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Understanding Forecasts – A Unified Framework for Combining and Auditing Analyst and Strategy Forecasts

Past, Present and Future in Investment Management
Sydney Harbour Marriott Hotel, Circular Quay, Sydney
Friday 12 August 2005

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Introduction

- Portfolio builders face two related challenges when trying to convert return forecasts into alphas for optimisation
  - how to weight multiple forecasts and test for consistency
  - how to scale alphas so that they are consistent with the risk model used for the optimisation
- We first addressed these issues in Scowcroft and Sefton (2003) subsequent research has focused on the practical implementation of our approach and is summarised in Bulsing and Sefton (2004)
- A detailed description of our approach which also relates it to the contributions of Black and Litterman (1992) and Grinold and Kahn (2000) is contained in Sefton, Bulsing and Scowcroft (2004)

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Combining and auditing forecasts

- The issue of how to combine and audit forecasts – particularly strategy and analysts forecasts - was most recently summarised in Bulsing and Sefton (2004)
- Inconsistent forecasts will potentially give rise to diffuse priors - the audit process is intended to highlight such inconsistencies
- In essence the approach to combining forecasts we describe could be viewed as an extension of the classical stock level framework of Grinold and Kahn (2000)
- However, it owes much to the Mixed Estimation literature and the Bayesian approach of Black and Litterman (1992) – there are however important subtleties of interpretation which we hope to make clear

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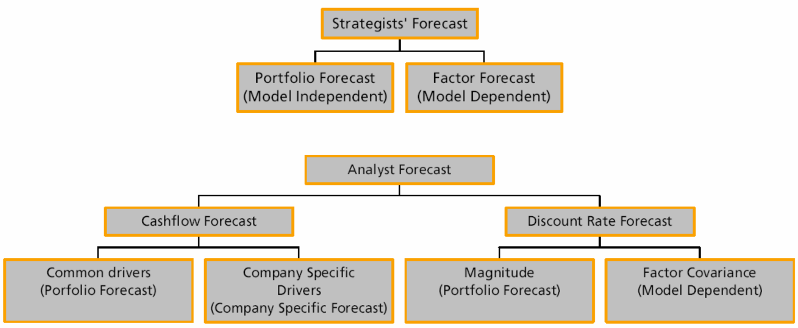
Taxonomy of Forecasts

- The objective is to implement market signals from different and potentially inconsistent sources in an optimal way



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Forecasts are expressed relative to Consensus

- Denote the returns at time *t* to all stocks by the vector

$$\boldsymbol{r}_t = \begin{bmatrix} r_{1,t} \\ \vdots \\ r_{n,t} \end{bmatrix}$$

- Denote the consensus expected returns given public information as

$$\boldsymbol{\mu}_{t+1} = E_t\left(\boldsymbol{r}_{t+1} \middle| \boldsymbol{I}_t\right)$$

- The forecaster is assumed to have additional information which allows an improvement on the consensus forecast

$$\boldsymbol{\mu}^+_{t+1} = E_t\left(\boldsymbol{r}_{t+1} \middle| \boldsymbol{I}^+_t\right) - \boldsymbol{\mu}_{t+1}$$

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… but are measured with error

- If we observe the forecast alphas, $\boldsymbol{\mu}^+_{t+1}$ the job is over!
- Unfortunately, strategists and analysts appear to be reticent in quoting return forecasts - there is a need to *interpret* their forecasts
  - e.g. Earning expectations. But is the stock fairly priced given these expectations?
  - e.g. Price Targets. But when is the stock likely to hit the price target?
  - e.g. Strategists publish their 'recommended' portfolio tilts, but what are the underlying expected returns?
- The problem is therefore how to combine these different forecasts so as to reveal the underlying alphas $\boldsymbol{\mu}^+_{t+1}$
- … and to check these forecasts for internal consistency

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The distribution of the data

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

$$\boldsymbol{r}_{t+1} = \mu_{t+1} + \boldsymbol{B}\boldsymbol{f}_{t+1} + \boldsymbol{\varepsilon}_{t+1} \quad \text{where}$$
$$\boldsymbol{f}_{t+1} \sim N\left(0, \boldsymbol{F}\right)$$
$$\boldsymbol{\varepsilon}_{t+1} \sim N\left(0, \boldsymbol{D} = \text{diag}(\delta_1, \delta_2, \cdots, \delta_n)\right)$$

implying therefore that returns are distributed

$$\boldsymbol{r}_{t+1} \sim N\left(\boldsymbol{\mu}_{t+1}, \boldsymbol{V} = \boldsymbol{B}\boldsymbol{F}\boldsymbol{B}' + \boldsymbol{D}\right)$$

