Vega Behavior

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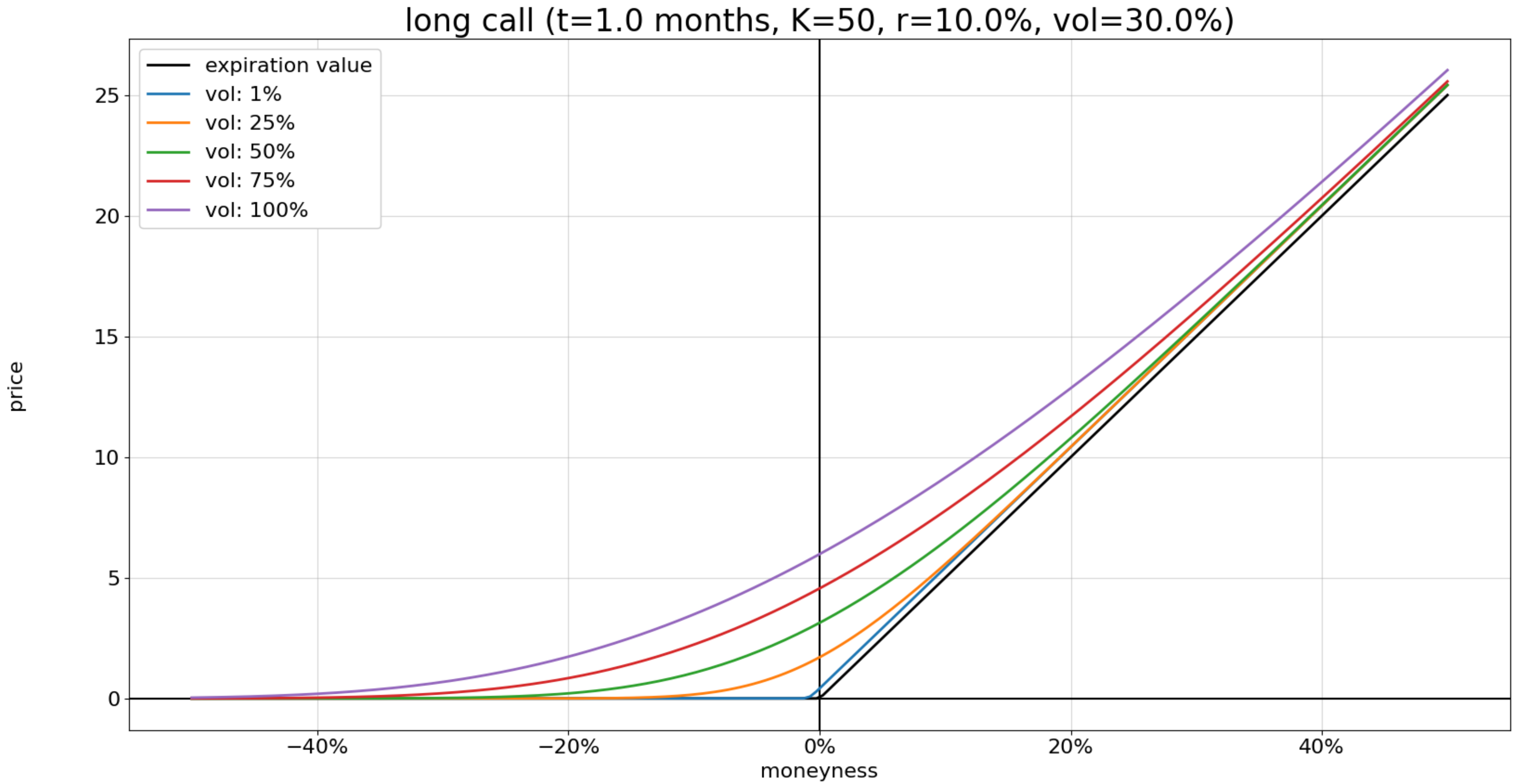
Vega

Call, Put

$$\nu = \frac{dC}{d\sigma} = \frac{dP}{d\sigma} = \frac{d\Delta}{dS_0} = S_0 n(d_1)\sqrt{T}$$

