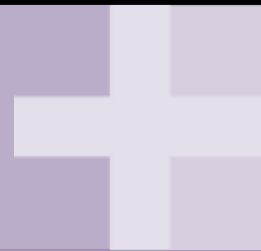


# Extrapolation of Equity Implied Volatility

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November 2007

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## 1. Introduction

This paper sets out Barrie & Hibbert policy on extrapolation of equity implied volatility beyond the maturities quoted in the market.

One general approach to extrapolation of implied volatility beyond quoted maturities is to develop a model for implied volatility which describes how implied volatility varies for all maturities. The resulting model implied volatilities are used as pseudo market prices which we can use in calibrating different ESG models.

For further details of the approach described in this note and analysis of its performance at past calibration dates see TAP Discussion Paper 2006/001, “Extrapolation of Equity Implied Volatility”.

## 2. Statement of Practice

The practice of extrapolation of equity implied volatility will proceed as follows:

1. For the purpose of extrapolation we will assume the following descriptive model for forward variance:

$$V^{MODEL} = (t) = IV_0^2 \exp(-\alpha t) + IV_\infty^2(1 - \exp(-\alpha t))$$

This implies the following functional form for implied volatility:

$$IV^{MODEL}(T) = \sqrt{\frac{1}{T} \int_{t=0}^T V^{MODEL}(t) dt} = \sqrt{IV_\infty^2 + \frac{1}{\alpha T} (1 - \exp(-\alpha T))(IV_0^2 - IV_\infty^2)}$$

2. We will minimise the Root Mean Square Error (RMSE) defined:

$$RMSE = \sqrt{\frac{1}{N} \sum_T (IV^{MODEL}(T) - IV^{MARKET}(T))^2}$$

Where the sum is over all maturities T for which we have reliable market data from the set of requested maturities: 0.25, 0.5, 0.75, 1, 2, 3, 4, 5, 7, 10, 15, 20, 25 and 30 years.

N is the total number of available maturities.

3. We will minimise the RMSE subject to the following constraints:

$$1.05 \times \sigma_{BE} \leq IV_\infty \leq 1.4 \times \sigma_{BE}$$

Where  $\sigma_{BE}$  is Barrie & Hibbert's standard best-estimate assumption for volatility for the particular equity market under consideration at the calibration date.

In addition  $\alpha$  will be assumed to be non-negative.

4. Optimisation will be carried out using Excel Solver or another equivalent optimisation algorithm of Barrie & Hibbert's choice.

While Barrie & Hibbert will endeavour to follow this practice in all markets covered as part of their standard market-consistent calibrations, exceptions may be made where the process is judged to give unsuitable fits.

## 3. Timetable for implementation

The practice described in this note will be implemented for Barrie & Hibbert's standard market-consistent calibrations at 31<sup>st</sup> December 2007 and subsequent calibration dates.

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