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The distribution of the forecast

- We observe a set of forecasts $\boldsymbol{g}_{t+1}$ with error - denote the portfolios by the $p \times n$ matrix so that $\boldsymbol{P}$

$$\boldsymbol{g}_{t+1} = \boldsymbol{P}\boldsymbol{\mu}^{+}_{t+1} + \boldsymbol{\eta}_t \quad \text{where} \quad \boldsymbol{\eta}_t \sim N\left(\boldsymbol{0}, \boldsymbol{\Omega}\right)$$

The term $\boldsymbol{\eta}_t$ represents the forecast errors, assumed to be independent

- Similarly Factor forecasts are modelled by the equation

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

- and Company Specific forecasts by the equation

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

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Computing the conditional forecast

- The problem is to reveal the underlying true information $\boldsymbol{\mu}_{t+1}^{+}$ given the forecasts $\boldsymbol{g}_{t+1}$ a detailed derivation is provided in Sefton, Bulsing and Scowcroft (2004)
- Given the strong but standard assumptions that the forecasts are unbiased and that the stock return innovations and forecast errors are jointly normal, the conditional forecast may be derived equivalently via either the Bayes or Gauss Markov theorems
- This will not be true for more realistic distributional assumptions where the conditional forecasts would have to be computed numerically
- In order to extend the basic forecasting equation to incorporate forecasts for stocks and factors, in addition to portfolio forecasts, it will prove easier to follow a more classical approach

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Mixed Estimation

- We denote the proportion of the return innovation that can be forecast with the parameter τ the variance of the incremental forecast is therefore proportional to the covariance of the stock return innovations:

$$Var(\boldsymbol{\mu}_{t+1}^{+}) = \tau^2 \boldsymbol{V}$$

- the variance of the forecast is therefore given by

$$Var(\boldsymbol{g}_{t+1}) = \tau^2 \boldsymbol{PVP}' + \boldsymbol{\Omega}$$

- The Mixed Estimator is given by

$$E_t\left(\boldsymbol{\mu}_{t+1}^{+} \middle| \boldsymbol{g}_{t+1}\right) = E_t\left(\boldsymbol{r}_{t+1} \middle| \boldsymbol{g}_{t+1}\right) - \boldsymbol{\mu}_{t+1} = \tau^2 \boldsymbol{VP}'\left(\tau^2 \boldsymbol{PVP}' + \boldsymbol{\Omega}\right)^{-1} \boldsymbol{g}_{t+1}$$

$$Var\left(E_t\left(\boldsymbol{\mu}_{t+1}^{+} \middle| \boldsymbol{g}_{t+1}\right)\right) = \tau^2 V - \tau^2 \boldsymbol{VP}'\left(\tau^2 \boldsymbol{PVP}' + \boldsymbol{\Omega}\right)^{-1} \tau^2 \boldsymbol{PV}$$

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The Expanded set of Forecasting Equations

- The approach can be expanded to include the other type of forecasts – equation (20) in Sefton, Bulsing and Scowcroft (2004)

$$E\left(\boldsymbol{r}_{t+1}\left|\mathbf{g}_{t+1},\mathbf{g}_{f,t+1},\mathbf{g}_{\varepsilon,t+1}\right.\right)-\boldsymbol{\mu}_{t+1}=$$

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

- This equation shows how to combine portfolio, factor and company specific forecasts to get the best estimate of expected returns given the additional forecast information available
- For a detailed discussion see the section on company specific and factor forecasts in Sefton, Bulsing and Scowcroft (2004)

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Connections to the Black and Litterman model

- 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 is set in a Theil (1971) framework where investors' prior views are updated in the light of data on expected equilibrium returns – Satchell and Scowcroft (2000)
- Forecasts are conditioned on the equilibrium expected returns that would clear the market in an ICAPM framework – in effect, the expected returns that would lead an MV optimiser to hold the global market portfolio
- In equilibrium all investors hold this market portfolio and partially hedge their currency risk by holding the same hedging portfolio in proportion to their market risk, Black (1990)

