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UBS Investment Research

A Quantitative Approach to Equity Valuation

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Section 1

The Conventional Valuation Process

The Valuation Process as it stands today

- The typical equity valuation involves so much uncertainty that the results are arbitrary for practical purposes.
- Discounted cash flow models typically rely on strong assumptions. They are also highly sensitive to their inputs.
- We introduce a novel technique to take account of uncertainties in the valuation process.

Conventional Approach

- Point forecasts
- Fixed inputs
- Uncertainty is rarely accounted for

Advanced Statistical Approach

- Uses a probabilistic (Bayesian) approach to allow for uncertainty in inputs
- Can include accounting identities and fundamental insights
- Forms an enriched model which incorporates quantitative and fundamental investment approaches

The Valuation Process: Conventional Approach

- Analysts are required to give investors **point forecasts** by constructing a model based on inputs they have no certainty about.
- The typical equity analyst uses **fixed inputs** which have remained the same for years.
- The **Gordon Growth Model**, for example, is a simplification of the dividend discount model that assumes a constant cost of equity (k_e):

$$Stock\ value = \frac{E[DPS_{t=1}]}{k_e - g} = DPS_{t=0}\frac{1+g}{k_e - g}$$

The Upside is then given as:

$$Upside = \frac{Stock\ Value}{Current\ Price} - 1 = Div.Yield \cdot \frac{1+g}{k_e - g} - 1$$

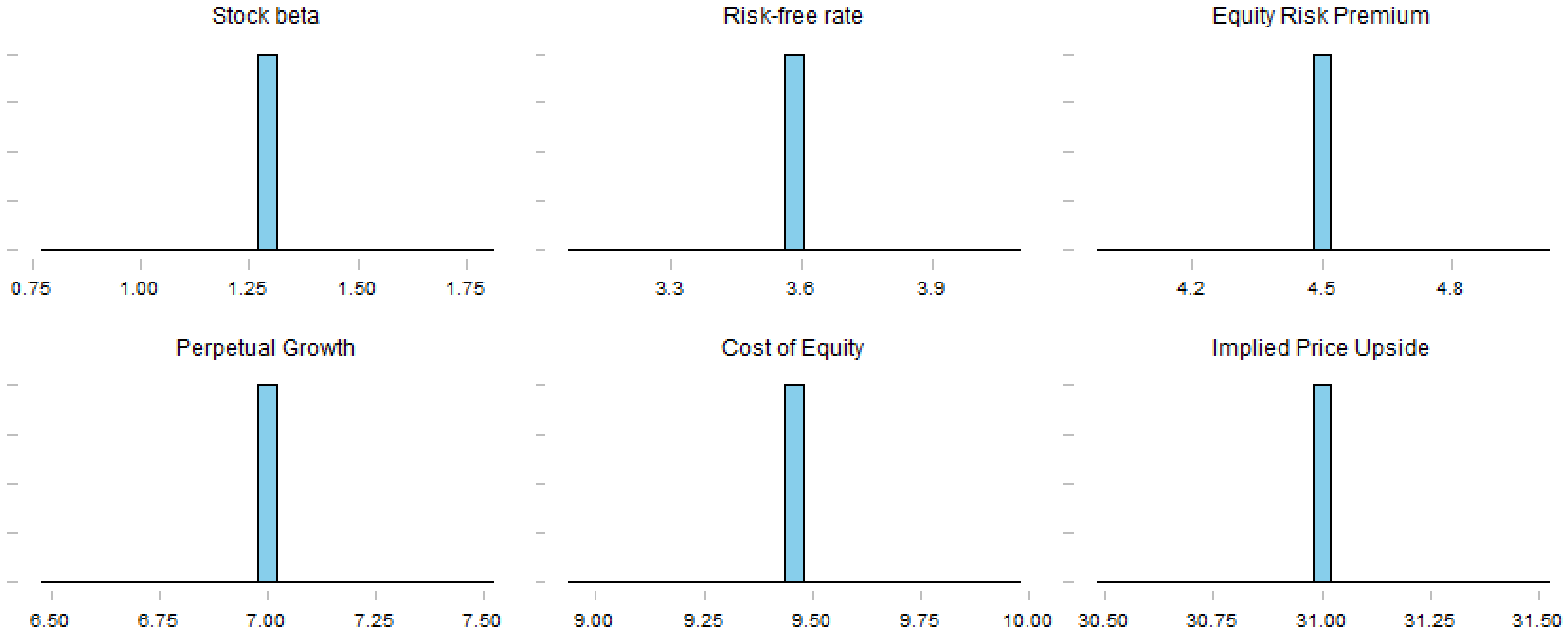
Pros:

1) Simple ✓

2) Intuitive ✓

... but is highly sensitive to its (assumed) inputs!!!!

