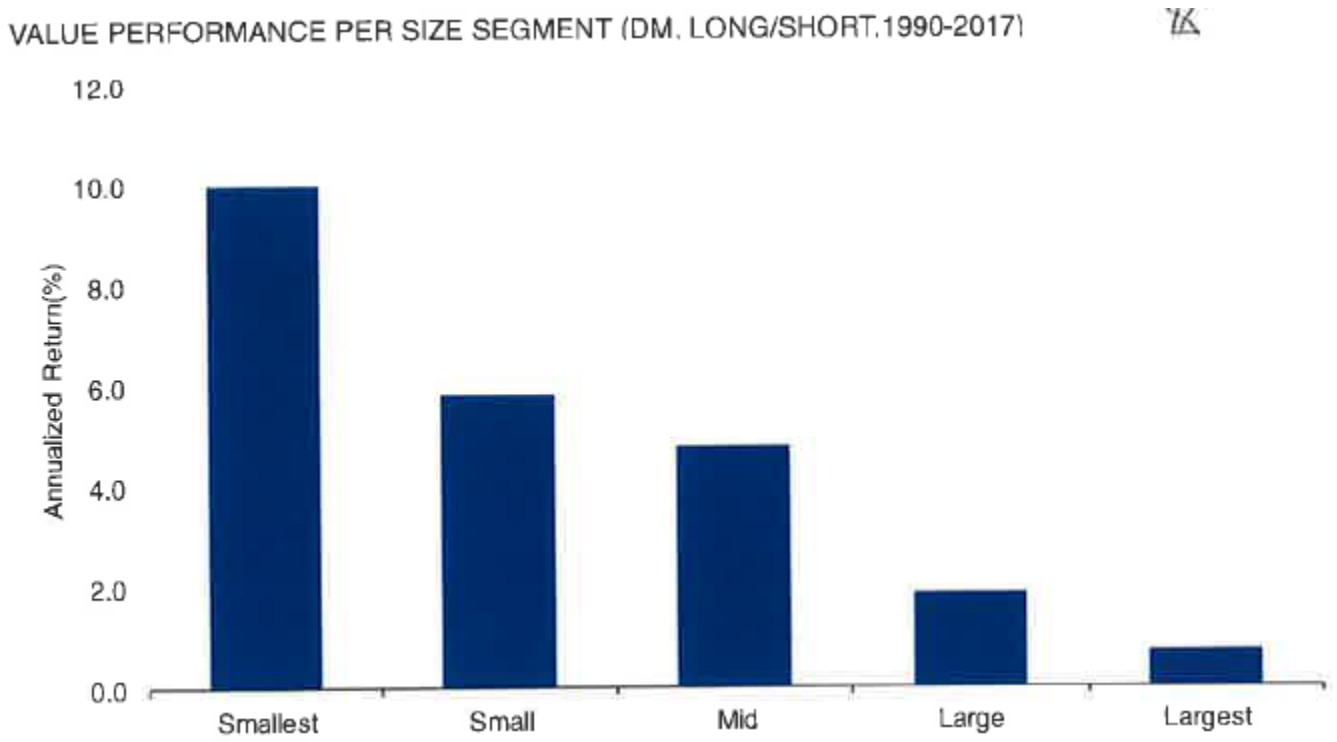
Understanding the implied risk of a Risk Premia can be a significant advantage