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Connections to the Black and Litterman model

- In contrast, the approach described here distinguishes between expected returns conditional on publicly available information and expected returns conditional on both public and private information sets
- Forecasts are therefore expressed relative to consensus views as opposed to an equilibrium set of returns – this has a number of practical advantages
- If the consensus view is taken to be that the global market is in equilibrium the two approaches are equivalent
- In the following slide we will assume that μ_{t+1} the consensus forecast of expected returns equals the market equilibrium return and show the equivalence of the conditional portfolio forecasting equation and the Black and Litterman (1992) model

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Proof of equivalence

- 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

$$\begin{aligned} \boldsymbol{E}\left(\boldsymbol{r}_{t+1} \middle| \boldsymbol{g}_{t+1}\right) &= \boldsymbol{\mu}_{t+1} + \tau^2 \boldsymbol{VP}'\left[\boldsymbol{\Omega}^{-1} - \boldsymbol{\Omega}^{-1}\boldsymbol{P}\left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\right]\boldsymbol{g}_{t+1} \\ &= \boldsymbol{\mu}_{t+1} + \left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{g}_{t+1} \\ &= \left(\tau^{-2}\boldsymbol{V}^{-1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\boldsymbol{P}\right)^{-1}\left(\tau^{-2}\boldsymbol{V}^{-1}\boldsymbol{\mu}_{t+1} + \boldsymbol{P}'\boldsymbol{\Omega}^{-1}\left(\boldsymbol{g}_{t+1} + \boldsymbol{P}\boldsymbol{\mu}_{t+1}\right)\right) \end{aligned}$$

- The final term is the forecast of absolute returns given the public and private information sets. Hence if μ_{t+1} is defined as the market equilibrium this is equivalent to the Black and Litterman formula
- For full details see section 3 and the appendix in Sefton, Bulsing and Scowcroft (2004)

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Connections to the Grinold and Kahn model

- Grinold and Kahn (1999) concentrate almost exclusively on stock specific forecasts and derive, in the context of a single asset and single forecast, the rule of thumb that, “forecasts have the form volatility × IC × score”
- This is easily shown:

$$E\left(\mu^{+}_{t+1,i}\middle|g_{t+1,i}\right)=Cov\left(g_{t+1,i},r_{t+1,i}\right)\times Var\left(g_{t+1,i}\right)^{-1}\times g_{t+1,i}$$

$$=\underbrace{Std(r_{t+1,i})}_{\text{Volatility}}\times\underbrace{\frac{Cov(r_{t+1,i},g_{t+1,i})}{Std(r_{t+1,i})Std(g_{t+1,i})}}_{\text{IC}}\times\underbrace{\frac{g_{t+1,i}}{Std(g_{t+1,i})}}_{\text{Score}}$$

- However, generalising this formula is problematic: “With multiple assets and multiple forecasts, it is more difficult to apply the basic forecast rule. This is because we lack sufficient data and insight to uncover the required structure.” Grinold and Kahn (1999, p. 271)

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Connections to the Grinold and Kahn model

- In the technical appendix to Chapter 11, “Advanced Forecasting”, Grinold and Kahn examine a number of special cases and show what assumptions are required to keep the forecasts in the form

$$volatility\times IC\times score$$

- In our view, these assumptions are only likely to be satisfied in the case of pure company specific forecasts, for only in this situation are the constant IC and diagonal covariance structure reasonable approximations
- These assumptions would appear to be inconsistent with factor forecasts, or forecasts based upon stock screens, for detailed proofs see Sefton, Bulsing and Scowcroft (2004, section 4)

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Time Series IC versus Cross Sectional IC

- Grinold and Kahn recognise that managers typically do not produce a time series forecast for each stock but rather a single forecast for the cross section of all stocks – this gives rise to the debate as to which volatility, IC and score to use?
- We have already argued that factor forecasts are inconsistent with Grinold and Kahn's assumptions and are better modelled directly as factor forecasts or, more generally, as the returns to a factor mimicking portfolio
- In the case of a single factor forecast the form volatility $\times$ IC $\times$ score is preserved but in the cross section whereas the time series analogues are appropriate for stock specific forecasts
- The cross sectional equations are however cumbersome, for a detailed proof see Sefton, Bulsing and Scowcroft (2004, section 4)

