UBS

Investment Research

Using proprietary data in portfolio construction

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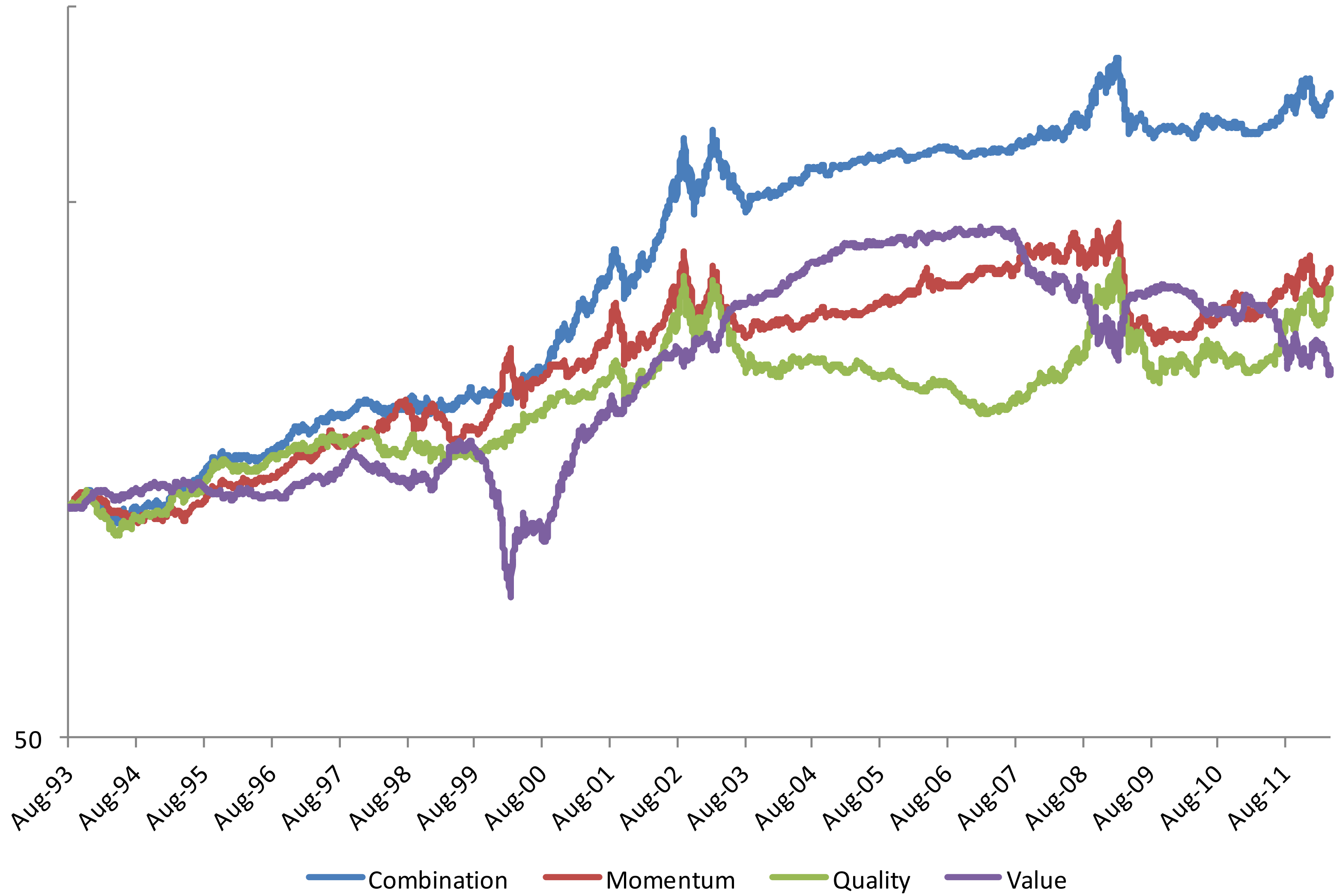
Performance of European factor portfolios

- The chart shows the performance of European long / short factor portfolios from 1993. We can see the generally low performance of quant strategies since 2008.



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Source: UBS Quants. Data to 3rd May 2012.

SECTION 1

The signals

What data & models do we have?

- UBS Analysts
  - Recommendations
  - Price targets
  - Alpha Preferences
- Trading data – implied volatilities
- Flows
- Growth surprise index
- Survey data

SECTION 1.A

The signals

UBS analyst data

UBS analyst data

- From our analysts we have many sources of data. These include
  - Recommendations
  - Price targets
  - “Alpha preferences” – most and least preferred stocks in their sector
  - Other revision data
- For sake of simplicity we’ll focus on the European Alpha Preferences data

European Alpha Preferences are our analyst best stock picks

- The chart shows a back test of the performance of our Alpha Preferences portfolio (here built as a market neutral portfolio with equal investments in the long and short side).

Source: UBS

SECTION 1.B

The signals

Volatility Skew

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Option Skew

- There are lots of definitions of skew used and discussed in the academic literature. We have chosen a simple definition of the difference between the 90% strike implied volatility and the 110% strike implied volatility.
- Data from the UBS option trading systems from March 2003 (proprietary UBS dataset)
- The data comes to us as a parameterised implied volatility surface. We convert this to implied volatilities at constant moneyness and maturities.
- The universe for the examples below is the largest 500 names in the Dow Jones Europe index
- Unless otherwise stated, we build our portfolios by dividing the universe into equal thirds and equal weighting the names in each third.

The two rebalancing methods are:

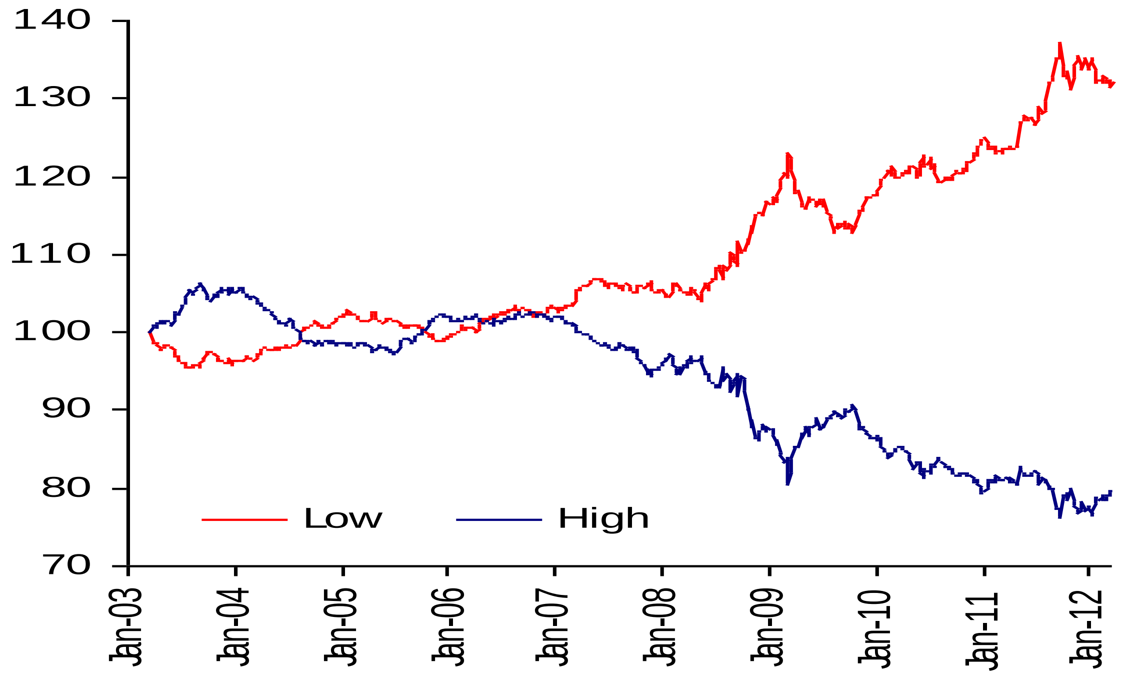
i) Weekly on Thursdays using close of Wednesday options data

ii) Monthly on the first week-day of the month using data from the close of the last week-day of the previous month

Performance

- The low skew portfolio has tended to strongly out-perform the benchmark.

