Theta Behavior

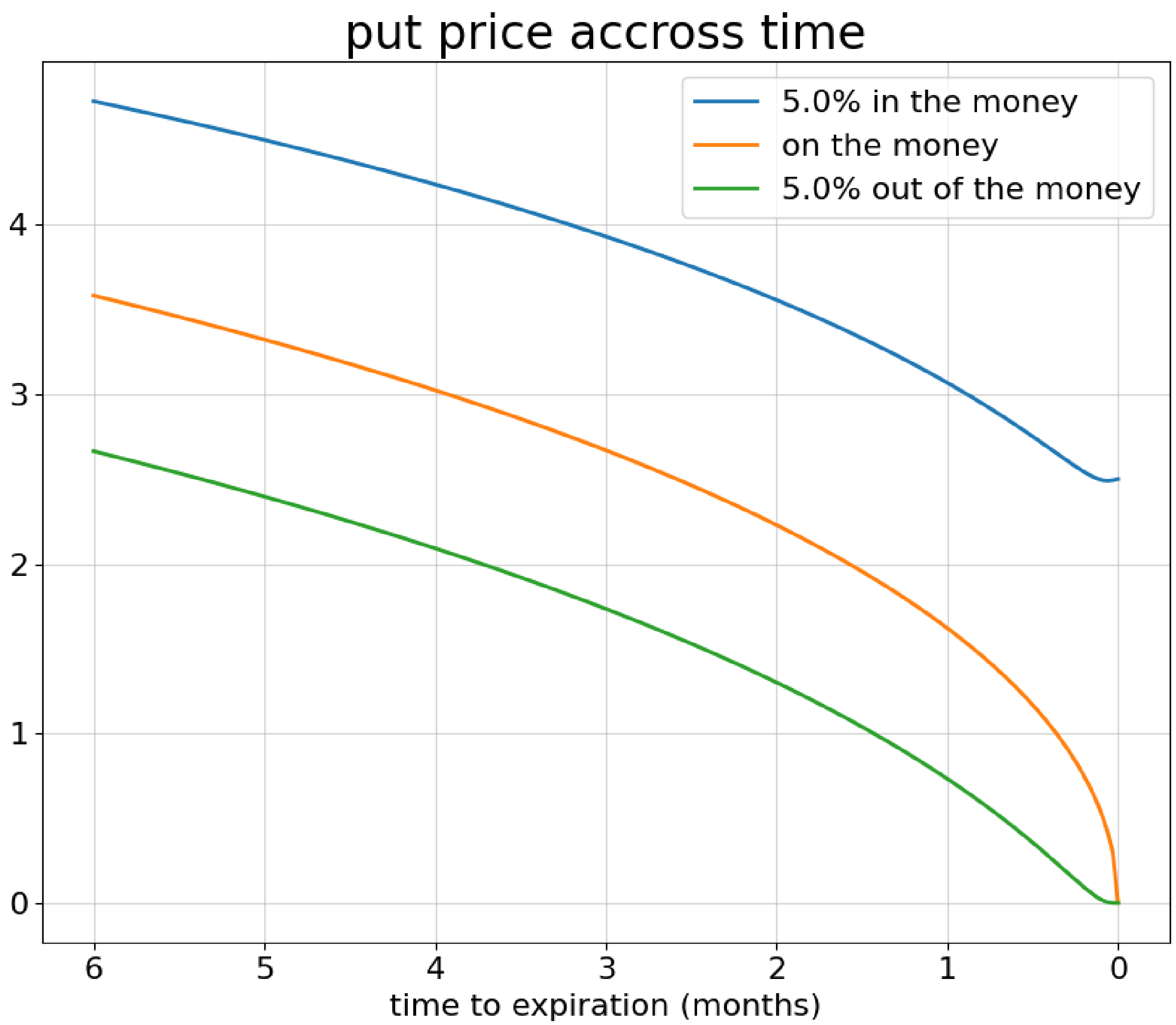
Pedro Giraldi

Theta

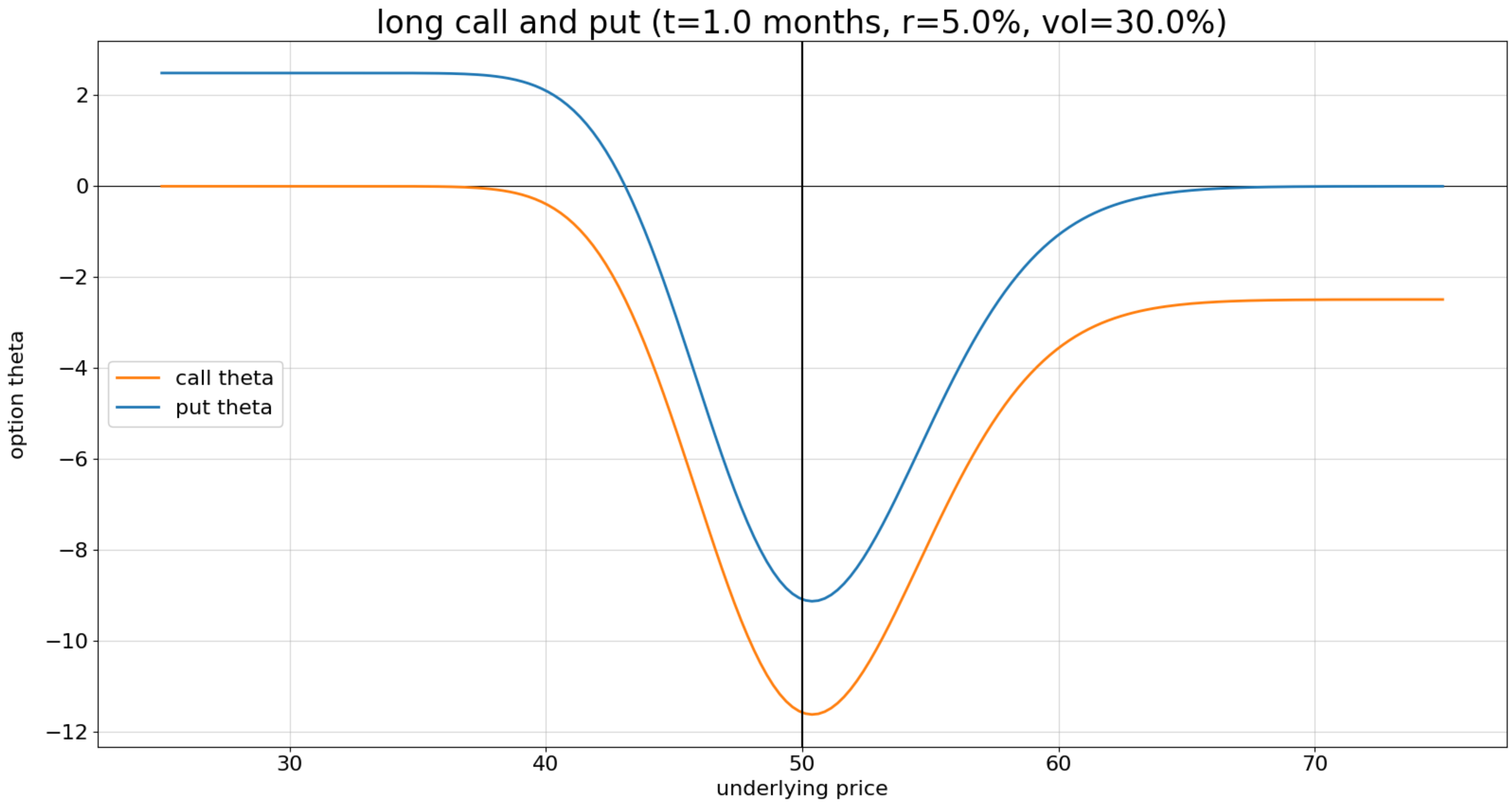
$$\theta_{call} = \frac{dC}{dt} = -\frac{S_0 e^{-rt} n(d_1)\sigma}{2\sqrt{t}} - Ke^{-rt}N(d_2)$$

$$\theta_{put} = \frac{dP}{dt} = -\frac{S_0 e^{-rt} n(d_1)\sigma}{2\sqrt{t}} + Ke^{-rt}N(-d_2)$$