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Calibration - estimating omega

- Our preferred approach to estimating omega recognises that our models typically don't forecast returns directly but instead forecast conditioning variables such as accounting ratios
- As is well known, Schiller (1981), stock prices are far more volatile than can be explained using, for example, expected dividends
- This leads to an errors in variables problem when estimating the correlation between the forecast and the realised return
- We therefore introduce the coefficient of forecastability τ to represent the proportion of returns that can be forecast
- We then define κ as the ratio of the volatility of our forecasts to the volatility of realised returns

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A formula for omega

- The Information Coefficient or IC of our forecasts and κ are therefore given by:

$$\kappa = \frac{\mathrm{Std}(g_{t,i})}{\mathrm{Std}(\mathbf{P}_i\mathbf{r}_t)} = \frac{\sqrt{(\tau^2\mathbf{P}_i\mathbf{V}\mathbf{P}_i' + \omega_{ii})}}{\sqrt{\mathbf{P}_i\mathbf{V}\mathbf{P}_i'}}$$

$$IC = \frac{\tau^2\mathbf{P}_i\mathbf{V}\mathbf{P}_i'}{\sqrt{\mathbf{P}_i\mathbf{V}\mathbf{P}_i'}\sqrt{(\tau^2\mathbf{P}_i\mathbf{V}\mathbf{P}_i' + \omega_{ii})}}$$

- Substituting κ into the IC formula and rearranging allows us to calculate ω directly from known statistics:

$$IC = \frac{\kappa\tau^2\mathbf{P}_i\mathbf{V}\mathbf{P}_i'}{\tau^2\mathbf{P}_i\mathbf{V}\mathbf{P}_i' + \omega_{ii}}$$

$$\sqrt{\frac{\omega_{ii}}{\tau^2}} = \sigma_{iA} \times \sqrt{\frac{\kappa}{IC} - 1}$$

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Calibration of Error Process

- From a data sample of UBS Price Targets for the FTSE 100 stocks over the previous 3 years

$$0.1 \le IC \le 0.2$$

$$0.35 \le \kappa \le 0.65$$

- which implies the rough calibration

$$\sigma(\boldsymbol{Pr}_{t+1}) \le \sqrt{\left(\frac{\Omega_{ii}}{\tau^2}\right)} \le 2\sigma(\boldsymbol{Pr}_{t+1})$$

- and

$$0.2 \le \tau \le 0.4$$

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Some practical examples

- The first example illustrates the importance of conditioning on the full covariance matrix using a small cap forecast
  - turnover ME < GK
  - single forecast otherwise broadly equivalent
- The second example illustrates the construction of an enhanced index fund from a hedge fund based on ten stock pairs, each chosen within a sector
  - Information ratio ME > GK

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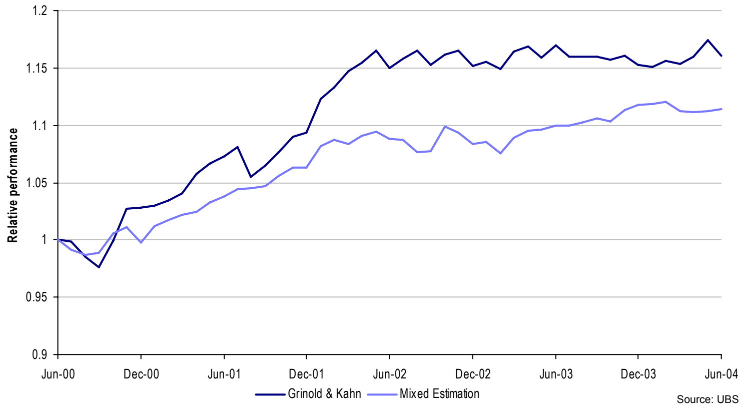
Performance of a small cap forecast

- Forecast on a monthly basis of small cap against the S&P 500
  Forecast TE in both cases = 2%; actual = 3.5% (GK), 2.4% (ME)
  Information ratios = 1.08 (GK), 1.12 (ME)



