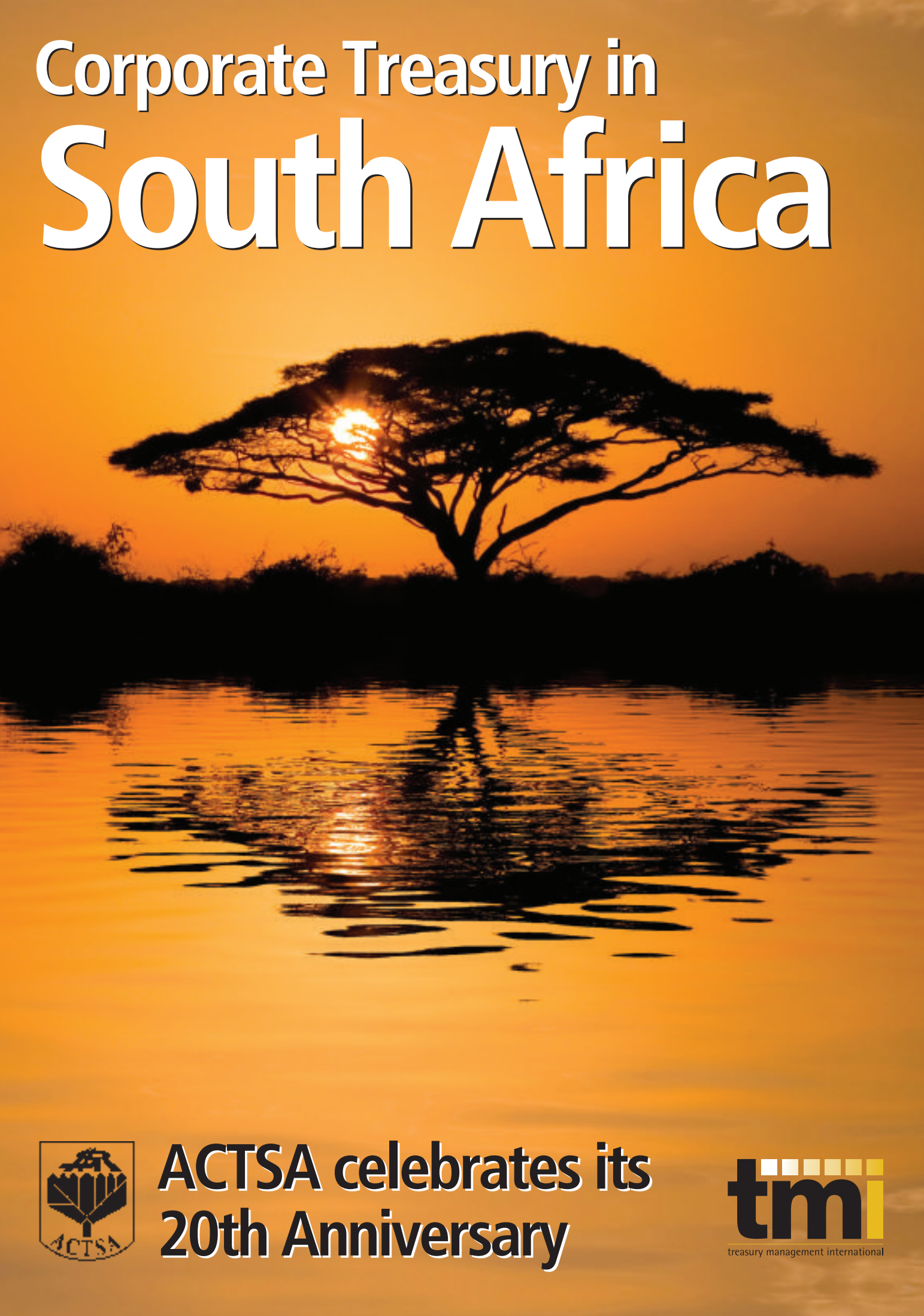
# Corporate Treasury in South Africa



## ACTSA celebrates its 20th Anniversary

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# Corporate Treasury in South Africa

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*TMI would like to thank Artemis Galatis, General Manger of ACTSA, for all her help and assistance in putting together this commemorative publication, and would also like to send the members and the Board of ACTSA congratulations and good wishes on the occasion of their 20th Anniversary.*

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## Contents

# Employee Stock Options

by Graeme West, Financial Modelling Agency

Employee or executive stock options (ESOs for short) are call options granted by a company to an employee on the stock of the company. These options are part of the remuneration package of the employee. However, they differ from ordinary options in at least one crucial way: they cannot be transferred, and in the event of the employee leaving the company, they are forfeited.