Volatility is more impactful on at the money option prices



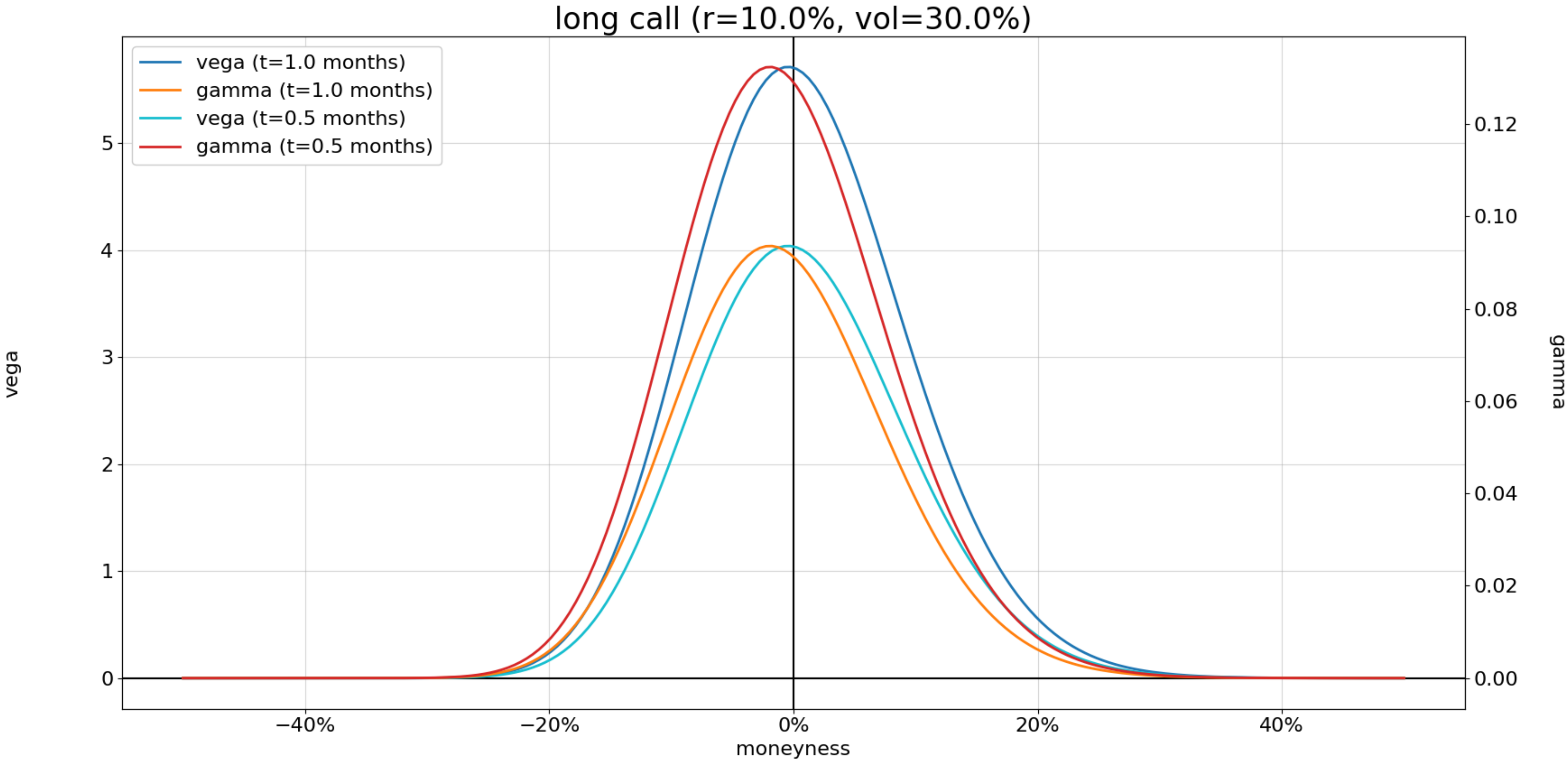
Gamma and Vega Relationship

Given $\nu = S_0 n(d_1)\sqrt{T}$ and $\Gamma = \frac{n(d_1)}{S_0 \sigma \sqrt{T}}$ then