Call and put prices decay rather similarly as time passes



Call and put prices decay rather similarly as time passes



Theta can be decomposed between two components

$$\theta_{call} = -\frac{S_0 e^{-rt} n(d_1)\sigma}{2\sqrt{t}} - Ke^{-rt}N(d_2)$$

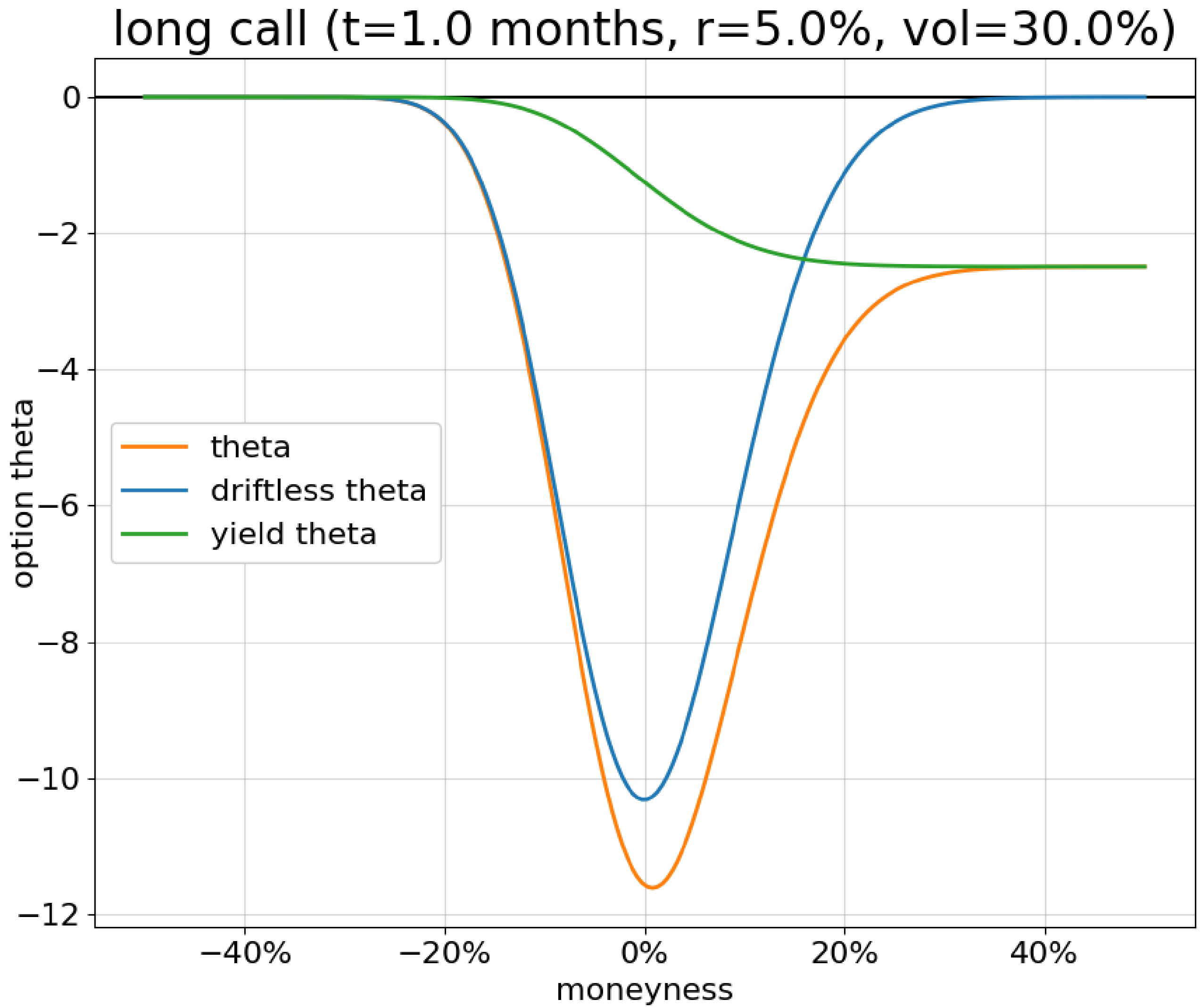
$$\theta_{call} = -\frac{S_0 e^{-rt} n(d_1)\sigma}{2\sqrt{t}} + Ke^{-rt}N(-d_2)$$

