Employee Stock Option Plans

Employee stock options are a widely used instrument to align interests of managers and shareholders. Especially in early-stage companies employee stock options are one good remedy to console the founders for the dilution they had to go through in the fund raising process. Every time a company issues employee stock options (and the corresponding conditional shares) it has to value them for accounting and tax purposes. This is typically the CFO's or the valuation guy's task. We therefore give here a short primer on what there is to do.

The Stock Option Plan

The company issues options to their employees. The options are usually only vested after a certain blocking period. The employees can then execute the option at the moment of their choice or sometimes within predefined execution windows until maturity of the option; but usually only as long as they are still with the company.

Let's assume the following Employee Stock Option Plan (ESOP): The share price is at USD 120 (2,500,000 shares outstanding), 20,000 options are issued with a strike of USD 120, a 3 year blocking period, expiring after 10 years. The long term risk-free interest rate is 4%, the company on average pays a dividend of 3% of the share price, and the volatility of the share price is 43%.

Black-Scholes

For financial options the Black-Scholes formula applies. Employee stock options don't fulfil a number of conditions of the Black-Scholes formula, e.g. they are not tradable, but the formula is applied

because it is generally accepted and the absolute standard. The formula goes as follows:

$$V=exp(-dT)SN(d_1)-exp(-rT)KN(d_2),$$
$$d_1=(ln(S/K)+(r-d+\sigma^2/2)T)/(\sigma\sqrt{T}),$$
$$d_2=d_1-\sigma\sqrt{T},$$

Where S is the share price, K the strike (usually equal to the share price at issuance), T is the maturity, r the interest rate, d the dividend yield, and σ the volatility of the share price. The interest rate and the dividend yield are here continuously compounded, so one has to transform the discretely compounded interest rate r_d in the following way:

$$r=ln(1+r_d)$$

$N(.)$ is the normal distribution (in Excel it's NormSDist).

The price of one option of the ESOP with Black-Scholes amounts to USD 47.09.

Early Execution

Tradable options are only executed at maturity (or at dividend payments[1]) because you can always sell them at a better price than what you get by executing them. For employee stock options this doesn't hold because you cannot sell the option. Various reasons lead to early execution of the option; the holder thinks that the share price is at a high and is going to fall in the future, maybe the holder plans to change employer and wants to cash in all his options while he still can do so, or maybe he just

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[1] Villiger, Ralph, „Valuation of American Call Options." Wilmott 2006, March.

needs to buy his fiancée a ring. Therefore we can assume that the options are executed all over the life-time between the end of the blocking period until maturity. With this additional assumption an option of the ESOP is worth 11% less, i.e. USD 41.88.

Fluctuation

Of course employees don't stay forever in the same company and some fluctuation naturally occurs. For the valuations of ESOPs it is important to estimate how many options won't be executed because the holders are not in the company anymore. If we assume a yearly fluctuation rate of 4%, i.e. 4% of employees participating in the ESOP leave the company each year, then the average value of an option becomes USD 31.95, corresponding to a 32% value reduction with respect to the original Black-Scholes price.

Dilution

Finally, the execution of the options leads to additional shares although the share capital is not increased. Current shareholders therefore get diluted. This dilution can be considered in the valuation by assuming that the options are actually warrants. If the company has N shares outstanding and the company issues n options, then this means that the value of the option satisfies the following equation:

$$V = V((NS+nV)/(N+n),\ K,\ d,\ r,\ T,\ \sigma)$$

In our example the expected dilution reduces the value a bit more down to USD 31.66. All in all the correct value of the option is 32.8% lower than the Black-Scholes price. This number is significant for the CFO as he has to make less provisions for the ESOP. It is therefore worthwhile to spend a bit time to run a sophisticated valuation.

ESOP for private companies

Within biotech companies we face various difficulties. First, we do not have a share price at every moment, but only at financing rounds. The price for the ESOP calculation can be derived from the last financing round provided no significant event happened meanwhile. Otherwise a new valuation has to be performed. Second, we do not have a volatility since we do not have a historical share price development. For early stage companies, in particular biotech companies, this volatility can amount to 100%-200%, which then increases the value of the ESOP enormously. As far as possible we recommend using volatilities of comparable companies. The huge volatility is mainly a consequence of the clinical success and the subsequent large value change; therefore Monte Carlo simulations also provide good approximations for the volatility.

For a calculation sheet of such ESOPs please visit our website http://www.avance.ch/shop/excels.html. For setting up an ESOP tailored to your company you can contact our partners at JT AssetCompensation (www.jtassetcompensation).