Relative performance of top/bottom third of stocks by skew, weekly rebalancing



	Europe	
	Low	High
Annualised return	17.5%	11.1%
Annualised SD	22.6%	26.9%
Sharpe	0.70	0.41
Information Ratio	0.67	-0.35
Hit rate	53%	46%

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Source: UBS quant, for illustrative purposes only.

Is this a new factor?

- Regressing on the Carhart factors, we find that the low skew portfolio has significant and positive returns in Europe.

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept (BP per week)	**7.2**	**3.0**	**2.44**	**0.015**
Market	0.975	0.011	85.47	0.000
Book to price	-0.173	0.032	-5.49	0.000
Momentum	-0.079	0.022	-3.55	0.000
Size	0.186	0.032	5.78	0.000

Weekly, European returns to the low skew basket

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept (BP per month)	**48.0**	**15.6**	**3.08**	**0.003**
Market	0.925	0.032	29.34	0.000
Book to price	-0.142	0.087	-1.63	0.107
Momentum	-0.066	0.057	-1.16	0.249
Size	0.134	0.090	1.49	0.138

Monthly, European returns to the low skew basket

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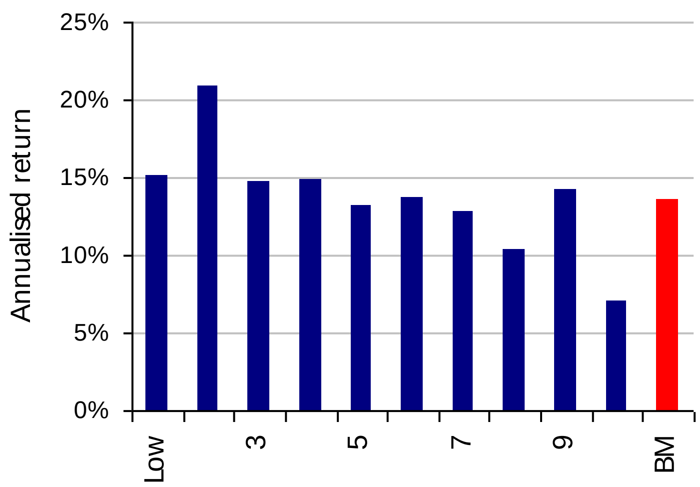
Source: UBS quant, for illustrative purposes only.

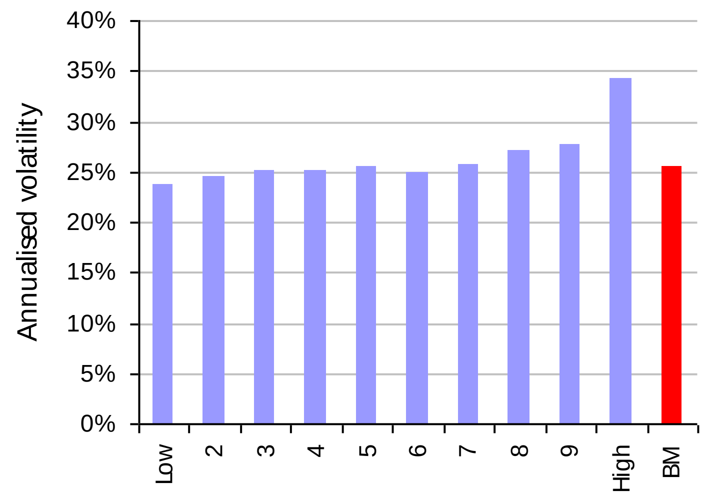
How are the returns distributed?

- Looking at the returns in each decile we see that the highest portfolio underperforms and has higher risk (much higher than average in Europe).

Europe, returns profile



Europe, risk profile



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Source: UBS quant, for illustrative purposes only.

SECTION 1.C

The signals

Growth Surprise Index

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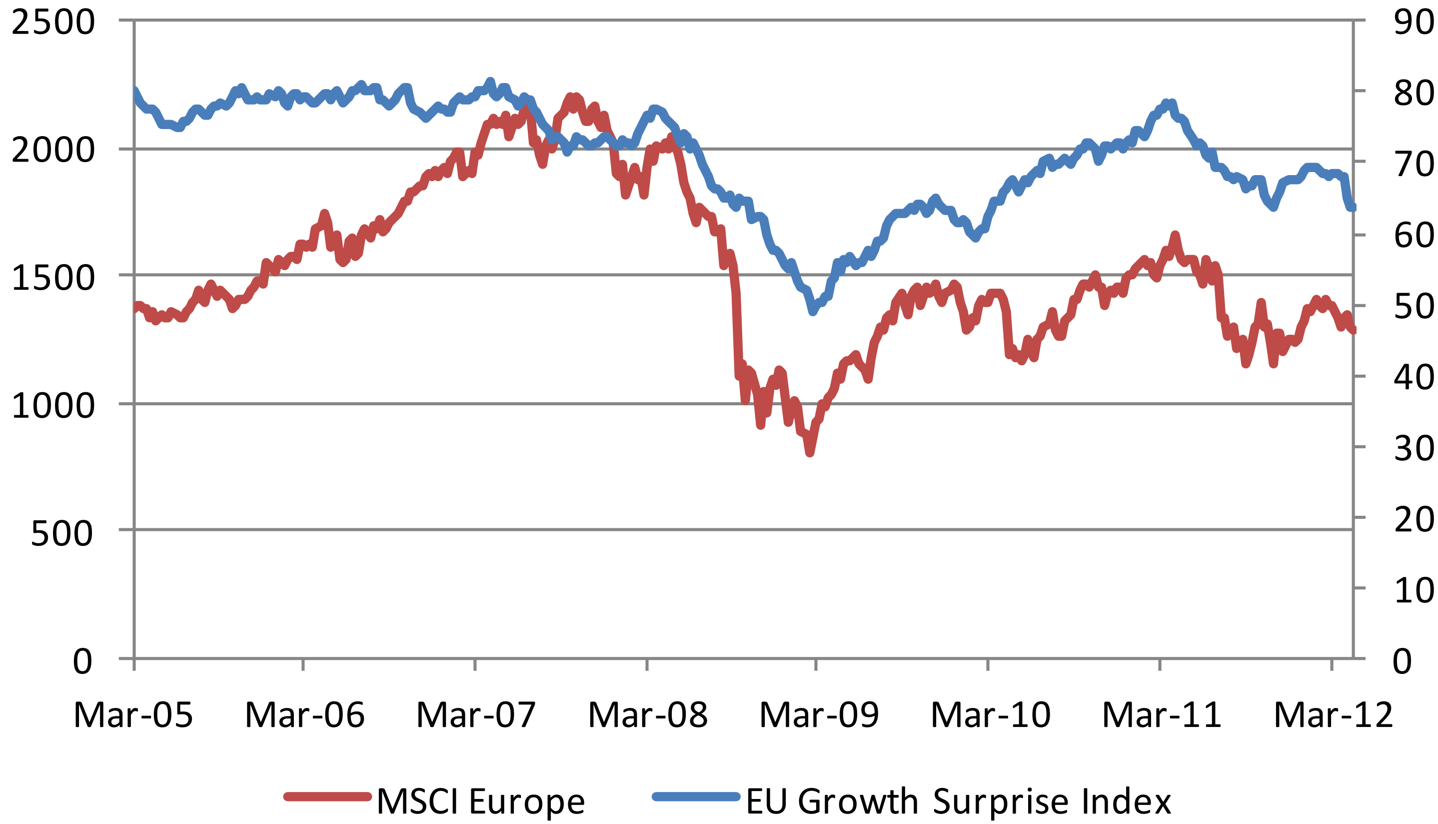
Growth surprise index