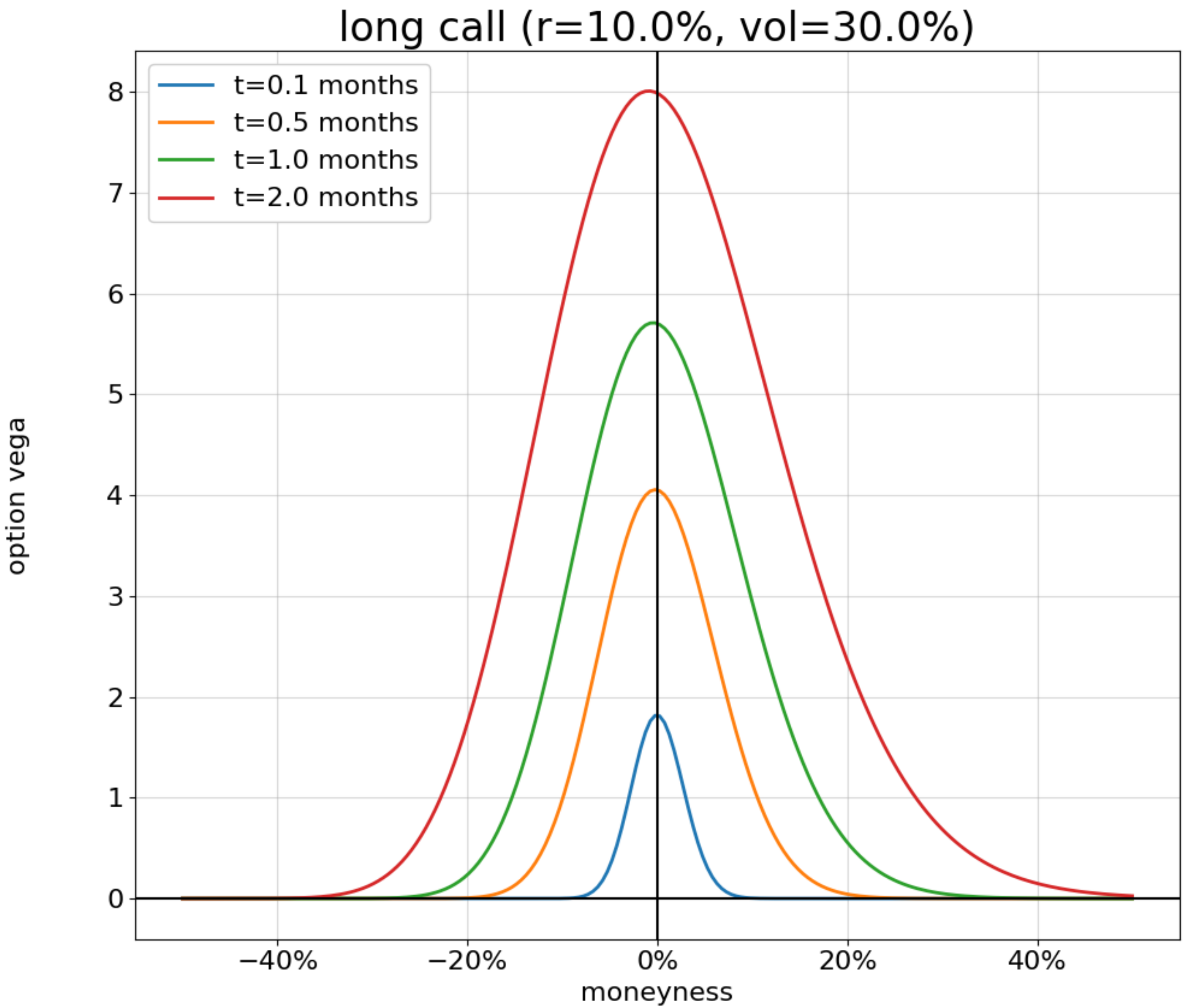
$$\nu = \frac{\Gamma}{{S_0}^2 \sigma T}$$