Understanding the implied risk of a Risk Premia can be a significant advantage



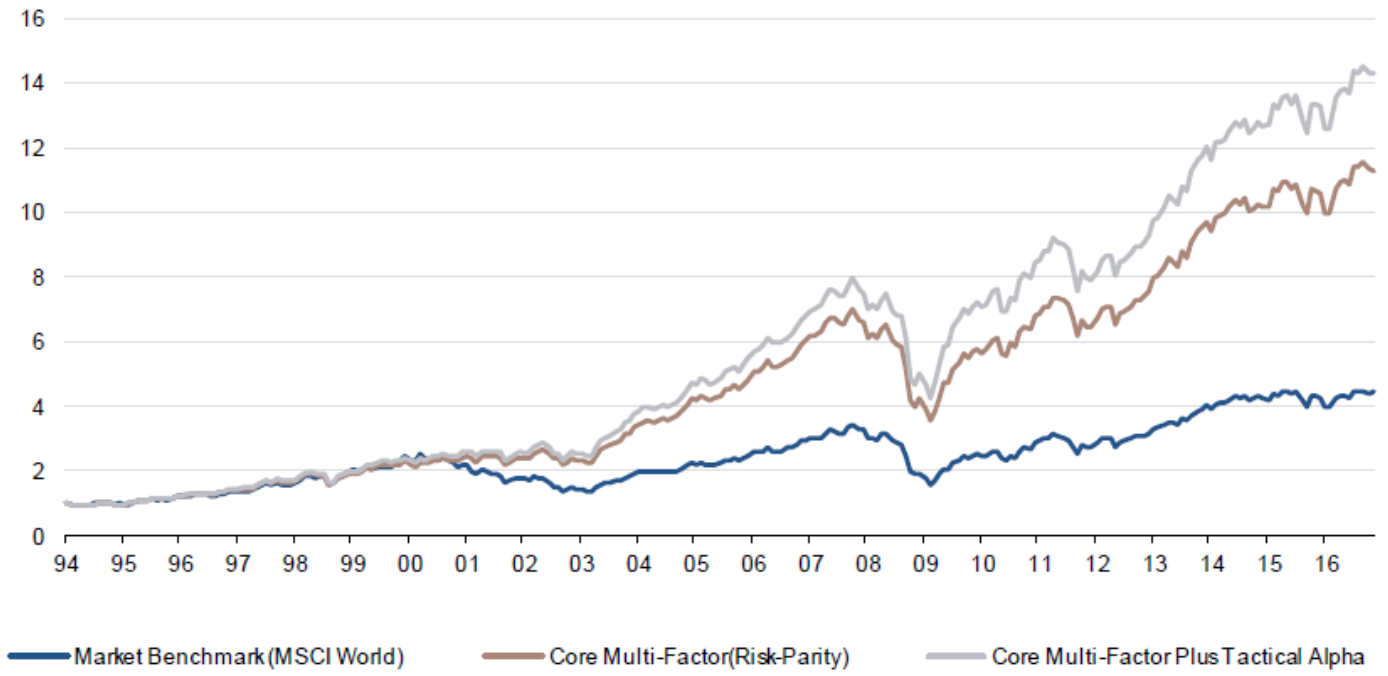
Value sounds to be dependant on the size
… and it apparently does not work with big cap