The Conventional Approach continued…



Source: UBS Quant

The Conventional Approach continued…

The **standard assumptions** in an equities valuation model include:

- The risk-free rate -> average US 10yr yield (3.6%)
- The company is stable with annual dividend growth -> 7%
- Security beta -> 1.3
- Equity risk premium -> 5%
- Current dividend yield -> 3%

The **implied cost of equity** is then: 3.6% + 1.3 x 5% = 10.1%
… and the **valuation upside** is 3% x (100 + 7)/(10.1 - 7) – 1 = +3.5%

- The precise valuation has been reached without using fundamental insights but with supposedly "known" drivers.
- A small change in any one of these inputs can lead to a very different valuation. For example, reducing the ERP by 0.5% leads to a valuation upside of +31%!!!!!!!!!!!!

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Section 2

Accounting for Uncertainty in Valuations

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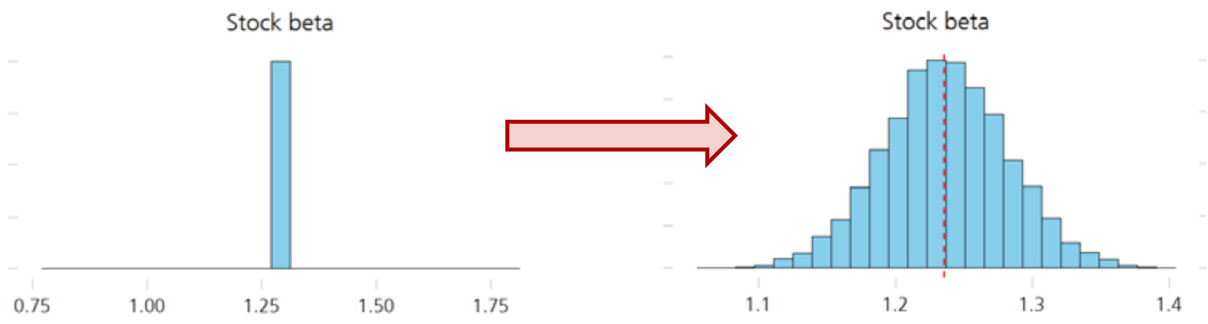
Accounting for Uncertainty

We use a flexible and powerful **Bayesian** computational framework called [Stan](#) to model input uncertainties and allow the user to incorporate accounting identities and fundamental insights.

First step: Let's assume security beta is not static and, instead, estimate it via a Bayesian linear regression of the CAPM.