They are a sweetener for the employee: they encourage him or her to remain an employee, and they encourage him or her to work towards an increase in the financial health of the company, which will translate into an increased share price, and eventual increased wealth of the employee.

## A very brief history of valuation questions

Until the birth of option pricing algorithms in the 1970s the common wisdom concerning ESOs was that they were not an expense because there were no cash flow implications for the firm. The first valuation methodology to be introduced was that options should be expensed at their intrinsic value on grant date. Provided that these options were granted at the money, which was typical, there would be no profit and loss or bottom line effect.

In the 1990s it was recognised that options, even those struck at the money, had economic value, and thus needed to be expensed. However, very few companies chose to record any expenses for their ESOs, especially when there was no legal or regulatory requirement for such accounting treatment. In the USA for example, the Financial Accounting Standards Board only made footnote disclosure of such expenses mandatory, and because of this many companies did not record the impact of their ESO's, further than referring to it in a footnote to their financial statements.

After the dotcom crash, it was realised just how much of a burden ESOs were to the company. Many dotcom companies had relied very heavily on ESOs to incentivise employees, and these companies would have looked unprofitable a long time before they actually did, if those ESOs had been expensed, rather than just

appear as footnotes to the accounts.

It is now almost universally accepted that ESOs are an expense to the company that need to be accounted for - see Bodie et al. [2003]. Audit requirements for ESOs fall under IFRS2 IASCF [2006] regulations. The company is buying services from the employee; the remuneration is share-based. As such this remuneration needs to be expensed using a recognised option pricing formula.

## The typical ESO structure

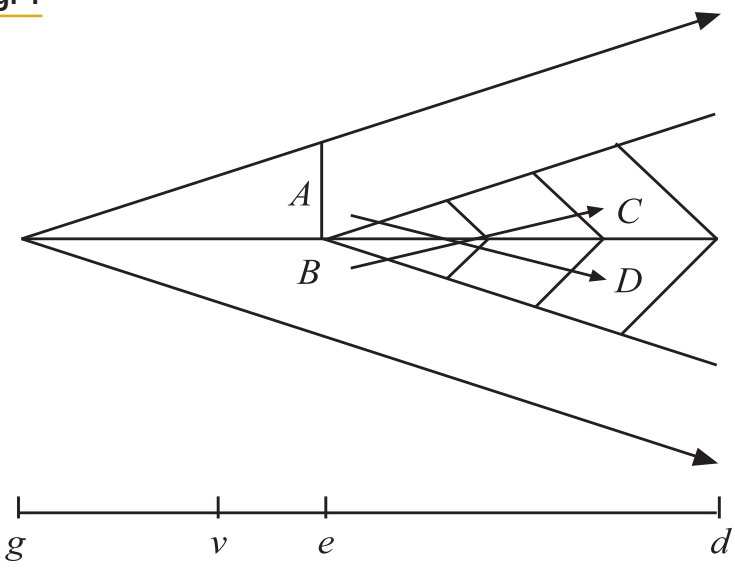
Typically employee stock option grants are Bermudan options, where, after some vesting period, the employee may until some `drop-dead' date exercise the options and take possession of the stock, or possibly receive cash. After vesting there may also be some closed periods, where exercise is not allowed. These will typically be in the period or periods before year-end or half-year results announcements. This may constitute as much as five months of the year, for example. Option holders will also be prevented from exercising if the company issues a cautionary notice to the market.

Typically, the vesting of the options proceeds in proportions. For example, an employee might have 40% of their options vest after three years, 30% after four years, and the last 30% after five years. To handle this one simply splits the analysis up into three separate grants, and aggregates at the end.