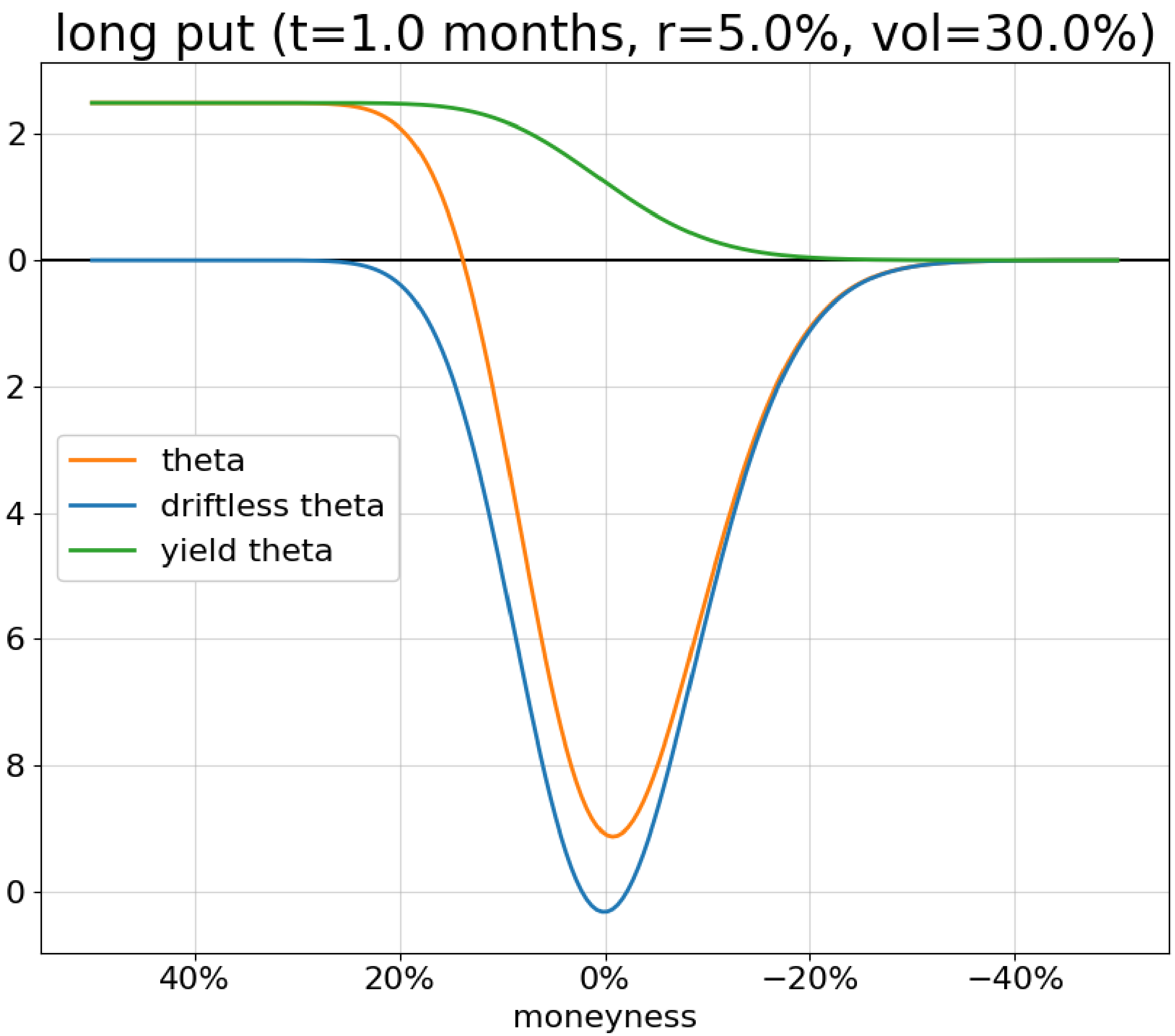
$$\theta = \theta_{liq} + \theta_{juro}$$

$$\theta_{liq\ call} = \theta_{liq\ put} = -\frac{S_0 e^{-rt} n(d_1)\sigma}{2\sqrt{t}}$$