Fixed vs. Estimated Beta



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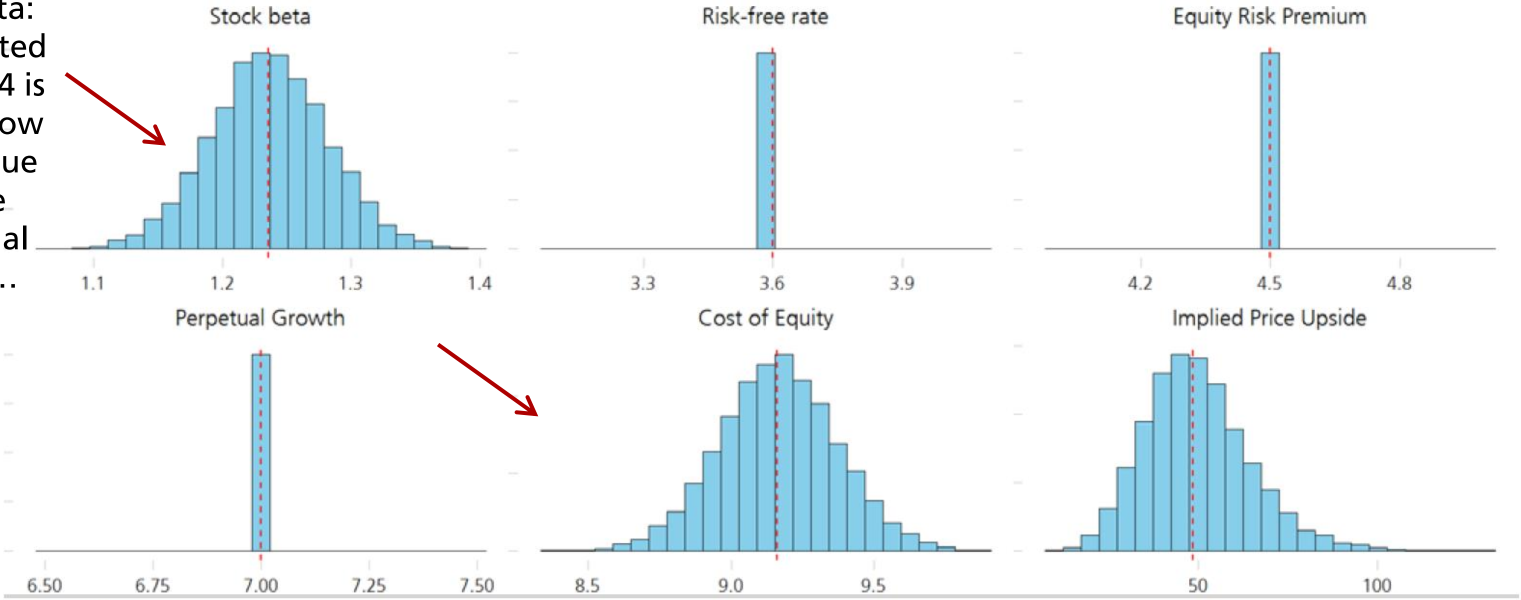
The Impact of Estimating CAPM Stock Beta

Allow for uncertainty in security beta: The estimated beta of 1.24 is slightly below 1.3 (the value fixed in the conventional approach)…



Source: UBS Quant

… the impact on the cost of equity and subsequent expected upside is significant (3.5% vs 50%)!

Incorporating uncertainty everywhere

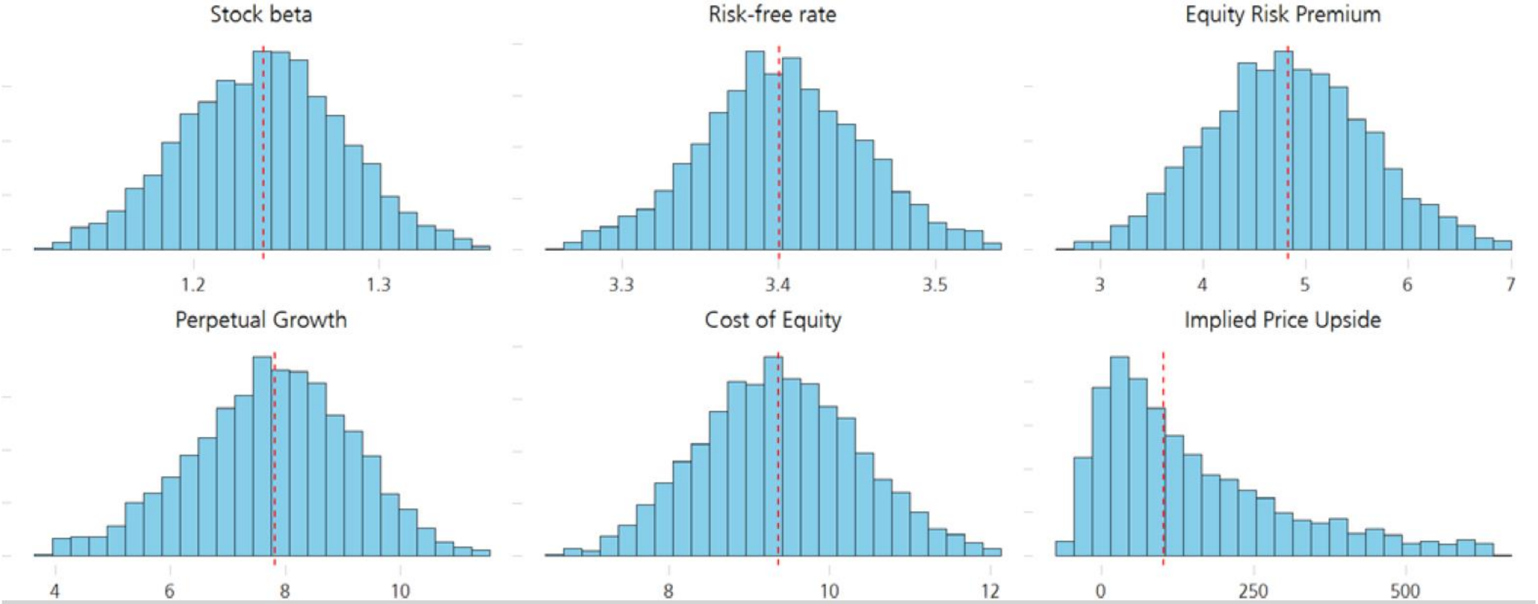
Next Step: Allow for uncertainty in all the parameters.