- The UBS Economics team calculate a range of surprise indices. Here we are focused on the growth surprise index for the Eurozone.
- Our growth surprise indices are calculated using the data for economic outcomes and consensus forecasts from Bloomberg. When the outcome from a given economic data release, such as industrial production, housing starts, retail sales or GDP, exceeds the published consensus (by even the smallest of margins) our surprise index moves up by 1 point. When it falls short of the published Bloomberg consensus it moves down by 1 point. For indicators such as unemployment, the signs are reversed. No allowance is therefore made for the degree to which an outcome has deviated from the consensus forecast. And no allowance is made for subsequent revisions to economic data.
- To get to a Eurozone index, the aggregations is a GDP-weighted (PPP-adjusted) average of the country-specific indices that form the make-up of the region.

Relationship with the market

- The growth surprise index has had a reasonable relationship with the market (here the MSCI Europe).



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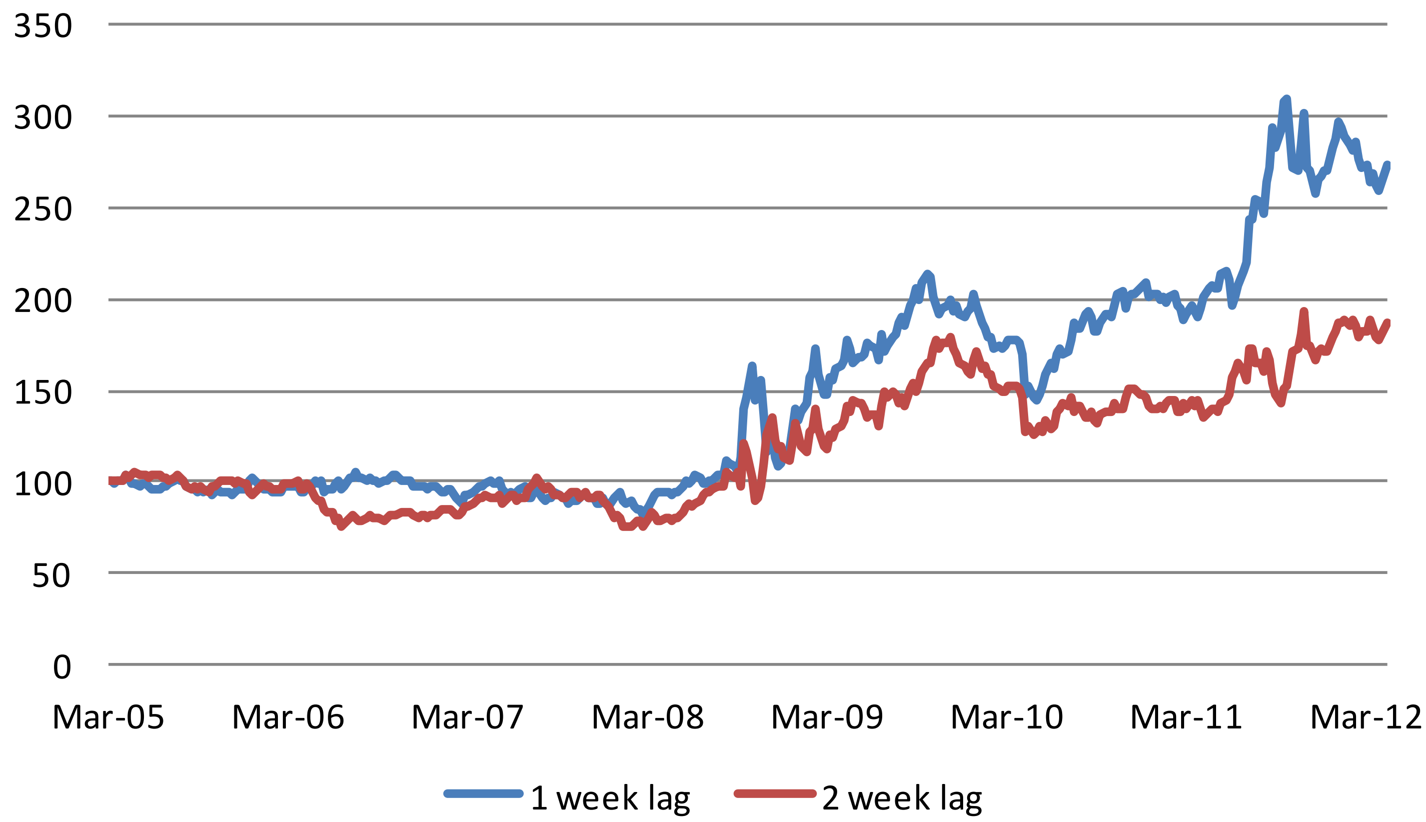
Source: UBS quant, for illustrative purposes only.

But there seems to be some information

- A strategy of buying the market if the growth surprise index went up last week and shorting it if it fell seems to give us some information (a hit rate of 55%). If we trade a week later then the hit rate falls to 52%.



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Source: UBS quant, for illustrative purposes only.

SECTION 2

Adding to our portfolio

Understanding our forecasts

- Before we embark on attempting to combine our new information into our basic quant portfolio, we need to consider what information is contained in the forecasts.
- Our approach of how to think about this is to work in the framework of breaking forecasts into stock specific and factor (or "portfolio") forecasts. Given this hopefully intuitive separation then we need to ask the question "Where is the information within the forecast"?
- So in some cases we need to neutralize the forecast to the factor model we are using. This also has the advantage of making the portfolio construction process more stable. We consider the alpha preferences views in this way – our analysts are making stock specific forecasts, not factor forecasts.
- Our forecast from the growth surprise index is obviously a factor forecast. Given the pattern of returns from our skew factor we will consider this to be a portfolio forecast.

Neutralisation - why it works! (but some notation first)

- Assume that stock returns can be described by the following Linear Factor Model

$$\boldsymbol{r}_{t+1} = \alpha + \boldsymbol{B}\boldsymbol{f}_{t+1} + \boldsymbol{\varepsilon}_{t+1} \quad \text{where}$$
$$\boldsymbol{f}_{t+1} \sim N\left(0, \boldsymbol{F}\right)$$
$$\boldsymbol{\varepsilon}_{t+1} \sim N\left(0, \boldsymbol{D} = \text{diag}(\sigma_1^2, \sigma_2^2, \cdots, \sigma_n^2)\right)$$

- implying that returns are distributed

$$\text{Cov}(\boldsymbol{r}_{t+1}) = \boldsymbol{V} = \boldsymbol{B}\boldsymbol{F}\boldsymbol{B}' + \boldsymbol{D}$$

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A Quant Manager decomposes his signal

- We first decompose our signal, (s $\propto$ μ) into factor and stock specific exposures
  - Regress the signal onto the sensitivities (*n.b.* A Generalised Least Squares) to estimate *g*

$$\mu = \boldsymbol{B}g + \hat{\alpha} \quad \text{where} \quad \begin{cases} \hat{\alpha} \sim N\left(0, \boldsymbol{D}\right) \\ g = E_t\left(f_{t+1}\right) \end{cases}$$

  - The quant stock picker uses α as his neutralised signal – the signal after removing any factor exposures.
  - These stock specific alphas, α, are orthogonal to the factor sensitivities

$$\hat{\alpha}^{\boldsymbol{T}} \ \boldsymbol{D}^{-1}\boldsymbol{B} = 0$$

Mean- variance optimisation for the stock picker

- The mean-variance problem is find portfolio *w* to maximise

$$w^T \mu - \lambda w^T V w$$

- The unconstrained optimal portfolio is

$$w = \lambda V^{-1} \mu$$

- If the quant manager only uses α as his alphas

$$w = \lambda V^{-1} \hat{\alpha} = \lambda \left(BFB^T + D \right)^{-1} \hat{\alpha} = \lambda D^{-1} \hat{\alpha}$$

as .

$$\hat{\alpha}^{\boldsymbol{T}} \ \boldsymbol{D}^{-1} \boldsymbol{B} = 0$$

A portfolio stock weight is its
alpha over variance
Robust and Stable

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Returning to Alpha Preferences

- The chart shows a back test of the performance of our Alpha Preferences portfolio (here built as a market neutral portfolio with equal investments in the long and short side).