Business cycle approach for multi-factor allocation

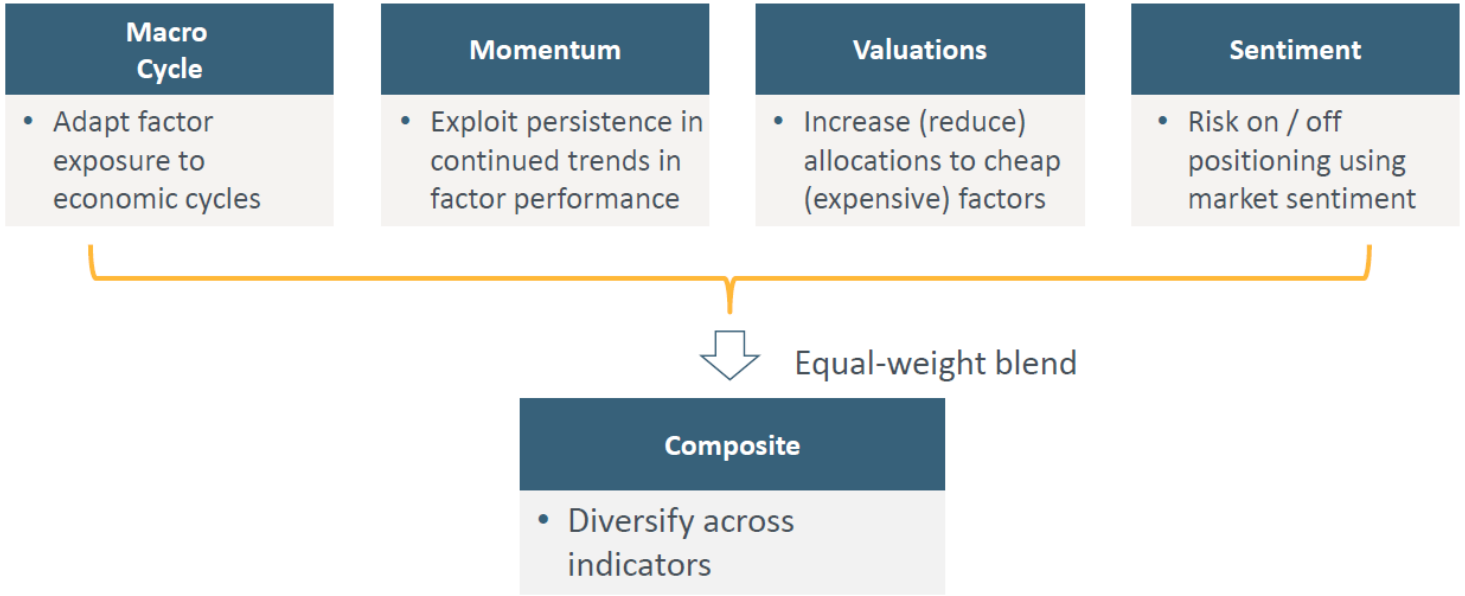
Tactical Allocation can help to outperform risk-based agnostic strategies in the multi-factor universe

Performance Comparison: Market Benchmark, Core Multi-Factor Portfolio and Tactical Alpha, Global Universe, 1994-2016



Source: SG Cross Asset Research/Equity Quant

MULTIFACETED APPROACH TO ADAPTIVE MULTI-FACTOR ALLOCATIONS



RESEARCH ON ADAPTIVE FACTOR ALLOCATION

Macro Environment

Date	Author	Title
1992	Zarnowitz, V.	Composite Indexes of Leading, Coincident, and Lagging indicators
1999	Shumaker el al	Equity Style Timing
2002	Black	The impact of monetary policy on value and growth stocks: An international evaluation
2006	Arshanapalli et al	Equity-style timing: A multi-style rotation model for the Russell large-cap and small-cap growth and value style indexes

Trend

Date	Author	Title
2008	Tibbs et al	Using Style Index Momentum to Generate Alpha
2013	Moskowitz et al	Value and Momentum Everywhere
2014	Alighanbari et al	Multi-Factor Indexes Made Simple