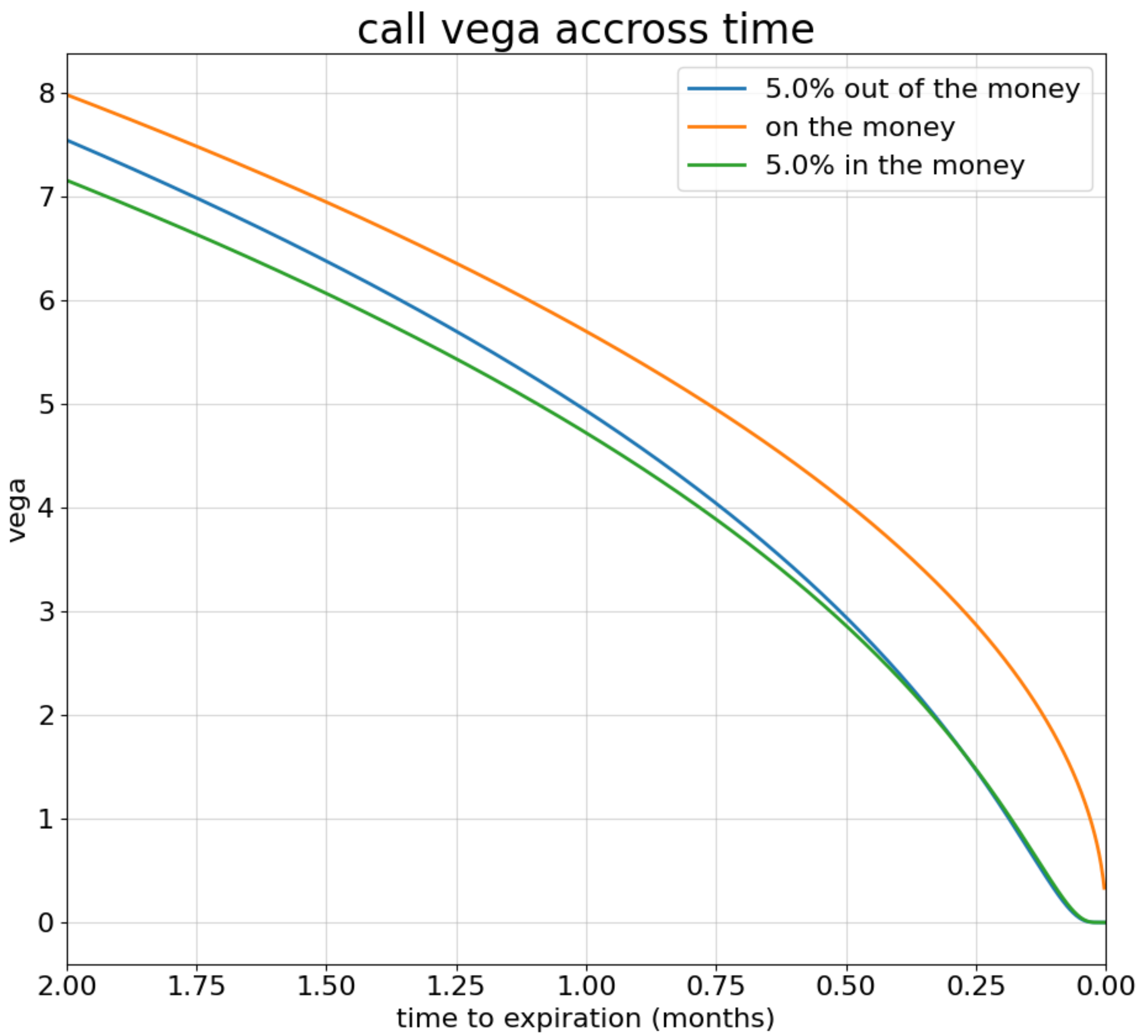
Which shows that gamma and vega are inversely related in respect to time. What about volatility?