- Adopt **structural time-series** models to robustly estimate the risk-free and dividend growth stream
- Estimate the equity risk premium by taking the difference between the annual long-run historical equity market return and the average US 10yr bond yield.

This will be our first step to improving the original model. Further improvements can then be made to incorporate fundamental insights into how the input variables change through time and across business phases.

The full probabilistic valuation model

- The implied price upside is now much more variable with a median of 120%, LQ of 39% and UQ of 280%.



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- Note that this is illustrative – the results here are practically ineffective; the inputs can be better defined given our intuition and knowledge as to how the inputs change through time.

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Section 3

Incorporating Intuition and Fundamental Insights

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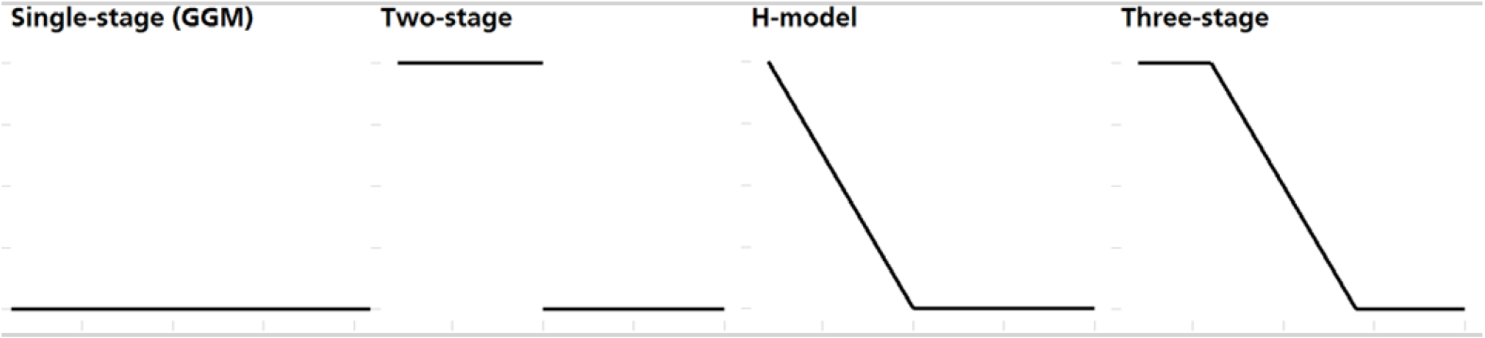
Extensions…

- So far, we have allowed for uncertainty in all the parameters without being consistent with our economic understanding.
- For example, a company cannot continue to grow its dividends or earnings at 8% into perpetuity; its perpetual growth is effectively bounded from above by economic growth.
- The model we have presented above does not account for the business phase the company is experiencing.

Possible Solution: **Multi-stage models**.



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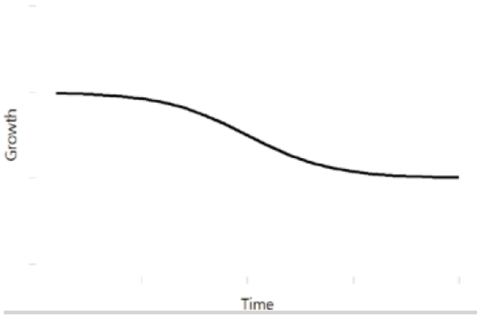
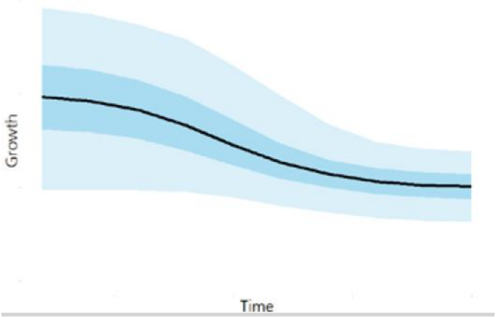
However, this just replaces untenable assumptions with more questionable ones…

