Shout Options

[This article is submitted by Professor Yue Kuen KWOK, Department of Mathematics, Hong Kong University of Science and Technology, Hong Kong, China for the Encyclopedia of Financial Engineering and Risk Management.]

The shout feature embedded in a derivative security resembles the American early exercise feature. In an American option, the early exercise payoff is taken to be the same as the terminal payoff. For the shout feature, the payoff upon shouting is another derivative with contractual specifications different from the original derivative. In its earliest form, the embedded shout feature in a call option allows its holder to lock in the profit via shouting while retaining the right to benefit from any future upside move in the payoff. The terminal payoff of a shout call option is the form: $C = \max(S_T - K, L - K, 0)$, where K is the strike price, S_T is the terminal stock price and L is some ladder value installed at shouting. The ladder value L is set to be the prevailing stock price S_t at the shouting instant t (Thomas, 1993). Hence, the terminal payoff is guaranteed to be at least $S_t - K$. Obviously, the holder should shout only when $S_t > K$. The number of shouting rights throughout the life of the contract may be more than one. Some other restrictions may apply, say, the shouting instants are limited to some predetermined times.

In a broader sense, the shout feature can be visualized as the right given to the derivative holder to *reset* certain contract specifications in the original derivative or receive a new derivative. In option contracts, the terms that can be reset include the strike price and maturity. The shout to reset may be chosen optimally by the holders at any moment or at preset instants. Consider the reset strike put option, where the strike price is reset to the prevailing stock price upon shouting. In other words, the holder receives an at-the-money put option when shouting commences. The shouting payoff is given by $\max(S_t - S_T, 0)$, which can be expressed as $\max(S_T - K, S_t - K, 0) - (S_T - K)$. Hence, the shout call option can be replicated by the reset strike put and a forward contract (put-call parity relation).

In other cases, the reset of contract terms may be automatic upon the satisfaction of certain preset conditions. For example, in late 1996, the Chicago Board Options Exchange and the New York Stock Exchange launched the trading of the S&P 500 index bear warrants with a three-month reset (Gray and Whaley, 1997). These warrants are index puts, where the strike price is automatically reset to the prevailing index value if the index value is higher than the original strike price on the reset date three months after the original issuance. As an additional example, the lowering of strike price and maturity extension of previously issued executive stock options become quite common in recent years (Brenner *et al*., 2000). Empirical studies showed that resetting has a strong negative relation with firm performance, in particular, when declining share prices have moved the stock options out-of-the-money.

In Australia, Macquarie Bank has been marketing the Geared Equity Investments with embedded reset put feature (Gray and Whaley, 1999). The Bank provides an investor with a loan, the proceeds of which are used to buy some Australian shares. In addition, Macquarie insures the investor against any share price decline with an embedded reset put option. The put option has an optional reset feature that automatically reset the strike price to the prevailing share price on a preset reset date should the share price exceed the original strike price.

Reset features are also common in bonds and funds. The Federal Government of Canada issued the extendible and retractable bonds (Ananthanarayanan and Schwartz, 1980). An extendible bond gives the bondholder the right of extending the maturity of the bond, on or before a fixed date at a predetermined coupon rate. A retractable bond gives the holder the right of choosing an earlier maturity. The Canadian segregated funds contain multiple embedded shout options that allow the holder to reset the guarantee level and the maturity date during the life of the contract (Windcliff *et al.*, 2001). In 1990's, in order to make the Japanese convertible bonds attractive to investors in the environment of stock market decline, the bond issuers incorporate the downward reset feature on the conversion price should the underlying share price fall below the preset threshold value on the preset date. Unfortunately, experiences showed that such "sweetener" is too poisonous for the bond issuers due to the plague of large negative gamma inherent in the reset convertible bonds (Nelken, 1998).

The valuation of derivatives with automatic reset feature is relatively straightforward. The payoff on the reset date is the maximum of the reset payoff and non-reset (original) payoff, depending on whether certain reset conditions are met or otherwise. The pricing procedure resembles that of a European compound option. However, the valuation of a derivative with reset via optimal shouting leads to an optimal stopping problem. In the valuation procedure, it is necessary to investigate the optimal shouting policy and determine the critical stock price at which it is optimal to shout (Kwok, 2003). The shout option value can be decomposed into two components: the European option component (stripping the shout feature) and the shouting premium. The shouting premium can be expressed as an integral over the remaining life of the contract of the delayed compensation cash flows integrated over the range of the stock price at which the holder should shout optimally (called the stopping region). In the binomial tree calculations, the shout option value can be computed using the usual dynamic programming procedure. In the backward induction procedure applied at each binomial node, we choose the maximum of the continuation value and the payoff upon shouting. In essence, valuation methods that are applicable for American options can be carried over to shout options. In summary, shout options are attractive to investors who would like to lock in the gain at the prevailing state and seek potential higher gain. However, shout option buyers have to pay certain shouting premium to the writer for such advantages.

References

Ananthanarayanan, A.L. and Eduardo S. Schwartz, Retractable and extendible bonds: the Canadian experience, *Journal of Finance*, **35**(1) (1980): 31-47.

Brenner, Menachem, Rangarajan K. Sundaram and David Yermack, Altering the terms of executive stock options, *Journal of Financial Economics*, **57** (2000): 103-128.

Gray, Stephen F. and Robert E. Whaley, Valuing S&P 500 bear market warrants with a periodic reset, *Journal of Derivatives*, (1997, Fall): 99-106.

Gray, Stephen F. and Robert E. Whaley, Reset put options: Valuation, risk characteristics, and an application, *Australian Journal of Management*, 24(1) (1999): 1-20.

Kwok, Yue Kuen, Mathematical Models of Financial Derivatives, second edition, Singapore: Springer, 2003.

Nelken, Israel, Reassuring the reset, *Risk*, **11**(10) (1998): 36-39.

Thomas, Bryan, Something to shout about, *Risk*, **6**(5) (1993): 56-58.

Windcliff, Heath A., Peter A. Forsyth and Kenneth R. Vetzal, Segregated funds: Shout options with maturity extensions, *Insurance: Mathematics and Economics*, 29(1) (2001): 1-21.