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Calibration of the SABR Model in Illiquid Markets

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Abstract

Recently the SABR model has been developed to manage the option smile which is observed in derivatives markets. Typically, calibration of such models is straightforward as there is adequate data available for robust extraction of the parameters required asinputs to the model. The paper considers calibration of the model in situations where input data is very sparse. Although this will require some creative decision making, the algorithms developed here are remarkably robust and can be used confidently for mark to market and hedging of option portfolios.

Keywords:

SABR model | equity derivatives | volatility skew calibration | illiquid markets

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Notes

1. Some care needs to be taken with machine precision issues here. One can have that z≈0 and χ(z) = 0 to double precision. This needs to be trapped, and the limit result invoked, again putting .

2. Although significantly, not all. Real Africa Durolink, a smaller bank, but major player in the equity derivatives market, failed within days of the introduction of the skew, as they were completely unprepared for the dramatic impact the new methodology would have on their margin requirements. See West (2005, Section 13.4).

3. The only difference here is that we do not make the assumption of zero means, which we do when using returns to calculate volatilities. The implementation is elementary.

4. When there are three real roots, they are of the order of −1000, 1 and +1000. So we take the root of order 1.

5. Of course, some experimentation with the choice of the weight determined by the quantum is necessary. One could choose Q^2 for example, or indeed any positive weight. There will be no requirement for any smoothness of the weight in what follows.

6. Note that the matrix will almost certainly not be of size greater than 5×5.

7. Of course, to very high precision they are always changing. Here we mean that they are unchanged up to the (fairly high) precision that we chose in the Nelder–Mead algorithm.