Incorporating the growth profile…

Better Solution: describe the uncertainty of the transition from one growth phase to another by parametrising the **growth profile** of the company using an inverted sigmoid …





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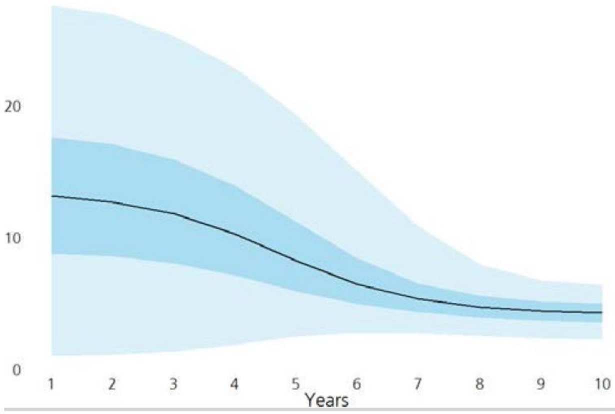
… then accounting for the uncertainty in these parameters…

Growth profile in practise



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- The variance in growth is assumed to shrink as the company matures.

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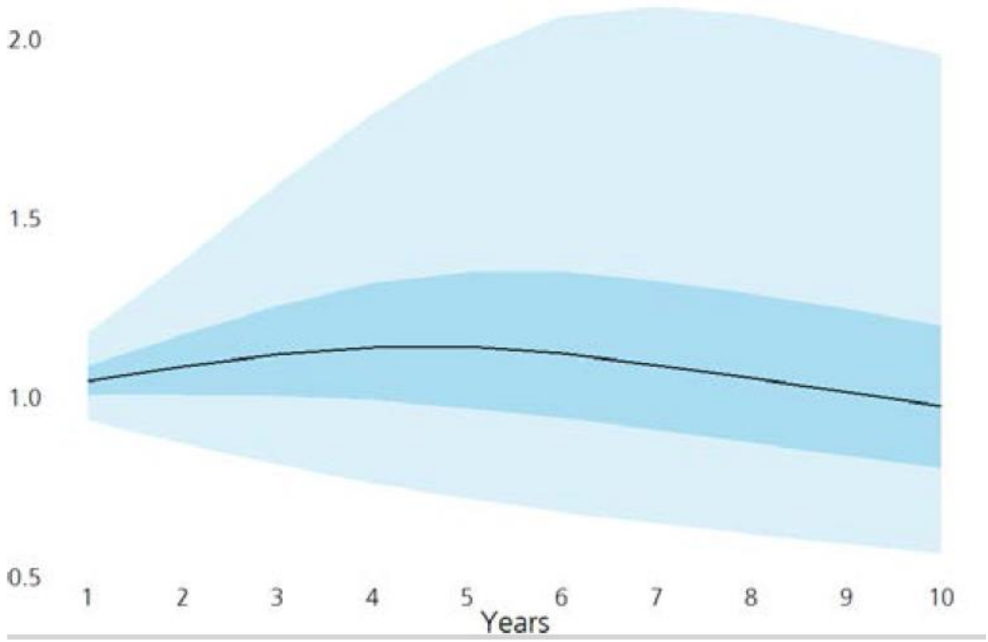
… and the profile of the Dividend Stream.

We can also observe the corresponding **uncertainty of the dividend stream** as it accretes to its terminal value.