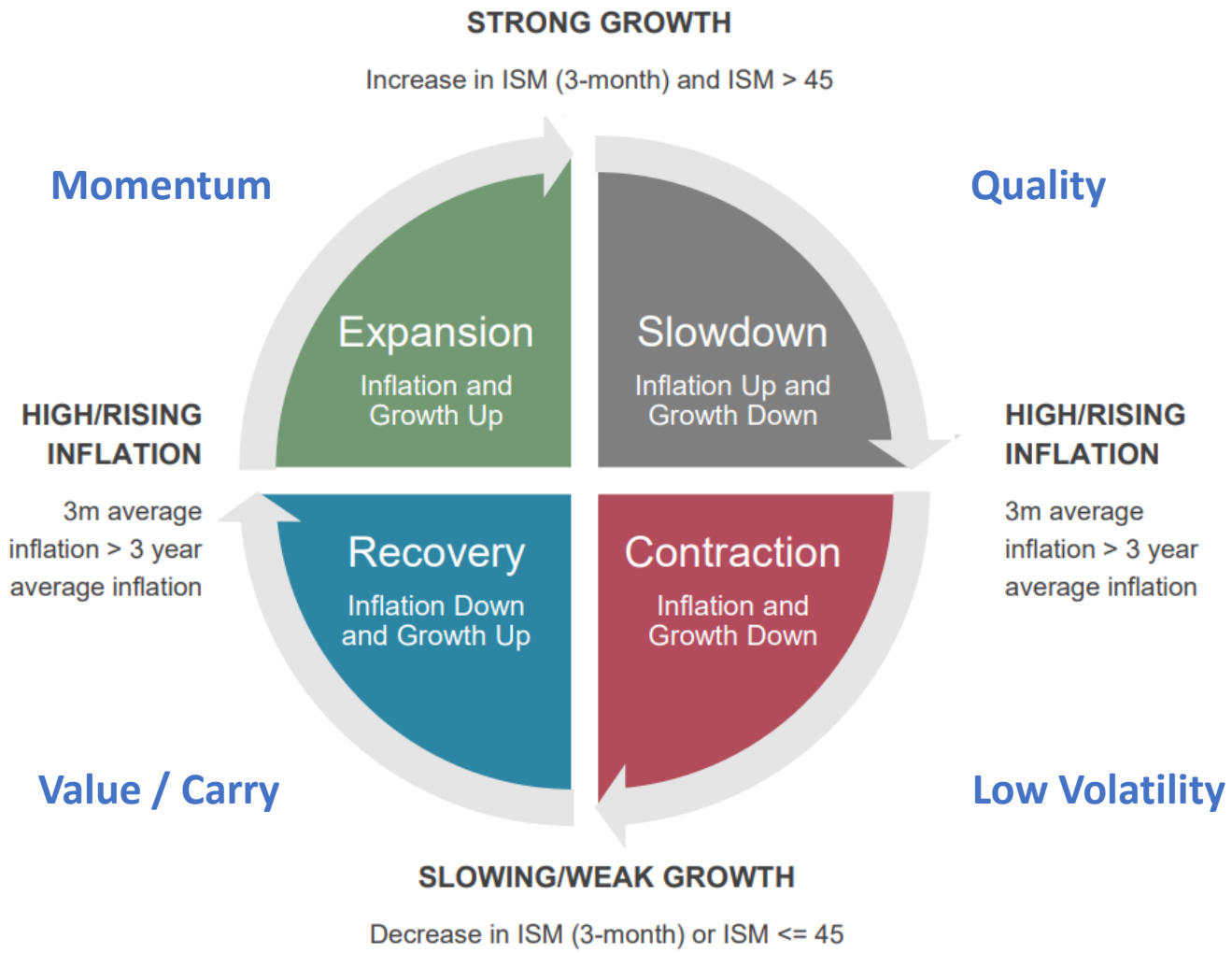
Fundamentals

Date	Author	Title
2014	Alighanbari et al	Multi-Factor Indexes Made Simple
2017	Hodges et al	Factor Timing with Cross-Sectional and Time-Series Predictors
2017	Asness et al	Deep Value