Source: UBS

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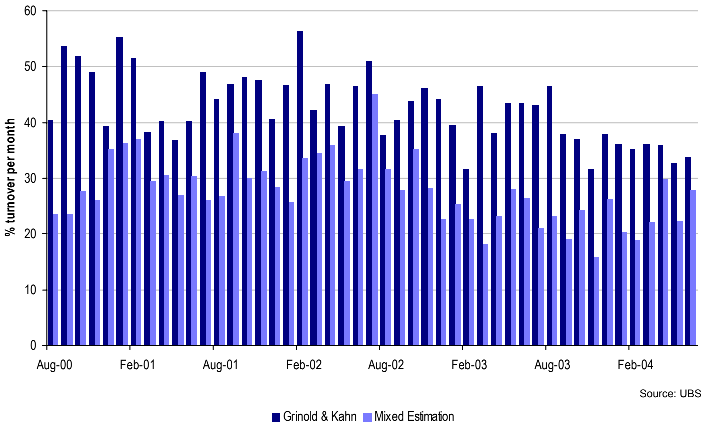
Turnover

- Turnover for G&K is consistently much higher than that for mixed estimation



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Enhanced index fund - example

- Using the OEX as a benchmark, we contrast three approaches to building an enhanced index fund, starting from 10 stock pairs, each chosen within a sector. The pairs are chosen so in aggregate they add value over the year - In each case, the forecast tracking error is set to (approx) 1% each month
- The three approaches:
  - increase the weights of the longs and shorts until the desired tracking error is reached, with each pair not increasing in size once the short side has reached a zero weight
  - using Grinold & Kahn (volatility * IC * score), with a score of +1 for the longs and –1 for the shorts
  - create a portfolio of all the longs against all the shorts and forecast the return to it
- Each simulation was run with the stock pairs being chosen at the start of the year and not changed

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Enhanced index fund – results

- The results below are created from 20 runs of the simulation. Runs of the simulation on other universes and over other periods gave similar results

	Average IR	Standard Deviation of IR
Mechanical	1.27	0.69
Grinold & Kahn	1.16	0.80
Mixed Estimation	1.47	0.79

Source: UBS

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Auditing your Forecasts

- Forecasts often come from very different sources and may therefore be based on conflicting assumptions
- We need to audit the forecasts for mutual consistency since inconsistent forecasts may give rise to diffuse priors
- Are the analysts' stock forecasts consistent with Sector or Style views, are strategists' Sector forecasts consistent with Country forecasts?
- An analysis of the implied factor forecasts will often reveal potential inconsistencies
- The Relative Risk Statistic is utilised to formally test the consistency of a forecast given that the remaining forecasts are taken to be true

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Implied Factor forecasts

- The conditional expected return forecast can also be decomposed into implied factor and stock specific returns
- The full joint distribution of forecasts given public information is given by:

$$\begin{bmatrix} \boldsymbol{f}_{t+1} \\ \boldsymbol{\varepsilon}_{t+1} \\ \boldsymbol{g}_{t+1} \\ \boldsymbol{g}_{f,t+1} \\ \boldsymbol{g}_{\varepsilon,t+1} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \boldsymbol{F} & \boldsymbol{0} & \tau^2 \boldsymbol{FB'P'} & \tau^2 \boldsymbol{FP'_f} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{D} & \tau^2 \boldsymbol{DP'} & \boldsymbol{0} & \tau^2 \boldsymbol{DP'_\varepsilon} \\ \tau^2 \boldsymbol{PBF} & \tau^2 \boldsymbol{PD} & \tau^2 \boldsymbol{PVP'} + \boldsymbol{\Omega} & \tau^2 \boldsymbol{PBFP'_f} & \tau^2 \boldsymbol{PDP'_\varepsilon} \\ \tau^2 \boldsymbol{P_f F} & \boldsymbol{0} & \tau^2 \boldsymbol{P_f FB'P'} & \tau^2 \boldsymbol{P_f FP'_f} + \boldsymbol{\Omega_f} & \boldsymbol{0} \\ \boldsymbol{0} & \tau^2 \boldsymbol{P_\varepsilon D} & \tau^2 \boldsymbol{P_\varepsilon DP'} & \boldsymbol{0} & \tau^2 \boldsymbol{P_\varepsilon DP'_\varepsilon} + \boldsymbol{\Omega_\varepsilon} \end{bmatrix} \right)$$