Source: UBS

Neutralising Alpha Preferences

- We take the Alpha Preferences portfolio and calculate the implied alphas from this

$$\mu = \frac{1}{\lambda}\mathbf{Vw}$$

- We then use our neutralisation equation

$$\mu = Bg + \widehat{\alpha}$$

- And finally use the stock specific alphas from this equation to create our neutralised portfolio

$$w^{*} = \lambda \mathbf{D}^{-1}\widehat{\alpha}$$

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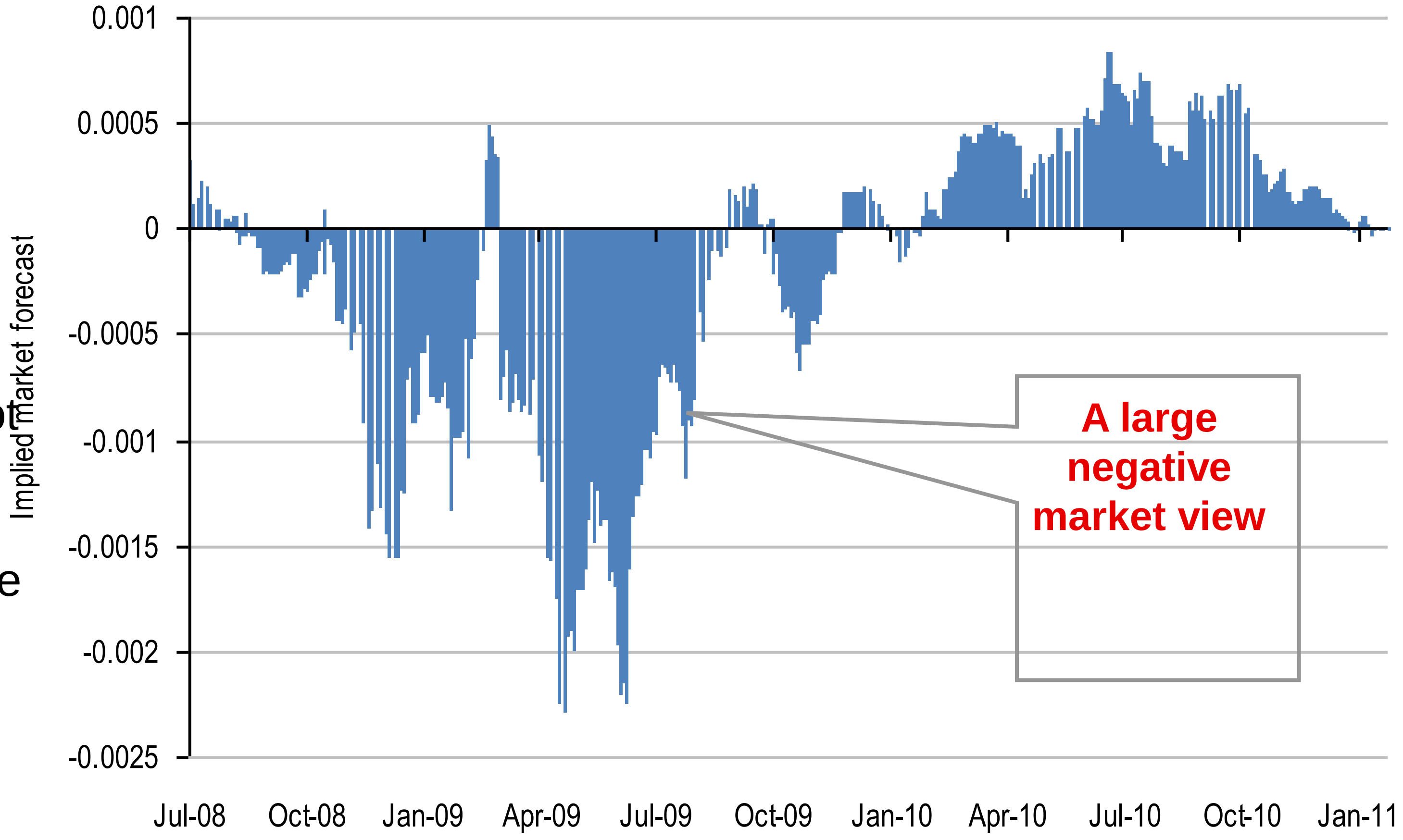
European Alpha Preferences historically

- This shows the implied forecast on the market factor (so the first element of f_{g})

- The portfolio is not market neutral! And note that we are negative to the market in March 2009