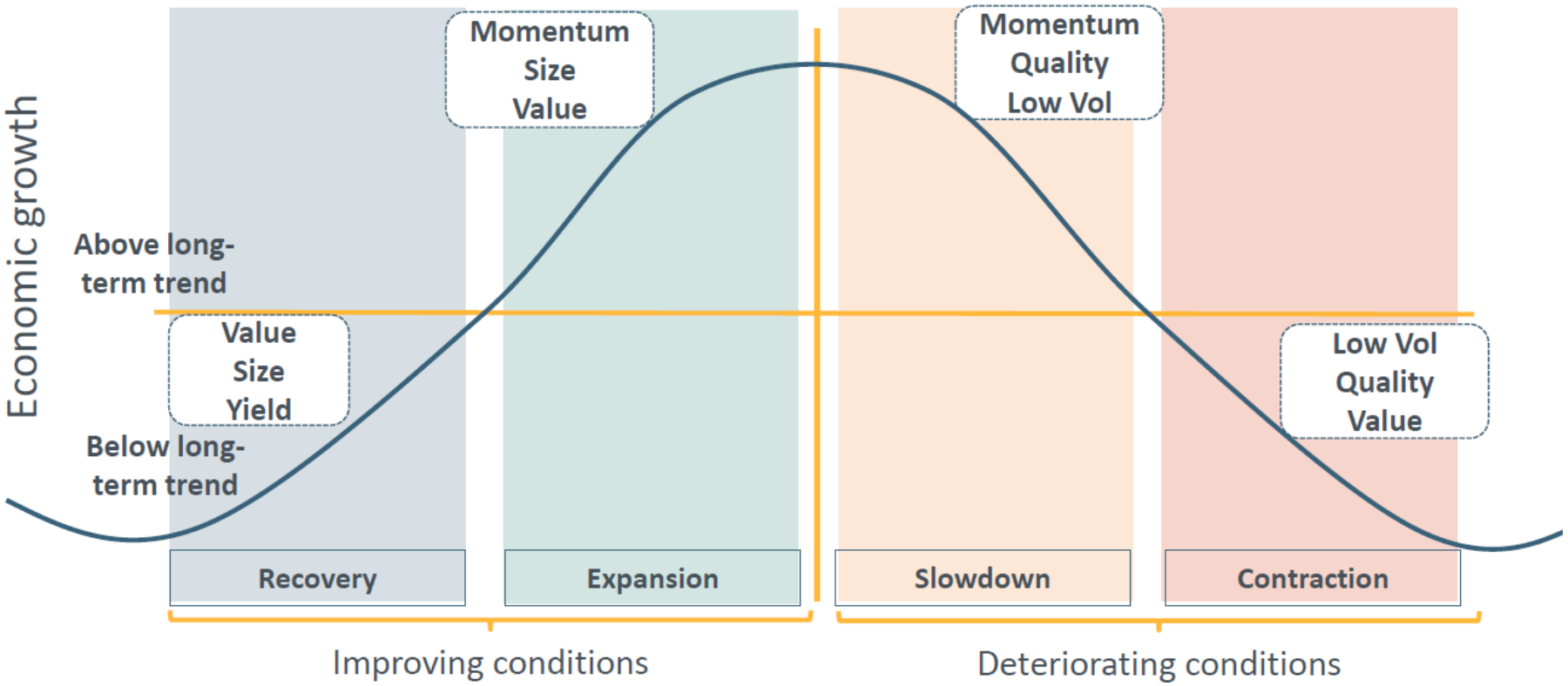
Sentiment

Date	Author	Title
1999	Copeland and Copeland	Market Timing: Style and Size Rotation Using the VIX
2007	Banerjee et al	Implied Volatility and Future Portfolio Returns
2011	Boscaljon et al	Market timing using the VIX for style rotation
2014	Efremidze et al	Using VIX Entropy Indicators for Style Rotation Timing
2017	Kaiser, L	Dynamic Indexes: Equity Rotation and Factor Timing