- Theorem 1.2.11 of Muirhead (1982, p. 12) implies that:

$$E\left(\begin{bmatrix} \boldsymbol{f}_{t+1} \\ \boldsymbol{\varepsilon}_{t+1} \end{bmatrix} \middle| \begin{matrix} \boldsymbol{g}_{t+1}, \\ \boldsymbol{g}_{f,t+1}, \\ \boldsymbol{g}_{\varepsilon,t+1} \end{matrix} \right) = \begin{bmatrix} \tau^2 \boldsymbol{FB'P'} & \tau^2 \boldsymbol{FP'_f} & \boldsymbol{0} \\ \tau^2 \boldsymbol{DP'} & \boldsymbol{0} & \tau^2 \boldsymbol{DP'_\varepsilon} \end{bmatrix} \begin{bmatrix} \tau^2 \boldsymbol{PVP'} + \boldsymbol{\Omega} & \tau^2 \boldsymbol{PBFP'_f} & \tau^2 \boldsymbol{PDP'_\varepsilon} \\ \tau^2 \boldsymbol{P_f FB'P'} & \tau^2 \boldsymbol{P_f FP'_f} + \boldsymbol{\Omega_f} & \boldsymbol{0} \\ \tau^2 \boldsymbol{P_\varepsilon DP'} & \boldsymbol{0} & \tau^2 \boldsymbol{P_\varepsilon VP'_\varepsilon} + \boldsymbol{\Omega_\varepsilon} \end{bmatrix}^{-1} \begin{bmatrix} \boldsymbol{g}_{t+1} \\ \boldsymbol{g}_{f,t+1} \\ \boldsymbol{g}_{\varepsilon,t+1} \end{bmatrix}$$

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Return decomposition analysis

- A worked example of the breakdown of forecasts into implied factor and stock specific forecasts is given in Scowcroft (2004)
- The decomposition we provide is the most natural in this conditional framework - it is the maximum likelihood decomposition. It is the most likely in a clearly defined probabilistic sense
- Grinold and Kahn propose a framework independently of the framework used for estimating expected returns by projecting the vector of expected returns onto the space spanned by the set of minimum variance portfolios
- It is not clear to us why this is more desirable than any other set of factor mimicking portfolios for example the set of FMPs with the lowest tracking error

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Forecast audit – the relative risk statistic

- The relative risk statistic measures how the likelihood of a forecast changes when the other forecasts are taken into account. If the sets of forecasts are called **g_1** and **g_2** then the relative risk statistic is defined as

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

Portfolio Name	Relative risk	p-value
Composite Growth	1.092	0.606
Composite Value	1.162	0.675
Health Care	1.053	0.580
Financials	1.094	0.672
Europe ex EMU / UK	1.013	0.555

Source: UBS PAS

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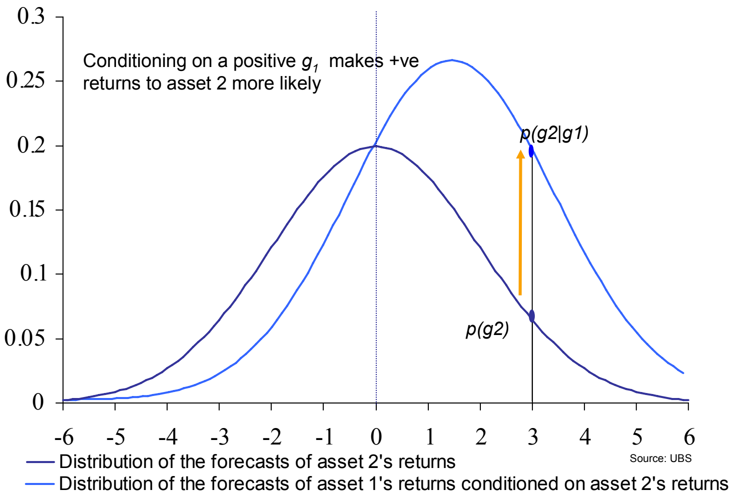
Consistent Forecast



$$\text{Relative Risk} = \frac{p(g_2|g_1)}{p(g_2)} > 1 \Rightarrow \text{ Forecasts Consistent}$$