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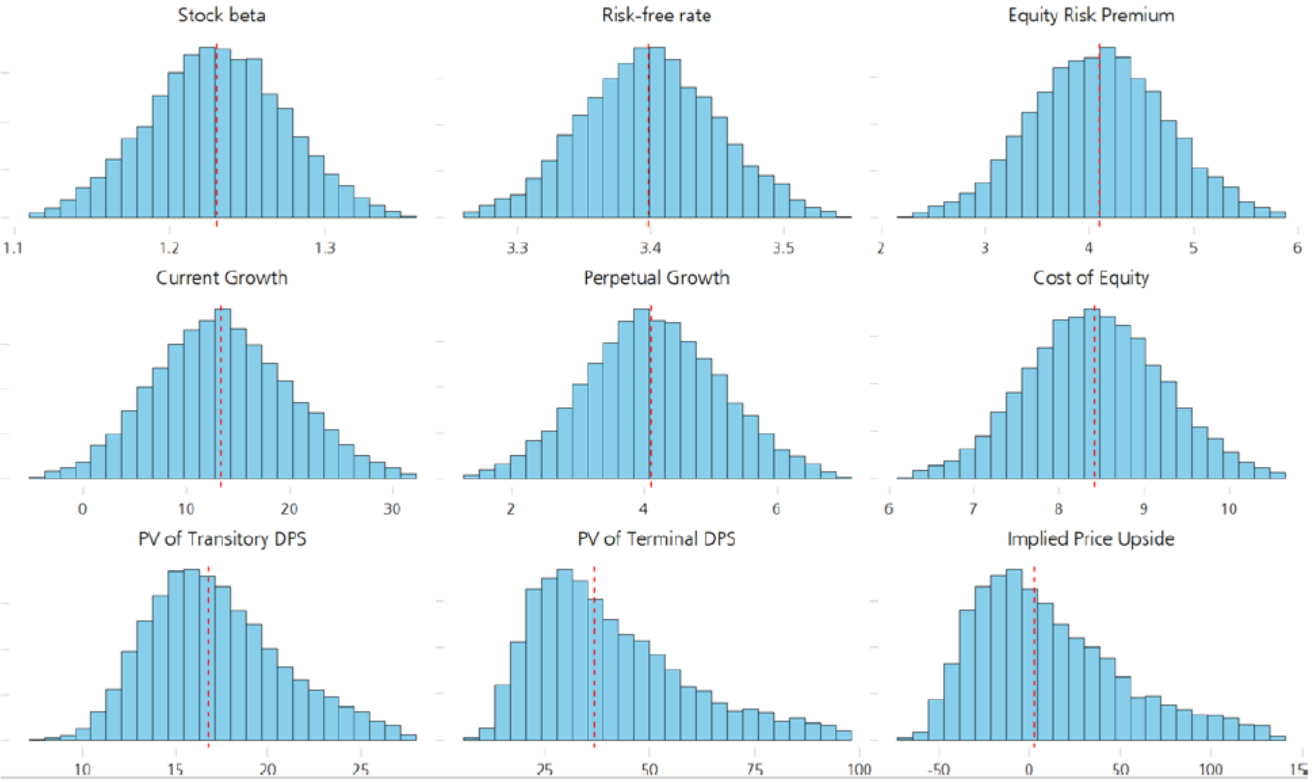
The Improved Model

- The variance in the **perpetual growth** rate has reduced;
- Consequently, the distribution of the **implied price upside** exhibits much less variation than in the previous model;
- The median of this forecast distribution is now roughly 0%; indicating our estimated equity value is **calibrated to consensus market expectations**.



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Section 4

Building Out Complexity

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Building out complexity

To enrichen the model, we can also incorporate the following:

- **Accounting identities**, e.g., the relationship between margins and ROE;
- **Economic expectations**, e.g. the inflation rate implied by the breakeven rate or the risk-free rate as implied by the central bank;
- **Forward-looking views** such as the ex-ante estimates of the equity risk premium;
- **Domain knowledge from various disciplines** including equity strategy, economics and sector analysts;
- **Different asset classes**, e.g., estimate the cost of debt as a floor of the cost of equity;
- **Adapt the definitions** of the existing input variables, e.g., redefine the cost of equity using a more sophisticated pricing model than CAPM.