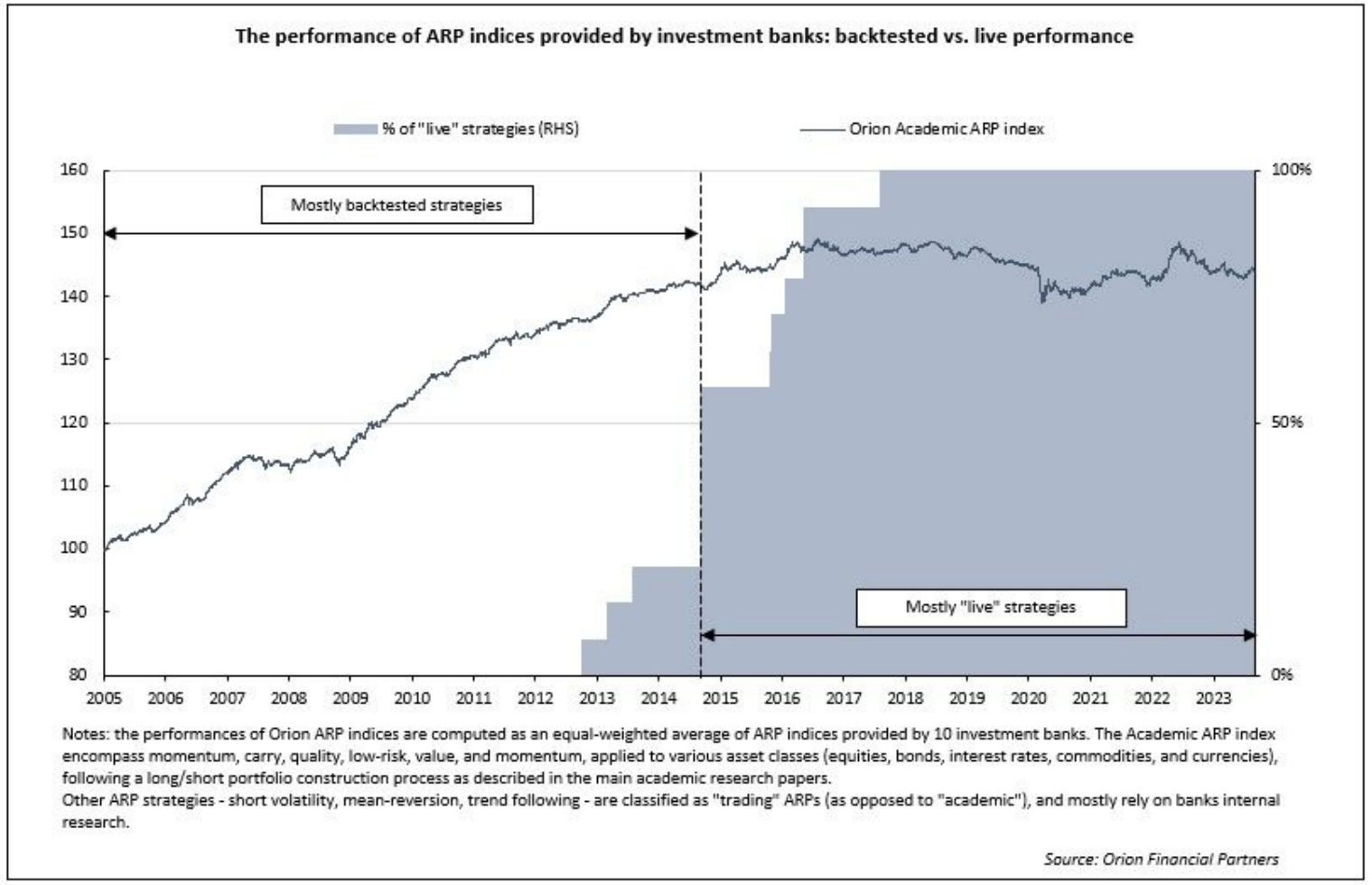
The investment clock: linking factor performance and economic cycles



MACRO CYCLE CAPTURING THE DIRECTION OF CHANGE



ARP Backtest & the law of overfiting: Mind the gap!



	AQR reference for academic factors	since 2015
value (HML)	-1.00%	-2.00%
quality (QMJ)	5.80%	0.70%
low risk (BAB)	6.40%	0.40%
momentum (UMD)	5.00%	-1.10%

- Before 2015, more than 50% of the performances reported by ARP providers are backtested performances, while after 2015, reported performances are mostly "live" or real performance... Mind the gap!
- Serious impact of backtesting bias, overfitting, and implementation gap

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