Gamma and Vega diverge in relation to time

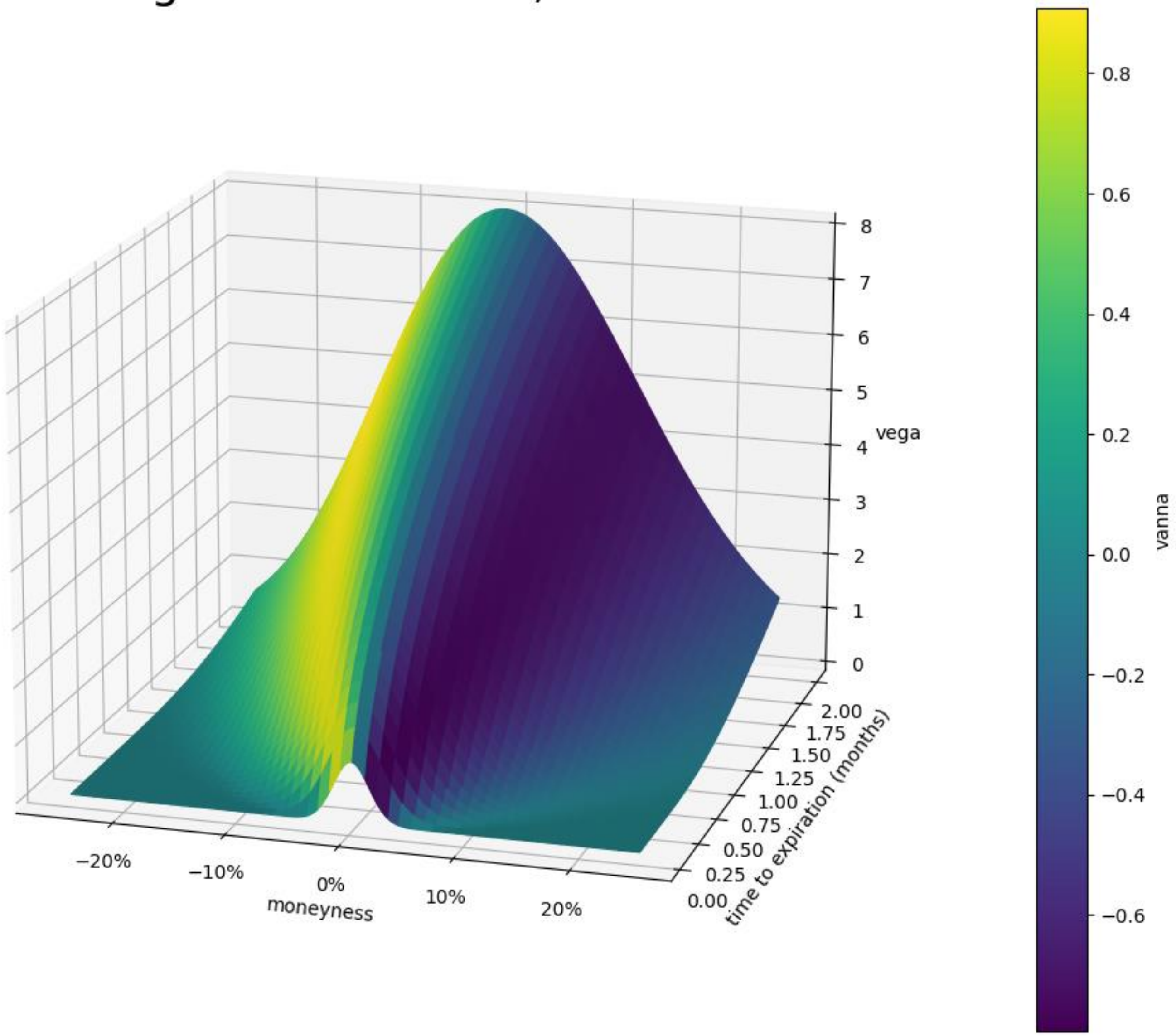


Vega decays as time passes





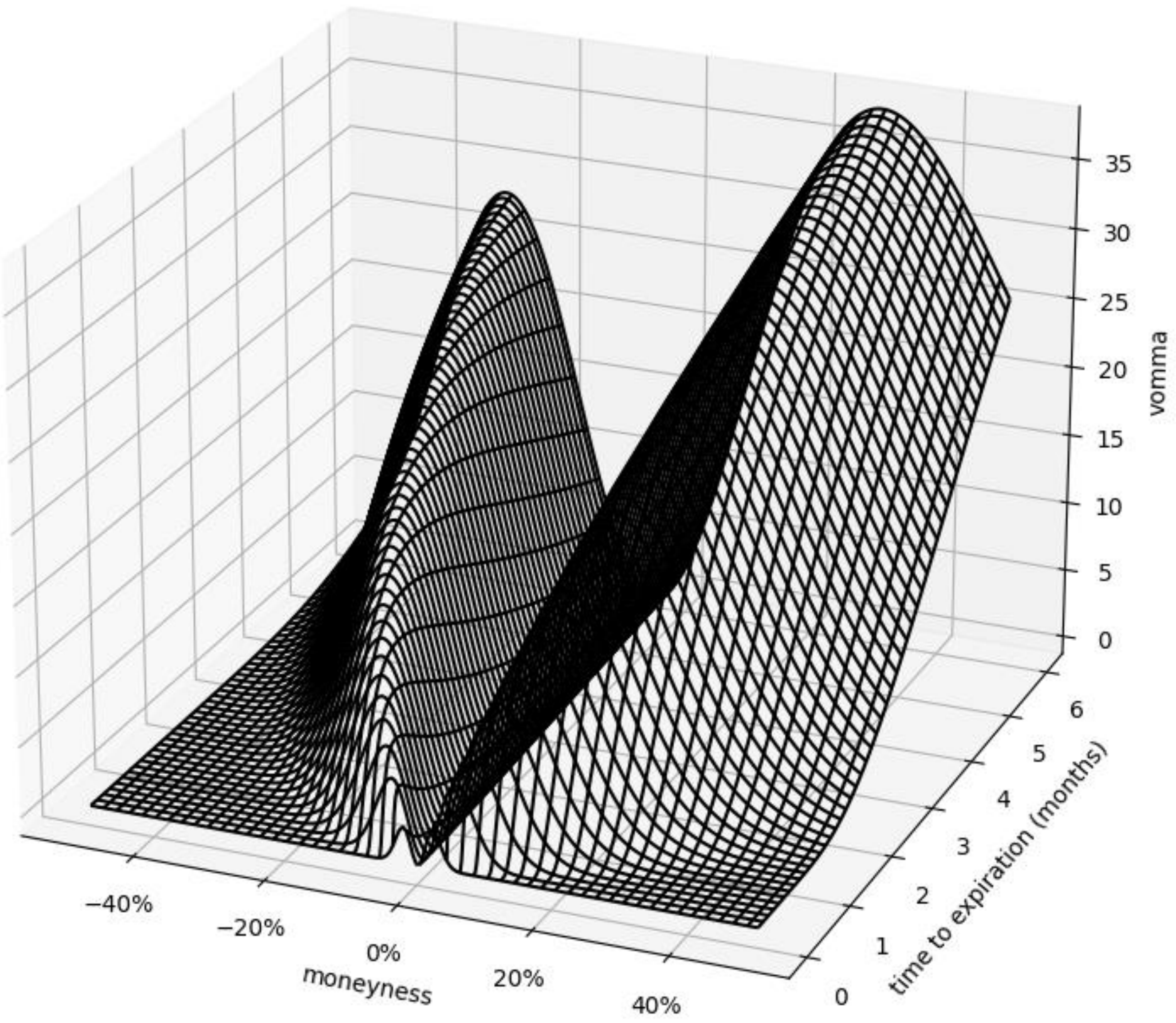
call vega for r = 10.0%, vol = 30.0%



$$vanna = \frac{d\ vega}{dS_0} = \frac{d\ delta}{d\sigma} = \frac{d^2C}{dS_0 d\sigma} = \frac{d^2P}{dS_0 d\sigma}$$

$$vanna = -n(d1) * \frac{d2}{\sigma}$$

call vomma for r = 10.0%, vol = 30.0%



$$vomma = \frac{d\ vega}{d\sigma} = \frac{d^2C}{d\sigma^2} = \frac{d^2P}{d\sigma^2}$$

$$vomma = vega * d1 * d2 * \frac{1}{\sigma}$$