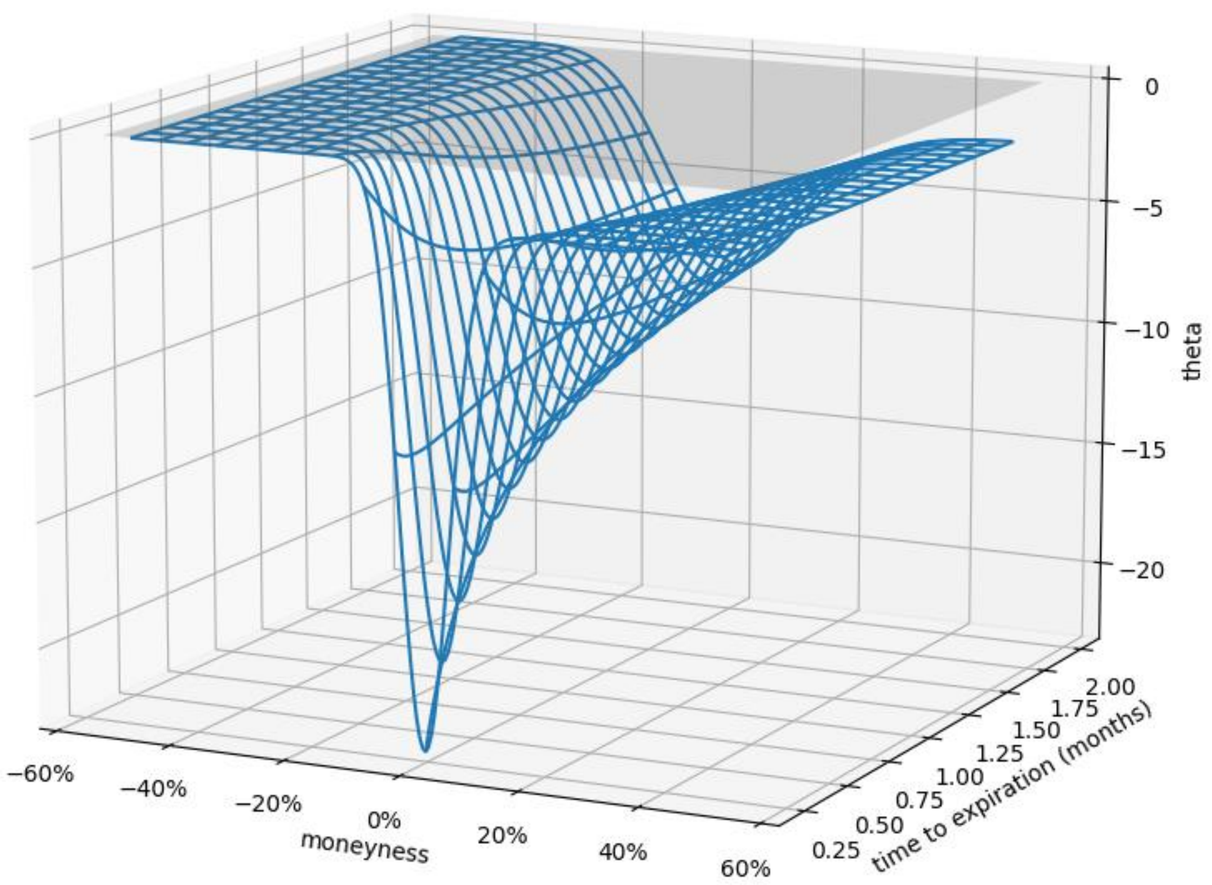
$$\theta_{juro\ call} = -Ke^{-rt}N(d_2)$$
$$\theta_{juro\ put} = +Ke^{-rt}N(-d_2)$$