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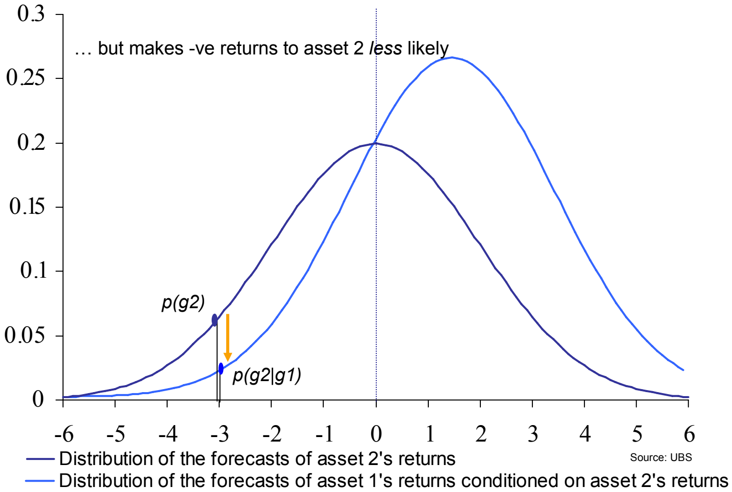
Inconsistent Forecast



$$\text{Relative Risk} = \frac{p(g_2|g_1)}{p(g_2)} < 1 \Rightarrow \text{ Forecasts Inconsistent}$$

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Conclusions

- We have seen that mixed estimation techniques provide a convenient framework for combining multiple forecasts incorporating non-sample information allowing for different levels of confidence in the forecasts
- Extensions of the basic approach allow for the inclusion of stock specific forecasts and factor forecasts in addition to portfolio forecasts
- Calibration of the model proves straightforward in practice
- The framework also facilitates forecast auditing both through an analysis of implied factor forecasts and tests of consistency using the relative risk statistic

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UBS rating	Definition	UBS rating	Definition	Rating category	Coverage[1]	IB services[2]
Buy 1	FSR is > 10% above the MRA, higher degree of predictability	Buy 2	FSR is > 10% above the MRA, lower degree of predictability	Buy	40%	41%
Neutral 1	FSR is between –10% and 10% of the MRA, higher degree of predictability	Neutral 2	FSR is between –10% and 10% of the MRA, lower degree of predictability	Hold/Neutral	49%	43%
Reduce 1	FSR is > 10% below the MRA, higher degree of predictability	Reduce 2	FSR is > 10% below the MRA, lower degree of predictability	Sell	11%	35%

1: Percentage of companies under coverage globally within this rating category.

2: Percentage of companies within this rating category for which investment banking (IB) services were provided within the past 12 months.

Source: UBS; as of 30 June 2005.

KEY DEFINITIONS

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% (an approximation of the equity risk premium).

Predictability Level The predictability level indicates an analyst's conviction in the FSR. A predictability level of '1' means that the analyst's estimate of FSR is in the middle of a narrower, or smaller, range of possibilities. A predictability level of '2' means that the analyst's estimate of FSR is in the middle of a broader, or larger, range of possibilities.

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Disclosures (continued)

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US Closed-End Fund ratings and definitions are: Buy: Higher stability of principal and higher stability of dividends; Neutral: Potential loss of principal, stability of dividend; Reduce: High potential for loss of principal and dividend risk.

UK and European Investment Fund ratings and definitions are: Buy: Positive on factors such as structure, management, performance record, discount; Neutral: Neutral on factors such as structure, management, performance record, discount; Reduce: Negative on factors such as structure, management, performance record, discount.

Core Banding Exceptions (CBE): Exceptions to the standard +/-10% bands may be granted by the Investment Review Committee (IRC). Factors considered by the IRC include the stock's volatility and the credit spread of the respective company's debt. As a result, stocks deemed to be very high or low risk may be subject to higher or lower bands as they relate to the rating. When such exceptions apply, they will be identified in the Companies Mentioned table in the relevant research piece.

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

Analyst Certification

Each research analyst primarily responsible for the content of this research report, in whole or in part, certifies that with respect to security or issuer that the analyst covered in this report: (1) all of the views expressed accurately reflect his or her personal views about those securities or issuers; and (2) no part of his or her compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed by that research analyst in the research report.

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