Section 5

Valuation Models vs. Price Forecasts

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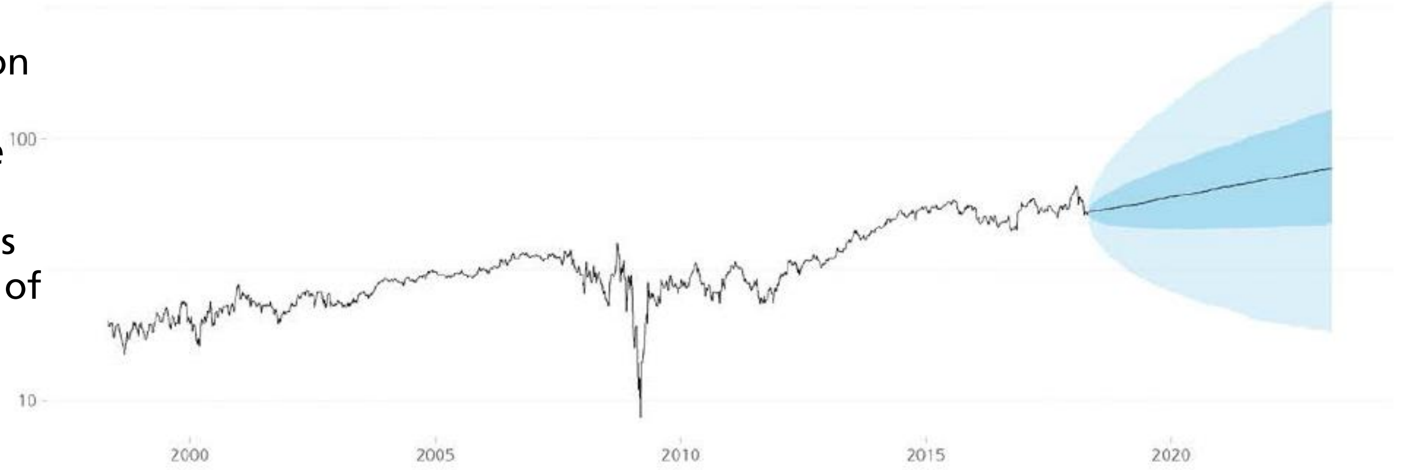
Valuation Models vs. Price Forecasts

- The **valuation distribution** is relatively static since it reflects the present value of all future dividends and therefore only updates with each successive dividend that turns ex or when expectations of the cost of equity or economic conditions change.

- Amongst the quant's arsenal of tools, we can use **time-series models** instead to forecast prices

- Over which time horizon though is it better to rely on price forecasts/valuation models?

- Unlike valuation models, the variance of the stock price forecast widens in the absence of an equilibrium condition.



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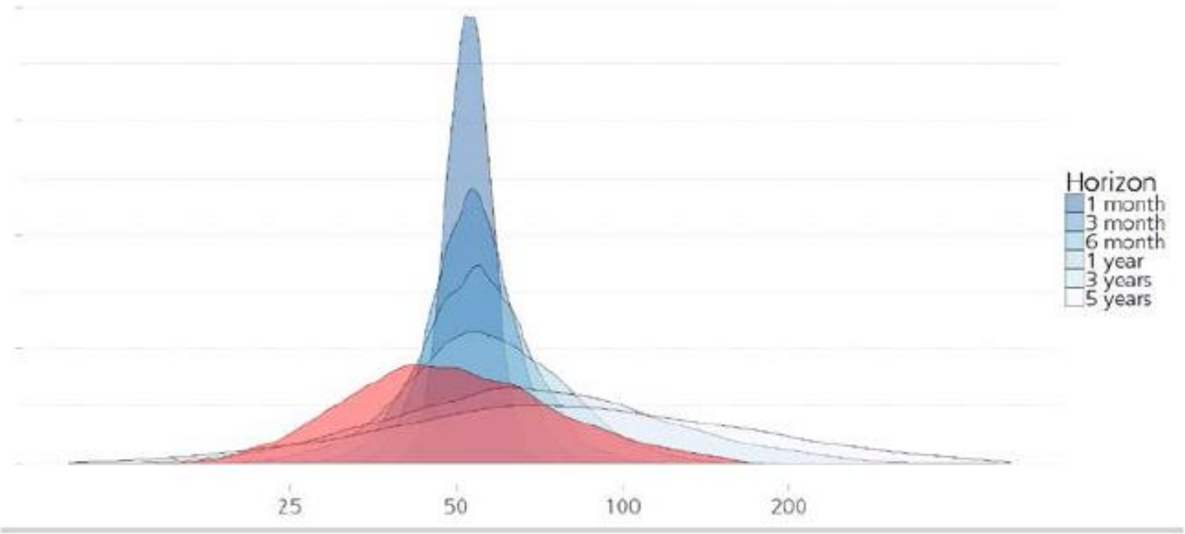
Valuation Models vs. Price Forecasts

- A useful exercise is to compare the distribution of the expected stock price for various forecasting horizons with the valuation distribution; at some 'critical' point the time-series model becomes less reliable than the valuation model.