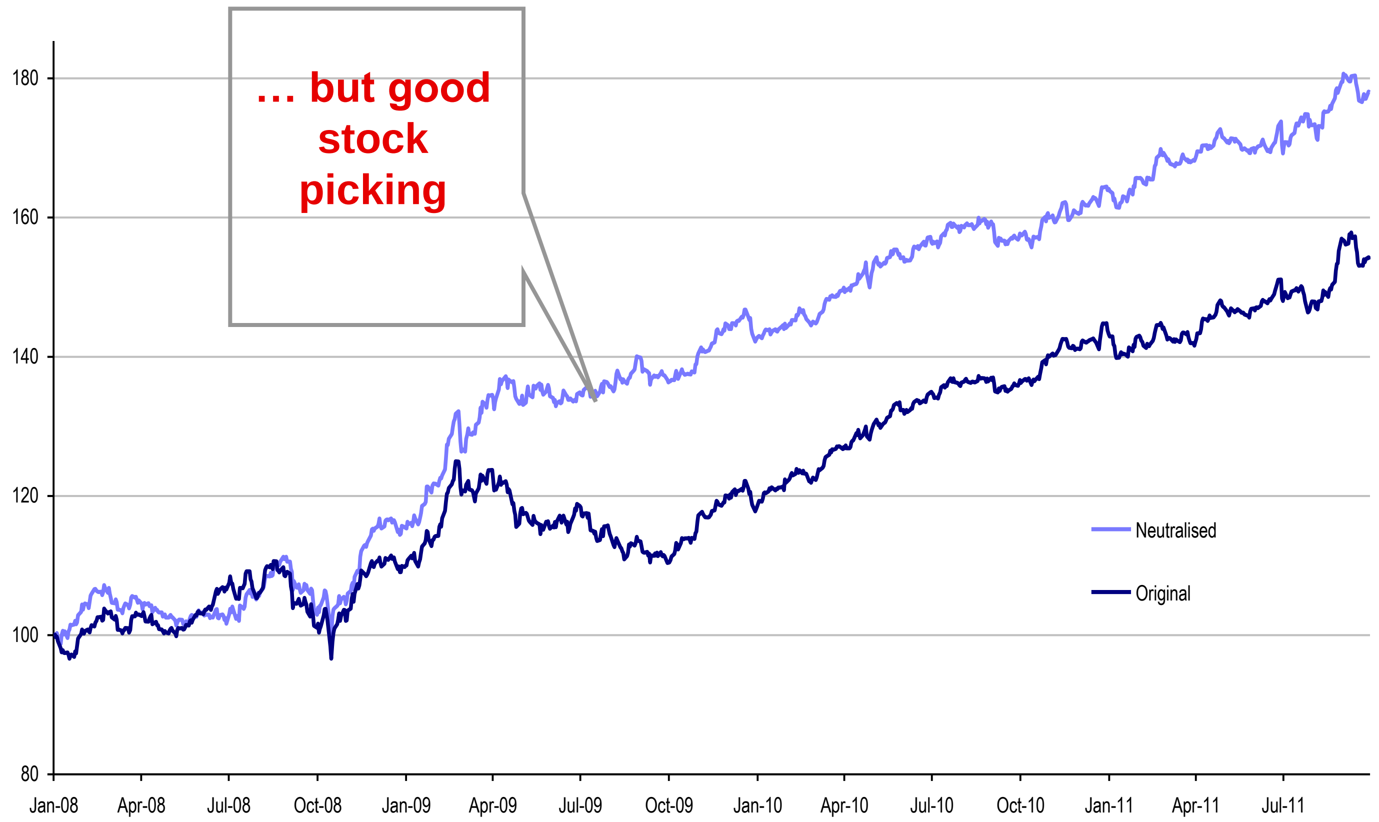


Source: UBS

Source: UBS Quants. For illustrative purposes only

Alpha Preferences historically

- This chart shows the returns to the portfolio with the factor positions removed.
- We see good stock specific performance over most of the period



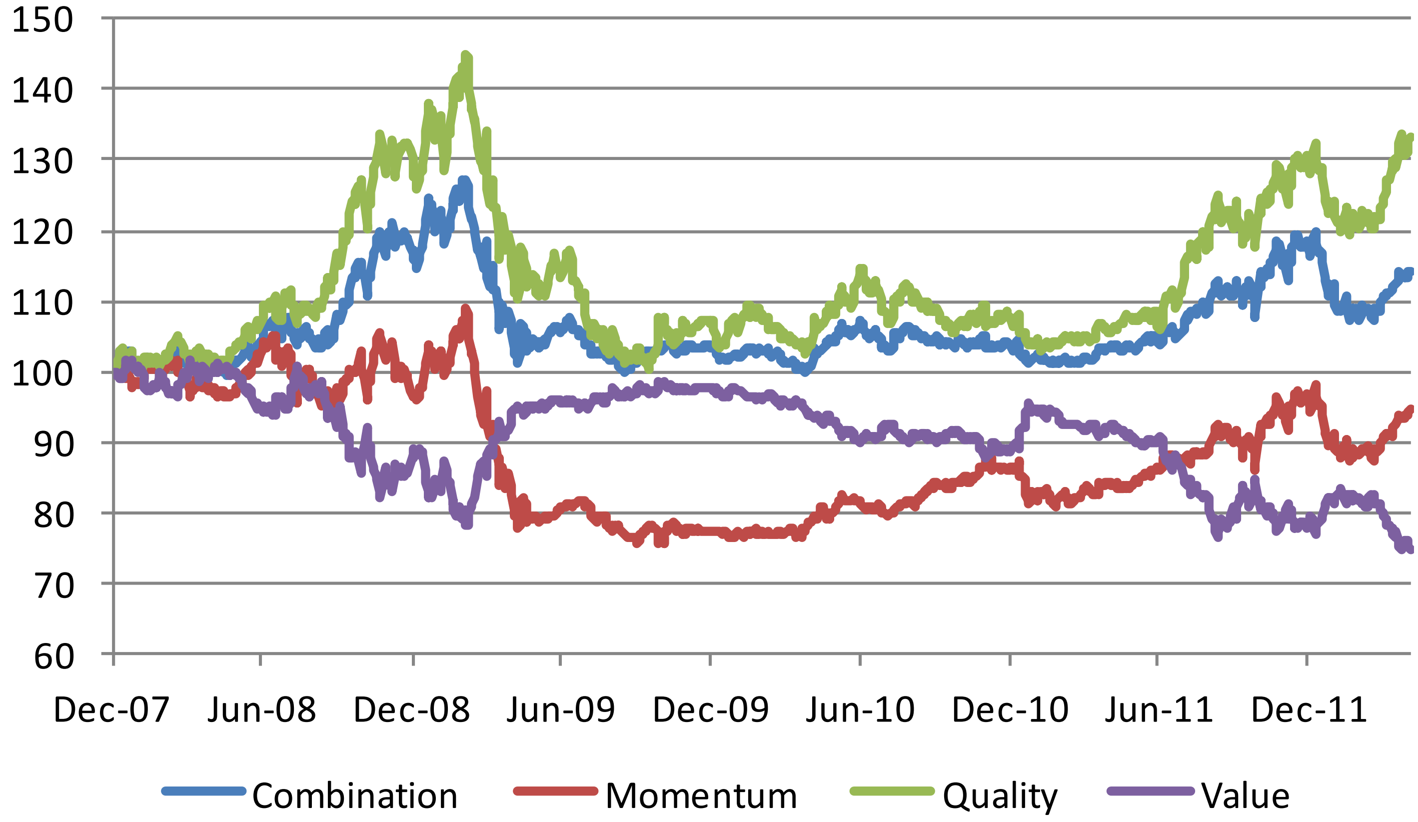
Source: UBS

SECTION 3

How to combine forecasts

The starting point

- We start from our three factor quant portfolio – value plus momentum plus quality.
- Our data starts in 2008 as that is when our history of alpha preferences starts.



Source: UBS

Mixed-Estimation or Black and Litterman Solution

- The Black and Litterman (1992) global asset allocation model was the seminal paper on the combination of investors' views with equilibrium expected returns
- The model can be set in a Theil (1971) framework where based on public information, investors have a prior view on expected returns. We shall call this the consensus view.
- Portfolio managers have more information. This information is represented as forecasts of expected return to a given set of portfolios.
- The consensus views are updated with these forecasts to derive a posterior estimate of the expected returns - amounts to imputing a set of expected returns that are a weighted average of the consensus and forecast views.

Combining forecasts with the consensus views

- Denote the consensus view of expected returns given public information as

$$E_t\left(r_{t+1}\middle|\boldsymbol{I}_t\right)=\mu_0$$

- The strategist has access to forecasts based on additional information which allows him to improve on the consensus view. We represent these forecasts as the return to *p* portfolios where

$$\boldsymbol{g}_{t+1}=\boldsymbol{P}E_t\left(r_{t+1}-\mu_0\middle|\boldsymbol{I}_t^+\right)+\boldsymbol{\eta}_t \quad \text{where} \quad \boldsymbol{\eta}_t\sim N\left(\boldsymbol{0},\boldsymbol{\Omega}\right)$$

The term $\boldsymbol{\eta}_t$ represents independent forecast errors and where the extra information I_t^+ can explain a proportion $\tau^2 V$ of the return

- Combing the two views gives us the Black and Litterman formula

$$\mu=E_t\left(r_{t+1}\middle|I_t,g_{t+1}\right)=\mu_0+\boldsymbol{VP^T}\left(\boldsymbol{PVP^T}+\tau^{-2}\boldsymbol{\Omega}\right)^{-1}\boldsymbol{g}_{t+1}$$

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Understanding the solution

- The optimal portfolio is the consensus portfolio (the market?) plus a tilt based on our forecasts

$$w = \lambda \boldsymbol{V}^{-1} \mu = w_0 + \lambda \boldsymbol{P}^{\boldsymbol{T}} \left(\boldsymbol{PVP}^{\boldsymbol{T}} + \tau^{-2} \boldsymbol{\Omega} \right)^{-1} \boldsymbol{g}_{t+1} = w_0 + \boldsymbol{P}^{\boldsymbol{T}} \tilde{\boldsymbol{g}}_{t+1}$$

The optimal portfolio tilt is just a weighted sum of the forecast portfolios *P!*

- The weights are just the adjusted returns to these forecast portfolios.

$$\tilde{\boldsymbol{g}}_{t+1} = \lambda \left(\boldsymbol{PVP}' + \tau^{-2} \boldsymbol{\Omega} \right)^{-1} \boldsymbol{g}_{t+1}$$

The adjustment is for the relative volatility in and covariance between the forecast portfolios

- And it will be stable as long as the forecast portfolios *P* are stable!