In reality, the employee may leave the employ of the firm at any time. In this case, any benefits of unvested or unexercised options are voided.

Broadly, the rationale for vesting, and in particular proportional vesting, is in order to 'lock in' the employee in the service of the company for as long as possible. Hence employee stock options are the so-called `golden handcuffs': they incentivise the employee to remain in the employ of the company, and as a group for the employees to work towards the best interests of the company (this assumes that the free-rider and other game-theoretic issues are not important).

**Fig. 1**




*g is the grant date, v is the vesting date, e the expected life of the option, d is expiry (drop dead) date.*

## The gross invalidity of the Black-Scholes expected life approach

Let us examine the issue of why lattice methods - binomial or finite difference - are to be favoured over Black-Scholes approaches, which have until recently been prevalent.

In order to shoehorn the Black-Scholes model into employee stock option grant pricing, the entire Bermudan window of exercise opportunity needs to be reduced to a single expiry date. Recall that the employee can exercise at any time from the vesting date to the drop-dead date. Refer to Figure 1 where these dates are denoted v and d respectively. In order to find a single approximate expiry date, the notion of `expected life' was introduced and calculated, as being a date intermediate between them, denoted e in the diagram. The option grant was then valued using the Black-Scholes formula with this date as the option expiry date.

Two problems then present themselves. The Black-Scholes formula is pricing the payoffs under the risk-neutral probabilities of the stock price ending in regions A and B. If the stock price ends in A , the option is in the money, and there is a payoff, if the stock price ends in B the option expires out of the money and worthless. However, if we consider the true picture, then from time e to d there is a chance of the stock price moving from B into the shaded region marked C, and a chance of the stock price moving from A into the shaded region marked D. Both of these potential moves are not modelled by the Black-Scholes formula. One represents a gain in value, one a loss, but they most certainly do not offset. In the case where the option has a long life, this error will be material.

The second problem is not unrelated to the first; it is that the whole concept of expected life is fraudulent, as it requires some kind of crystal ball prediction of the extent to which the option will be in the money on the vesting date. Arguments such as `the option will be so deeply in the money at the vest date that the expected life is not much more than the vest date' are clearly fraudulent: the whole point of

the option having an extensive Bermudan period is that it allows for the finding of a point where the moneyedness of the option is material enough for the holder to consider it attractive enough to exercise, and this may occur well after the vest date. The stock might indeed find this value after the option had been out the money for a significant period of time. This is especially clear in the case of a high volatility stock.

## The asymmetry of value, cost to the company and fair value

It is important to note that the value of the asset that the individual employee stock option holder has is not equal to the liability of the company. This is because the employee has various constraints pertaining to his/her holding as opposed to an ordinary stock option held by an outsider. For instance, the employee is unable to sell the option on, and is unable to hedge it, as insiders are prevented from short selling the stock.

In addition, if the employee resigns any unvested or undelivered options have to be forfeited. On the other hand, the employee may exercise early in order to achieve liquidity, because they are risk averse, or because of tax considerations.

As a result, an employee's valuation reflects risk aversion and other necessarily subjective preferences.

On the other hand, in a discussion memo dated December 15, 2003, FASB stated that the value of an employee stock option as measured by a company is the 'fair value' that the company would be required to pay a hypothetical market participant to assume the employee stock option obligations. That is the company's perspective. In particular, "the market participant is hypothetical and does not represent the biases of a particular participant, such as an employee whose personal wealth is concentrated in the employer's equity instruments, but rather reflects the notional consensus of the market." Indeed, if a company used employees' valuations, the resulting estimates would not represent fair value, because they would be the values to individual employees rather than to the marketplace.

*It is important to note that the value of the asset that the individual employee stock option holder has is not equal to the liability of the company.*

## The valuation of ESOS

ESOs are typically structured as Bermudan options. The only addition factors are that the option may be forfeited (because of resignation of the employee) or exercised early, which is sub-optimal from the usual option pricing point of view. As seen in Carpenter [1998], it is appropriate to price the option using the usual risk-neutral valuation methodology (either via a tree in the spirit of Cox et al. [1979] or a finite difference scheme) but with an additional factor, which models the per annum intensity of such early terminations.

