BBC (1997) model calibration

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Outline

▶ The art of calibration

▶ BCC (1997) calibration process

▶ Calibration results on EuroStoxx50 options

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The art of calibration

Although we usually follow the same steps, the calibration process can take different forms:

▶ Which market variable are we calibrating to? Which error function?

- Mean Squared Error (MSE) of option market prices (call/put?):

$$\min_{\alpha} \frac{1}{N} \sum_{n=1}^{N} \left(C_n^* - C_n^{Model}(\alpha) \right)^2$$

- MSE of relative option market price differences:

$$\min_{\alpha} \frac{1}{N} \sum_{n=1}^{N} \left(\frac{C_n^* - C_n^{Model}(\alpha)}{C_n^*} \right)^2$$

- MSE of options' implied volatilities

$$\min_{\alpha} \frac{1}{N} \sum_{n=1}^{N} \left(\sigma_n^* - \sigma_n^{Model}(\alpha) \right)^2$$

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BCC (1997) calibration steps

These are the SDEs for the BCC (1997) model:

$$dS_t = (r_t - r_J)S_t dt + \sqrt{\nu_t}S_t dZ_t^1 + J_t S_t dN_t$$

$$d\nu_t = \kappa_\nu(\theta_\nu - \nu_t)dt + \sigma_\nu\sqrt{\nu_t}dZ_t^2$$

$$dr_t = \kappa_r(\theta_r - r_t)dt + \sigma_r\sqrt{r_t}dZ_t^3$$

So, much like with Bates (1996) calibration, we need to take a sequential path:

1. Calibration of short-rates model $\rightarrow$ CIR (1985) model calibration

2. With the short rates from step 1, global calibration of Stochastic Volatility $\rightarrow$ Heston (1993) model

3. Using the parameters from steps 2 and 1, locally calibrate the jump component $\rightarrow$ (adjusted) Merton (1976) model

4. Using the parameters from steps 2 and 3 as guidance, globally calibrate the BCC (1997) model (using short rates from step 1).
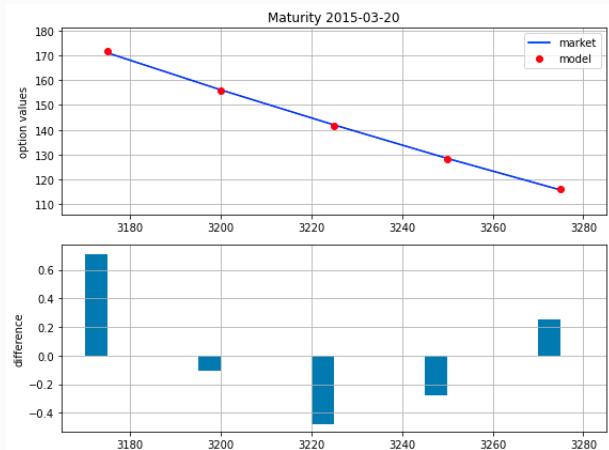
Calibration results BCC (1997)
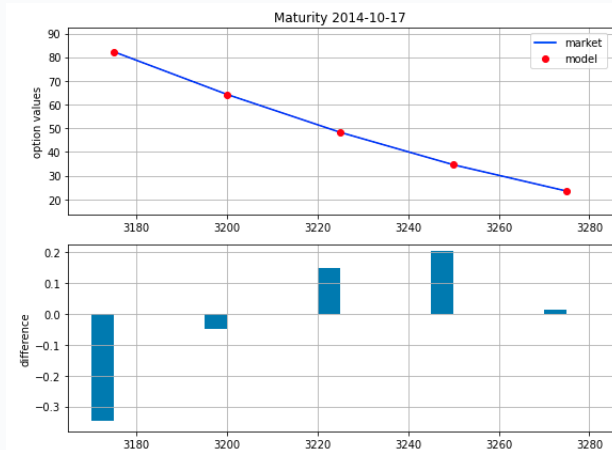
Calibration results BCC (1997)
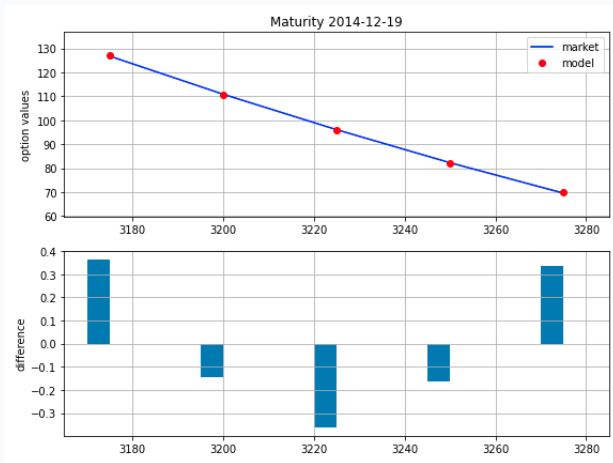
Calibration results BCC (1997)

Summary of Lesson 4

In Lesson 4, we have learned about:

- ▶ Main features of the calibration process
- ▶ Steps involved in the calibration of BCC (1997) model
- ▶ Results from BCC (1997) calibration to EuroStoxx50 options

$\Rightarrow$ **References for this lesson:**

Bakshi, Gurdip, et al. "Empirical Performance of Alternative Option Pricing Models." *The Journal of Finance*, vol. 52, no. 5, 1997, pp. 2003–2049.

$\Rightarrow$ **TO DO NEXT**: In the notebook associated with this lesson, we will guide you through the complete calibration process of the BCC (1997) model.

$\Rightarrow$ In the next module, we turn to Markov processes and chains, which are integral for the development of reinforcement learning, a field that has been gaining importance in quantitative finance given its broad applications.

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