Extending this to other forecast types

- The equation can be extended to encompass stock specific, pure factor and portfolio forecasts:

$$E_t\left(r_{t+1} \middle| \begin{matrix} g_{t+1} \\ g_{f,t+1} \\ g_{\varepsilon,t+1} \end{matrix} \right) = [\mathbf{B}\ \mathbf{I}]\ E_t\left(\begin{bmatrix} f_{t+1} \\ \varepsilon_{t+1} \end{bmatrix} \middle| \begin{matrix} g_{t+1} \\ g_{f,t+1} \\ g_{\varepsilon,t+1} \end{matrix} \right) =$$

$$\begin{bmatrix} \tau^2 VP' & \tau^2 BFP'_f & \tau^2 DP'_\varepsilon \end{bmatrix} \begin{bmatrix} \tau^2 PVP' + \Omega & \tau^2 PBFP'_f & \tau^2 PDP'_\varepsilon \\ \tau^2 P_f FB'P' & \tau^2 P_f FP'_f + \Omega_f & 0 \\ \tau^2 P_\varepsilon DP' & 0 & \tau^2 P_\varepsilon FP'_\varepsilon + \Omega_\varepsilon \end{bmatrix}^{-1} \begin{bmatrix} g_{t+1} \\ g_{f,t+1} \\ g_{\varepsilon,t+1} \end{bmatrix}$$

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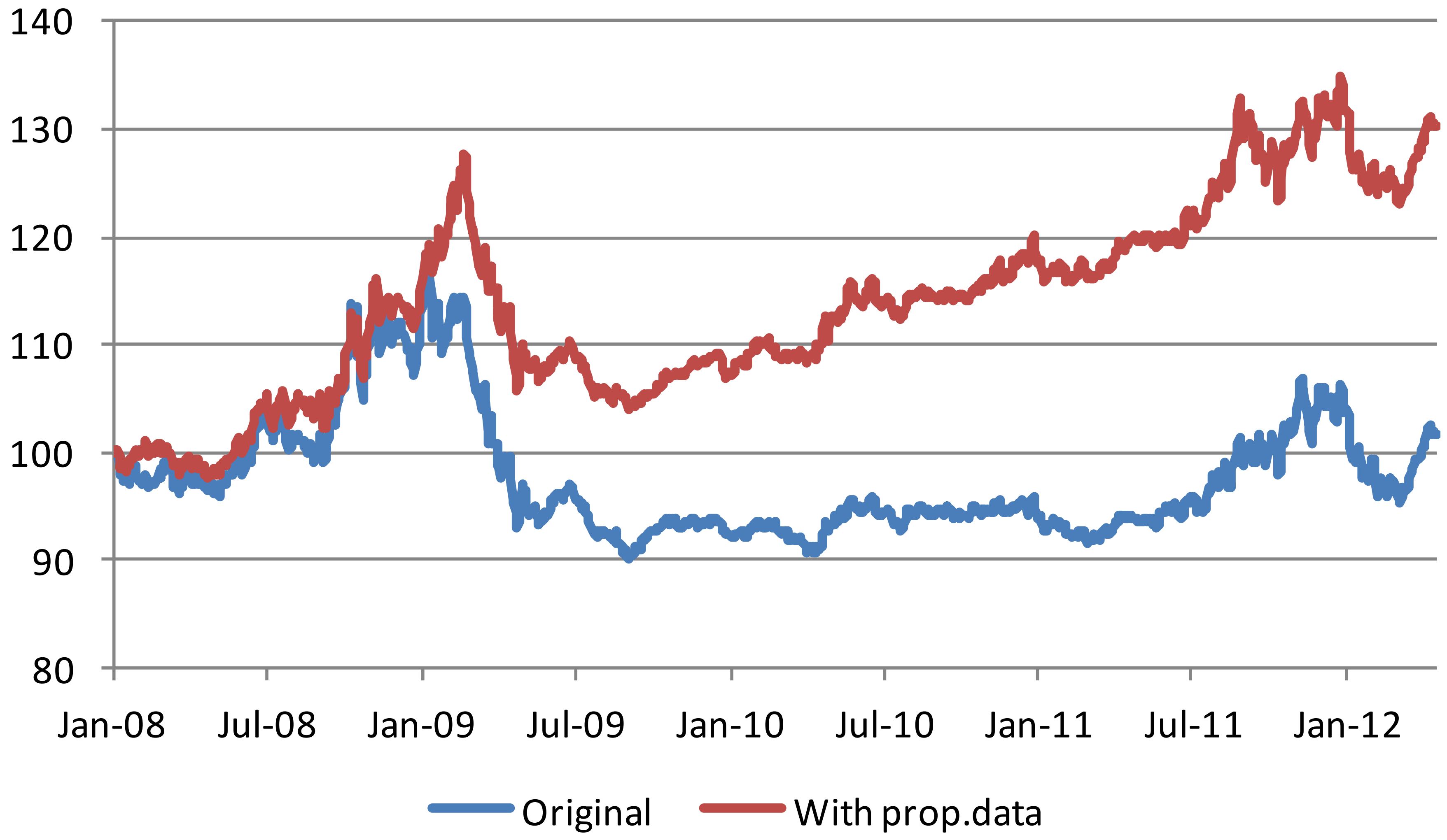
Putting it all together

- So in our case we have
  - Three factor forecasts from our underlying quant portfolio – value, momentum and quality. These are factor forecasts as we include these factors in our risk model
  - A factor forecast on the first factor in the risk model, the market factor
  - A portfolio forecast from the skew (long low skew, short high skew)
  - A set of stock specific forecasts from alpha preferences.

Putting it all together



Source: UBS

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APPENDIX A

How to audit forecasts

Forecast auditing

- This process takes forecasts and calculates the stock level alphas. However, we believe that the process can be improved by attempting to understand how the forecasts are being used, and whether the forecasts are consistent. We call this process forecast auditing.
- Mixed estimation maps your forecasts onto the factors in the risk model and stock specific risk. We calculate the implied factor returns using the equation

$$E(f_{t+1} \mid I_t, g_{t+1}) = \tau^2 \mathbf{F}\mathbf{B}'\mathbf{P}' \left(\tau^2 \mathbf{P} V \mathbf{P}' + \mathbf{\Omega} \right)^{\mathbf{-1}} g_{t+1}$$

- Why is this useful? The following example illustrates this.