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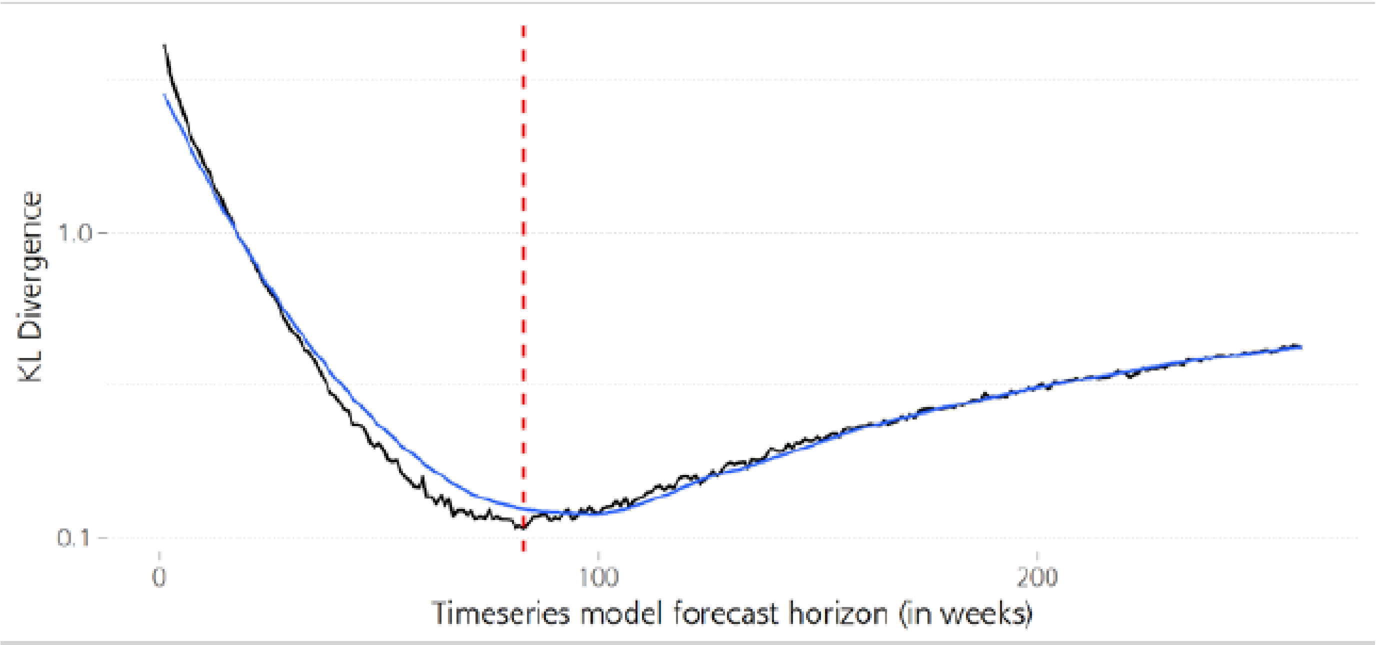
- Evidently, we are better off using our time series model for shorter horizons; for longer horizons the valuation model becomes more reliable.

Price vs. Valuation Forecast

- The **Kullback-Leibler (KL) divergence** will identify the horizon at which the difference in distributions (valuation vs. forecasting) is at a minimum.



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Concluding Remarks

- We have shown we can improve the conventional approach to valuing equities by accounting for:

- Uncertainty in the input parameters
- The business phase the company is experiencing
- Fundamental insights
- Economic intuition and knowledge from other fields (e.g. the credit environment)

- Furthermore, we have shown that there is a time horizon before which we are better off using price forecasts rather than valuation models; after this point the valuation model becomes a more reliable tool.

Valuation Method and Risk Statement

Our quantitative models rely on reported financial statement information, consensus earnings forecasts and stock prices. Errors in these numbers are sometimes impossible to prevent (as when an item is misstated by a company). Also, the models employ historical data to estimate the efficacy of stock selection strategies and the relationships among strategies, which may change in the future. Additionally, unusual company-specific events could overwhelm the systematic influence of the strategies used to rank and score stocks.

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Buy	FSR is > 6% above the MRA.	46%	25%
Neutral	FSR is between -6% and 6% of the MRA.	39%	23%
Sell	FSR is > 6% below the MRA.	15%	12%
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Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
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Source: UBS. Rating allocations are as of 31 March 2018.
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