

2008 Best Conference Paper Award

Description of the paper “Employee stock option valuation with an early exercise boundary”, forthcoming, *Financial Analysts Journal*.

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With the need to value employee stock options (ESOs) for accounting and economic purposes, increasing numbers of firms are recognizing that variants of the Black-Scholes formula are inappropriate for ESOs and are moving towards lattice models, the most influential of which is Hull and White (2004, *FAJ*). Hull and White assume that employees exercise voluntarily when the stock price reaches a *fixed multiple*, M , of the strike price. Conceptually, this introduces a ‘horizontal’ voluntary exercise boundary into the lattice. However, empirical evidence suggests that employees make a trade-off between *intrinsic value* captured and the opportunity cost of *time value* forgone, so requiring the stock to be at relatively *high* multiples of strike price to induce voluntary exercise *early* in the ESO life, yet willing to exercise at relatively *low* multiples of strike price later on.

We propose a model that explicitly recognizes and accounts for this reality. We assume that employees exercise voluntarily when the moneyness of the option reaches a fixed *proportion*, μ , of its remaining Black-Scholes value. This results in an intuitively appealing ‘downward sloping’ voluntary exercise boundary. Our ‘ μ -model’ is ‘FAS123R-compliant’, easily implemented, and readily encompasses ESO characteristics such as vesting restrictions, forfeiture and forced early exercise due to employment termination.

We show why our model may be less prone to bias than both the Hull and White model and the modified Black-Scholes model, when parameter inputs are calculated from historical observations of voluntary exercise behaviors. Given the known early exercise trade-off made by employees, a firm which has enjoyed rapid stock price growth will likely have experienced ESO exercises at somewhat high multiples of strike price (and early in the ESO lives), so using these historical observations to calibrate a Hull and White model will lead to high ESO valuations, (but low values if modified Black-Scholes is used). Conversely, a firm which has experienced sluggish stock price growth will have experienced ESO exercises at comparatively low multiples of strike price (and later in the ESO lives), so will obtain low ESO values from a Hull and White model (but high valuations from Black-Scholes). To the extent that our exercise boundary better describes the exercise decisions of employees, our model is less susceptible to these biases caused by atypical stock price histories. We illustrate this analytically by simulating stock price paths with a well-known utility-based model of employee exercise as a benchmark.

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