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Implied factor forecasts – an example

- Building a value and momentum fund: We have put equal forecasts of return on our value and momentum funds. The implied factor forecasts are shown below:

UBS Portfolio Analysis System

Forecast correlations	1	2
1 Composite Value <V>	1.000	
2 High Medium Term Price Momentum <M>	0.463	1.000

Factor forecasts and implied changes	Total	drop 1	drop 2
UBS World Index	-1.969	-0.386	2.045
UBSA Oil & Gas	6.819	-2.353	-2.969
UBSA Basic Materials	2.381	-0.816	-1.020
UBSA Industrials	-0.763	0.280	0.300
UBSA Consumer Goods	0.324	0.428	-0.747
UBSA Health Care	-0.048	0.445	-0.465
UBSA Consumer Services	-1.494	0.637	0.484
UBSA Telecommunications	-0.943	-0.273	1.079
UBSA Utilities	1.956	-0.420	-1.120
UBSA Financials	-1.155	0.060	0.869
UBSA Technology	-3.896	1.040	1.950
Canada	-0.147	0.110	-0.006
UK	0.503	-0.054	-0.348
Japan	-1.197	0.342	0.581
United States	-0.038	0.005	0.024
EMU	0.838	-0.249	-0.399
Europe Ex EMU/UK	0.474	-0.238	-0.116
Asia-Pacific Ex Japan	-0.085	-0.004	0.074
Latin America	-0.102	-0.002	0.085
Composite Growth <G>	-0.468	0.142	0.218
Composite Value <V>	0.461	-0.251	-0.090
High Medium Term Price Momentum <M>	-0.710	0.165	0.388
High Dividend Cover <Q>	-0.355	0.039	0.244
Mid Cap <S>	-0.214	0.083	0.078
High Free Cash-flow Yield <V>	0.224	-0.058	-0.116

Computing covariance matrix | Strategy: Value & Momentum | W | PAS_GLB

Source: UBS

Source: UBS Quants. For illustrative purposes only

Implied factor forecasts – an example (2)

- We can see we have a large negative forecast on the first, benchmark, factor. The reason for this is that high (low) momentum stocks currently have a low (high) market beta. Given that the market factor is the primary driver of return then this is where the mathematics maps the return. **But this isn't what we mean.**

- To fix this we add an artificial forecast of zero on the market portfolio (or the market factor). This leads to the implied returns seen here.

UBS Portfolio Analysis System

Factor forecasts and implied changes	Total	drop 1	drop 2
UBS World Index	-0.424	-1.545	0.065
UBSA Oil & Gas	6.973	-0.154	-2.251
UBSA Basic Materials	2.466	-0.084	-0.771
UBSA Industrials	-0.763	0.000	0.273
UBSA Consumer Goods	0.389	-0.065	0.435
UBSA Health Care	-0.019	-0.029	0.442
UBSA Consumer Services	-1.504	0.010	0.617
UBSA Telecommunications	-0.992	0.049	-0.280
UBSA Utilities	2.053	-0.097	-0.382
UBSA Financials	-1.218	0.062	0.041
UBSA Technology	-4.012	0.116	0.977
Canada	-0.150	0.003	0.106
UK	0.522	-0.020	-0.047
Japan	-1.220	0.023	0.326
United States	-0.044	0.007	0.003
EMU	0.869	-0.032	-0.234
Europe Ex EMU/UK	0.481	-0.006	-0.230
Asia-Pacific Ex Japan	-0.084	-0.001	-0.004
Latin America	-0.113	0.011	-0.005
Composite Growth <G>	-0.491	0.024	0.131
Composite Value <V>	0.485	-0.023	-0.237
High Medium Term Price Momentum <M>	-0.735	0.025	0.154
High Dividend Cover <Q>	-0.365	0.011	0.035
Mid Cap <S>	-0.203	-0.010	0.084
High Free Cash-flow Yield <V>	0.238	-0.014	-0.053

Computing covariance matrix | Strategy: Value & Momentum | W | PAS_GLB

Source: UBS

Checking the consistency of the Forecasts

- Forecasts often come from very different sources. Therefore may be based on different assumptions.
- Need to check the forecasts for mutual consistency. For example:
  - Are the analyst price recommendations consistent with the
    a) Sector calls b) Value/Growth Calls ?
  - Are the sector calls consistent with the
    a) regional calls b) value/growth Calls ?
- Developed the Relative Risk Statistic. Given forecasts, g_1 and g_2, the relative risk measures the probability of observing g_2 divided by the probability of observing g_2 given the forecasts g_1 .

More formally

- We have assumed that the joint distribution of forecasts is

$$\begin{bmatrix} \boldsymbol{g}_{1,t+1} \\ \boldsymbol{g}_{2,t+1} \end{bmatrix} \sim \boldsymbol{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \tau^2 \boldsymbol{P_1 V P_1' + \Omega_1} & \tau^2 \boldsymbol{P_1 V P_2'} \\ \tau^2 \boldsymbol{P_2 V P_1'} & \tau^2 \boldsymbol{P_2 V P_2' + \Omega_2} \end{bmatrix} := \begin{bmatrix} \boldsymbol{\Lambda}_{11} & \boldsymbol{\Lambda}_{12} \\ \boldsymbol{\Lambda}_{12}' & \boldsymbol{\Lambda}_{22} \end{bmatrix} \right)$$

which implies

$$g_{1,t+1} \sim N\left(0, \Lambda_{11}\right)$$

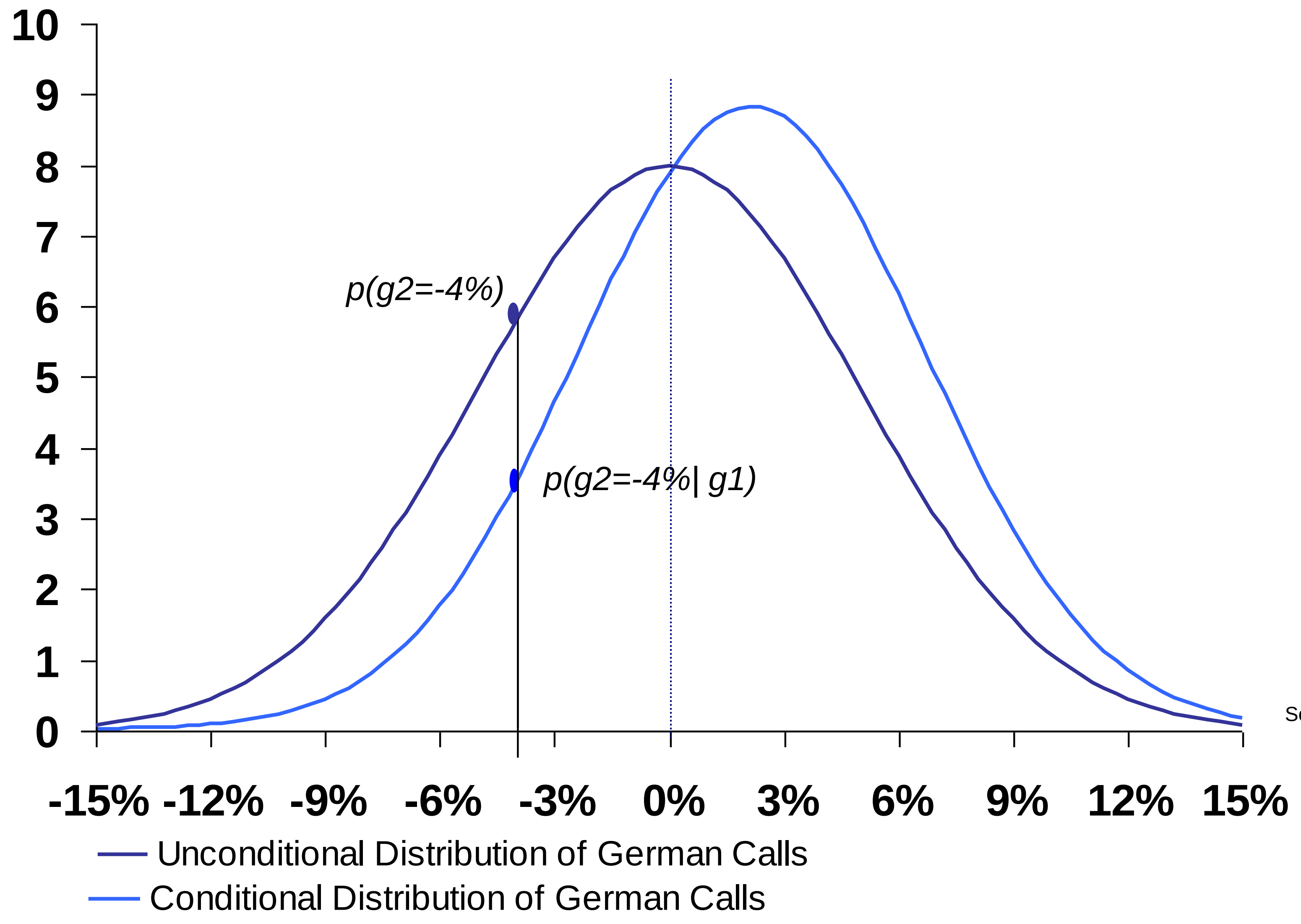
$$g_{1,t+1} \middle| g_{2,t+1} \sim N\left(\Lambda_{12}\Lambda_{22}^{-1} g_{2,t+1}, \Lambda_{11} - \Lambda_{12}\Lambda_{22}^{-1}\Lambda_{12}{}' \right)$$

