

Module 3: Lesson 3

BCC (1997) model



Outline

- ▶ Bakshi, Cao, and Chen (1997) model

A general framework model

During this and the previous course, we have seen different option pricing models that combine desirable features to have:

- ▶ Stochastic Volatility → Heston (1993)
- ▶ Stochastic Interest Rates → Cox-Ingersoll-Ross (1985)
- ▶ Jump diffusion → Merton (1976)

Since these are all desirable features to have in a model that aims to capture all stylized facts of underlying assets, it would be very convenient to incorporate them in our general framework model.

⇒ This is precisely what the Bakshi, Cao, and Chen (1997) model does.

Bakshi, Gurdip, Charles Cao, and Zhiwu Chen. "Empirical Performance of Alternative Option Pricing Models." *The Journal of Finance*, vol. 52, no. 5, 1997, pp. 2003–2049.

BCC (1997) model

The Bakshi, Cao, and Chen (BCC) model of 1997 incorporates stochastic interest rates into a setting with stochastic volatility and jump diffusion. So, essentially, this is a Bates (1996) type model, with interests rates following a CIR (1985) type model.

⇒ These are the SDEs for underlying asset (S_t), volatility (ν_t) and short rates (r_t) in BCC (1997):

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

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

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

where Z_t^i are standard Brownian motions, and N_t follows a Poisson process.

- Now, we already know how these two models work separately, so it will be very easy to, given some parameters, simulate different price paths following the BCC (1997) model.
- This is what we will do in the Python notebook that accompanies this lesson.

Summary of Lesson 3

In Lesson 3, we have:

- ▶ Explored the BCC (1997) model
- ▶ Introduced Monte-Carlo simulation of BCC (1997)

⇒ **References:**

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

⇒ **TO DO NEXT:** In the notebook associated with this lesson, we will guide you step by step through the simulation, using Monte Carlo, of the BCC (1997) model.

⇒ In the next lesson, we will see how to fully calibrate this model.