Which explains theta positivity for deep in the money puts

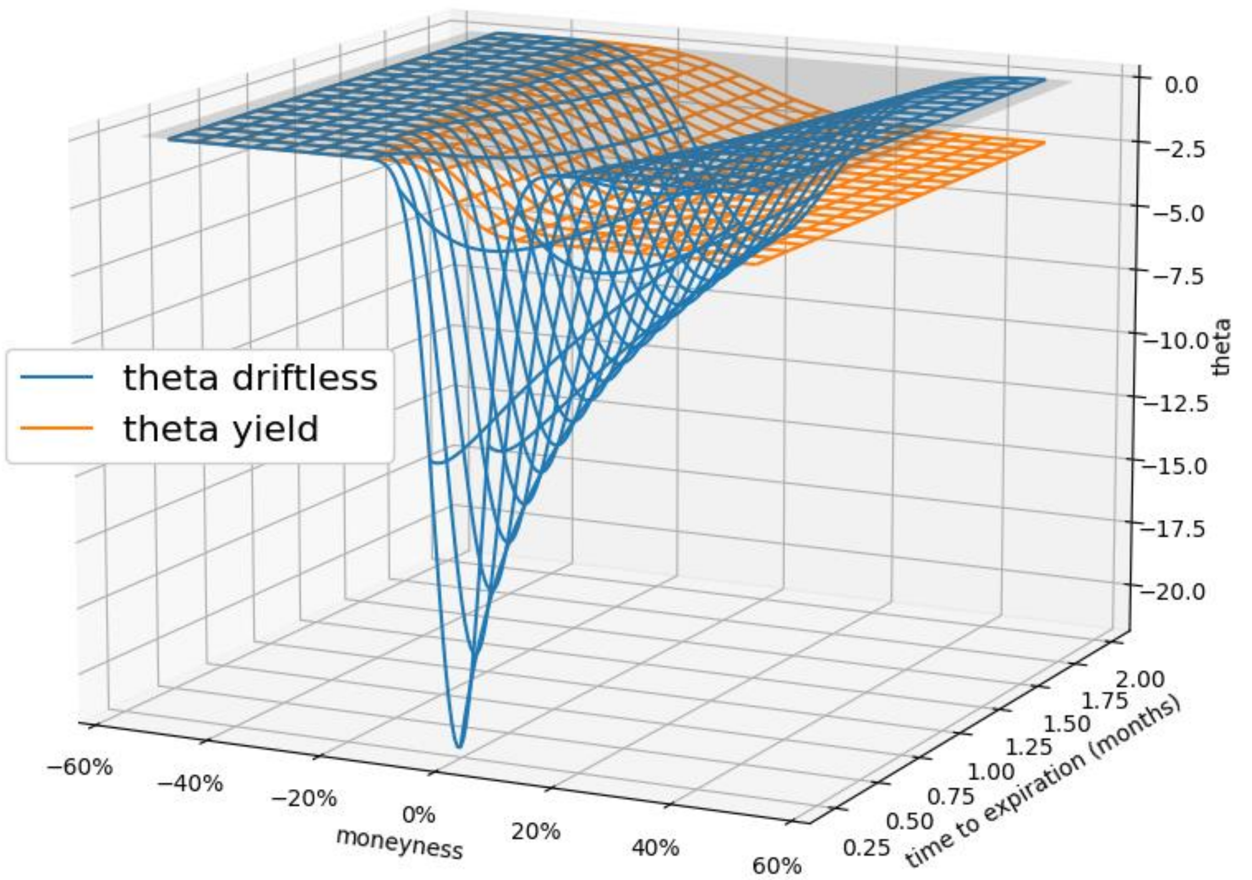


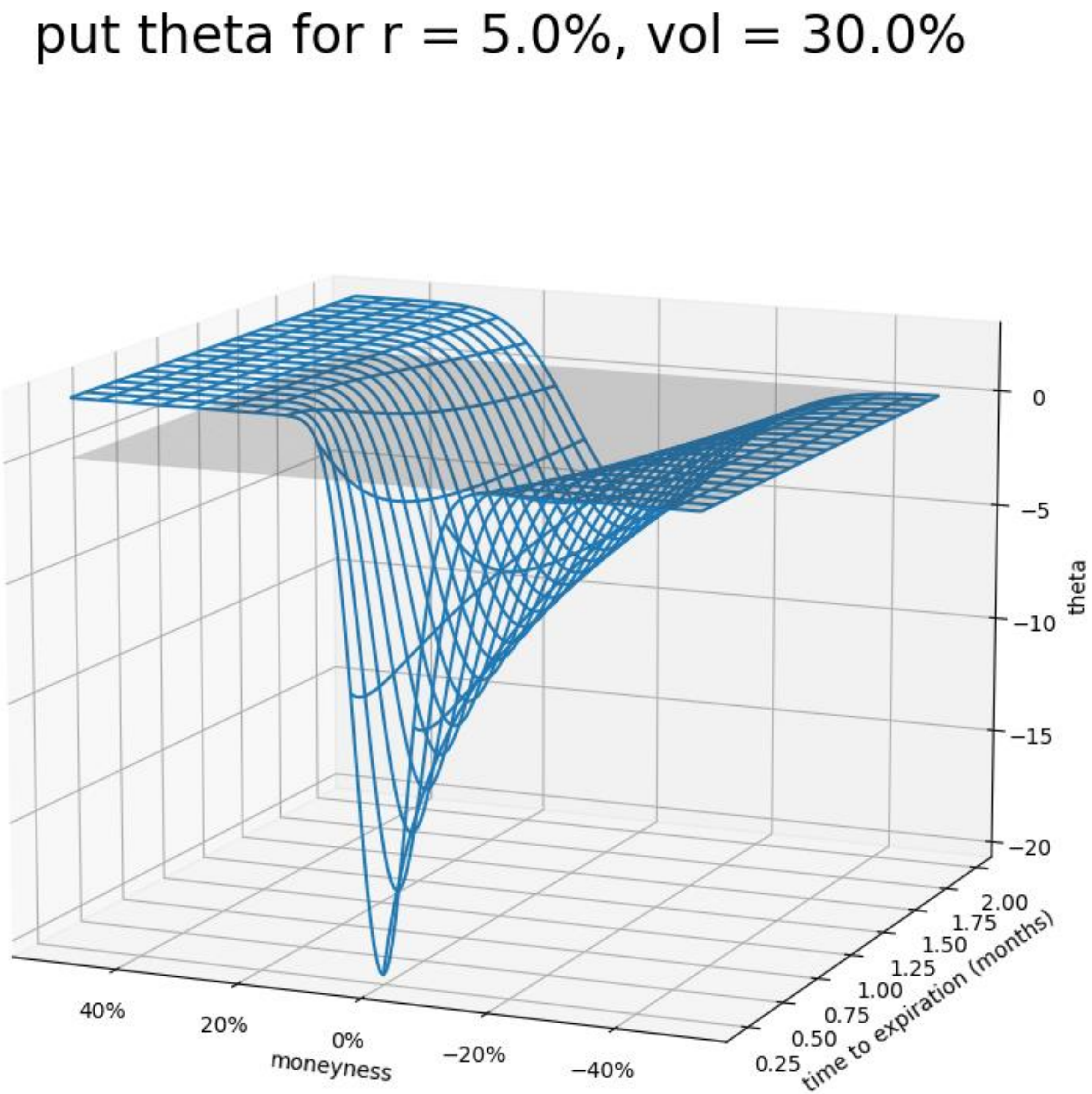


call theta for r = 5.0%, vol = 30.0%

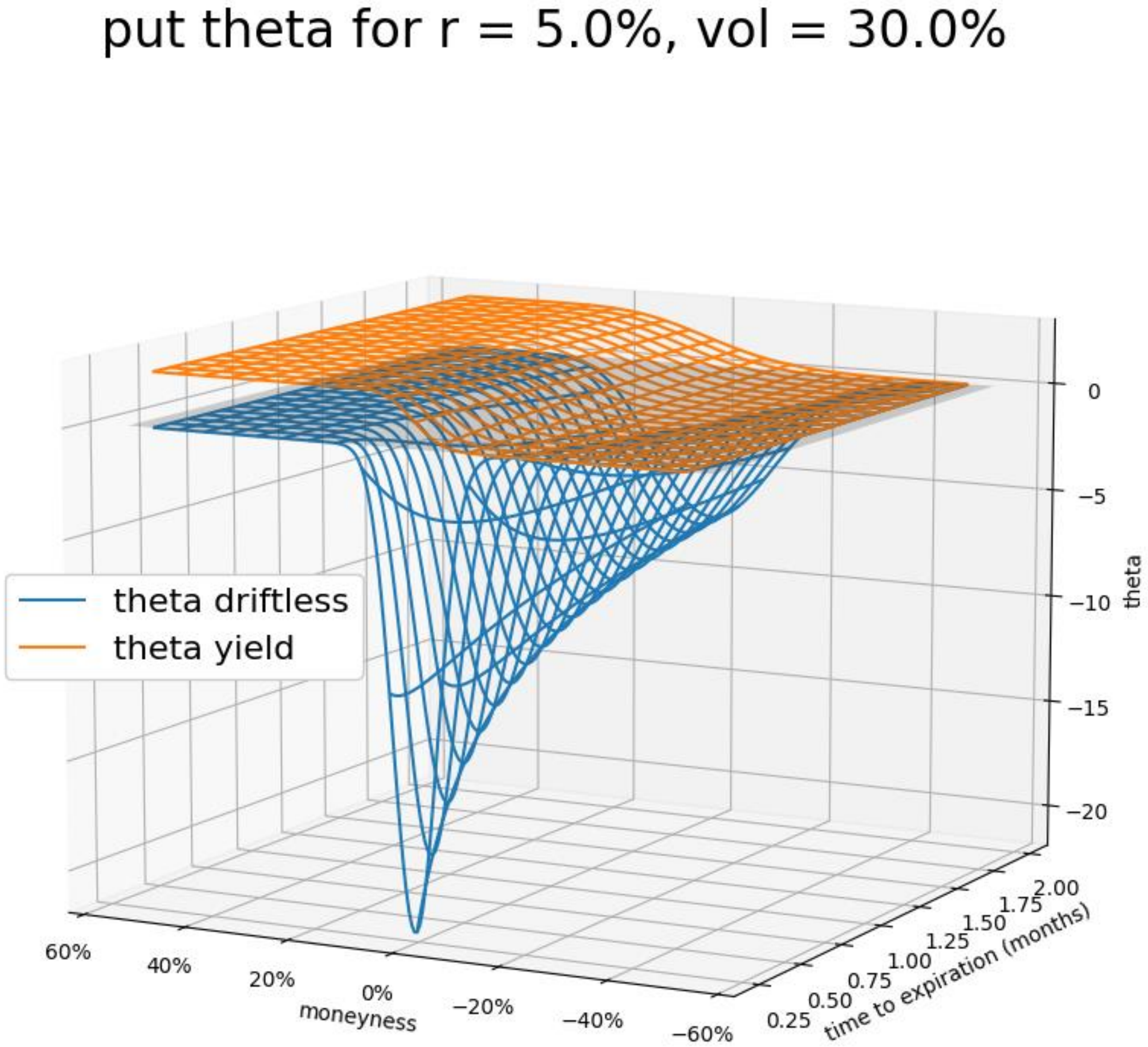


call theta for r = 5.0%, vol = 30.0%





put theta for r = 5.0%, vol = 30.0%
0
−5
−10
−15
−20
theta
40%
20%
0%
−20%
−40%
moneyness
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
time to expiration (months)



put theta for r = 5.0%, vol = 30.0%
theta driftless
theta yield
0
−5
−10
−15
−20
theta
60%
40%
20%
0%
−20%
−40%
−60%
moneyness
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
time to expiration (months)