- The relative risk statistic is defined

$$RR(g_1 | g_2) = \frac{p(g_1)}{p(g_1 | g_2)} = \frac{p(g_2)}{p(g_2 | g_1)} = RR(g_2 | g_1)$$

and its natural log is distributed as weighted sum of central Chi.

An example: Audit of the German Forecast



Source: UBS

$$\text{Relative Risk} = \frac{p(g_2)}{p(g_2|g_1)} = 1.66 > 1 \quad \text{p-value}=0.087$$

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APPENDIX B

Additional details on Black & Litterman

Equivalence to Black Litterman Formula

- From the matrix inversion theorem e.g. Lütkepohl (1996, p.29)

$$\left(\tau^2 \boldsymbol{PVP}' + \boldsymbol{\Omega}\right)^{-1} = \boldsymbol{\Omega}^{-1} - \boldsymbol{\Omega}^{-1}\boldsymbol{P}\left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}$$

- Hence

$$\begin{aligned} E_t\left(r_{t+1} \middle| I_t, g_{t+1}\right) &= \mu_0 + \tau^2 \boldsymbol{VP}'\left[\boldsymbol{\Omega}^{-1} - \boldsymbol{\Omega}^{-1}\boldsymbol{P}\left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\right]\boldsymbol{g}_{t+1} \\ &= \mu_0 + \left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{g}_{t+1} \\ &= \left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\left(\tau^{-2}\boldsymbol{V}^{-1}\mu_0 + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\left(\boldsymbol{g}_{t+1} + \boldsymbol{P}\mu_0\right)\right) \end{aligned}$$

- Therefore the final vector of expected returns is a weighted average of the forecasts and consensus views. This is often called a shrinkage or Bayes-Stein estimator.
- For full details see Sefton, Bulsing and Scowcroft (2004).

Conditioning the Forecasts reduces turnover

- The mean-variance optimisation problem is find portfolio ***w*** to maximise

$$w'\mu - \lambda w'\Sigma w$$

where the risk matrix ***Σ*** (in the optimiser) is different from the risk matrix ***V***.

- The unconstrained optimal portfolio is

$$w = \lambda \Sigma^{-1} \mu$$

and therefore using the conditioned returns from Black-Litterman,

$$w = \lambda \Sigma^{-1} \mu_0 + \lambda \left[\Sigma^{-1} \boldsymbol{V} \right] \boldsymbol{P}' \left(\boldsymbol{PVP}' + \tau^{-2} \boldsymbol{\Omega} \right)^{-1} \boldsymbol{g}_{t+1}$$

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Reducing Turnover (2)

- The term **[$\Sigma^{-1}V$]** can cause large turnover. To illustrate let

$$\Sigma = V - b\delta b'$$

Then a little algebra show that

$$b'[\Sigma^{-1}V] = \left(\frac{\delta^{-1}}{\delta^{-1} - b'V^{-1}b} \right) b'$$

but if the risk matrix **V** has a small eigenvalue the term $b'V^{-1}b$ can be very large. In fact the matrix product can tend to infinity for very small perturbations! For later, note that this condition is most likely to satisfied if *b* lies in the nullspace of ***B***.

- Therefore if the perturbation changes from one period to another, the portfolio can change by an almost arbitrary amount.

And this turnover promises elusive profits

- The promised information ratio from this portfolio

$$IR^2 = E\left(\mu'\Sigma^{-1}\mu\right) = E\left(Trace\left(\Sigma^{-1}\mu\mu'\right)\right)$$

$$= Trace\left(\Sigma^{-1}E\left(\mu\mu'\right)\right)$$

$$= Trace\left(\tau^2\left[\Sigma^{-1}V\right] - \tau^2\left[\Sigma^{-1}\boldsymbol{V}\right]\boldsymbol{P'}\left(\tau^2\boldsymbol{PVP'} + \boldsymbol{\Omega}\right)^{-1}\tau^2\boldsymbol{PV}\right)$$

- So the same argument applies. The optimiser promises phenomenal performance! (which unfortunately will not be delivered)

- **Solution**: Use the same risk matrix to condition the forecasts as is used in the optimiser, $\boldsymbol{\Sigma} = \boldsymbol{V}$, so that $\boldsymbol{\Sigma^{-1}V} = \mathbf{I}$

Analyst Certification

Analyst Certification

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UBS Investment Research: Global Equity Rating Allocations

UBS 12-Month Rating	Rating Category	Coverage[1]	IB Services[2]
Buy	**Buy**	51%	34%
Neutral	**Hold/Neutral**	40%	35%
Sell	**Sell**	9%	15%
UBS Short-Term Rating	**Rating Category**	**Coverage[3]**	**IB Services[4]**
Buy	**Buy**	less than 1%	25%
Sell	**Sell**	less than 1%	17%

1:Percentage of companies under coverage globally within the 12-month rating category.
2:Percentage of companies within the 12-month rating category for which investment banking (IB) services were provided within the past 12 months.
3:Percentage of companies under coverage globally within the Short-Term rating category.
4:Percentage of companies within the Short-Term rating category for which investment banking (IB) services were provided within the past 12 months.

Source: UBS. Rating allocations are as of 31 March 2012.

UBS Investment Research: Global Equity Rating Definitions

UBS 12-Month Rating	Definition
Buy	FSR is > 6% above the MRA.
Neutral	FSR is between -6% and 6% of the MRA.
Sell	FSR is > 6% below the MRA.
UBS Short-Term Rating	**Definition**
Buy	Buy: Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.
Sell	Sell: Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.

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Forecast Stock Return (FSR) is defined as expected percentage price appreciation plus gross dividend yield over the next 12 months.
Market Return Assumption (MRA) is defined as the one-year local market interest rate plus 5% (a proxy for, and not a forecast of, the equity risk premium).
Under Review (UR) Stocks may be flagged as UR by the analyst, indicating that the stock's price target and/or rating are subject to possible change in the near term, usually in response to an event that may affect the investment case or valuation.
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Equity Price Targets have an investment horizon of 12 months.

EXCEPTIONS AND SPECIAL CASES

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Unless otherwise indicated, please refer to the Valuation and Risk sections within the body of this report.

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