We have developed a model in the spirit of Carpenter [1998] which has a factor for forfeitures and another (separately calibrated) factor for early exercise. This model is a finite difference scheme, see West [2008].

In reality, the employee may leave the employ of the firm at any time. In this case, any benefits of exercised or unexercised options are voided as are any unsettled tax liabilities. One audit approach, advocated in IFRS2 IASCF [2006], is simply to estimate the hazard factor and then post-multiply the value of the employee stock options found by assuming no attrition with the survival fraction. Of course this assumption does not take into account any non-linearity in the hazard phenomenon. In that reference they open the door for more sophisticated approaches which we attempt in West [2008].

We have a significant preference for using the model which includes both the staff attrition factor and the early exercise factor. It is important to understand that there will be differences in valuation from taking the two approaches, and these differences could be material: the impact of attrition is not linear, for example, attrition is less likely when the option is well in the money and/or near to vesting than when not.

## Accounting implications of ESO

It is typical audit practice to simply

- Calculate the value of the options assuming that no employees resign before vesting;
- estimate the rate at which employees resign before vesting, and hence determine the survival fraction i.e. the proportion of employees who will still be in the employ of the company at vesting;
- multiply the value of the employee stock options found by assuming no attrition with the survival fraction.

This is the default approach specified in [IASCF, 2006, BC176], although it does allow one to apply a more sophisticated approach. Of course this default assumption does not take into account any non-linearity in the hazard phenomenon - it is assuming that forfeiture is independent of the stock price process followed in the vesting period. We prefer to use the

model described previously in order to include non-linearities within the model.

The accounting treatment of employee stock options divides into three cases:

**The employee stock options can only be exercised into shares:** in this case, the fair value is calculated at the issue date. This amount is then amortised on a linear basis from that accounting year to the year at which the options first vest. The only adjustment that is required is if the actual attrition rate observed is different to that predicted. Thus, at the end of each period, we will revalue the options, using all the same model inputs as originally, except we might adjust the attrition rate.

Here is a numerical example of what can be done:

Assume

- 4 years to first vesting;
- with a given attrition assumption, the ESO is valued at 100.

Thus in the first year 25 must be passed as an expense to the income statement.

Suppose after the first year the attrition experienced is in fact materially different to that used in the model originally. If this attrition rate had been used, the ESO would have been valued at 92. All other inputs to the original model are reused.

Now, 25 has already been expensed, but we see retrospectively that only 23 needed to be expensed, that is, we are `2 ahead'. Thus, in the second year, only 21 is expensed, with the intention to expense 23 in the third and fourth years.

This procedure continues until the vesting of the ESO.

**The employee stock options are cash settled:** in this case the ESO is treated as a true derivative. This means the ESO has to be revalued every year, with all inputs to the model (including expected attrition) being recalibrated. In every accounting period from issue date to first vesting date, the remaining value of the ESO has to be amortised on a linear basis.

For example, suppose at inception the ESO is worth 100 and there are 4 years to vesting. Then in the first year 25 has to be amortised. Suppose then at the end of the first year the ESO revalues to 124. Now 25 has already been amortised, but we now see that 31 should have been amortised. Thus we are `6 behind'. We amortise 37 in the second year, with the intention to amortise 31 in the third and fourth year.

This procedure continues until the vesting of the ESO.

**The employee stock options can be settled in cash or by the issue of shares depending on what the employee selects:**

In this case, it should be estimated what proportion of exercises will be into stock and what proportions into cash, and the amortisation performed accordingly. As exercise into cash is more plausible, given that employees are usually cash hungry, it seems best to assume the option is a cash liability to the company, until such time as the employee perchance chooses stock.

In the above analysis we have only considered once a year valuation. In fact what we do is perform a valuation just before the end of the financial year, and apply the valuation so obtained to that entire financial year. In particular, costs are amortised in such a way as if the valuation had been done at (just after) the beginning of that financial year.

Typically, a scheme will have many different options with many different vesting dates. In this case, each option must be treated separately in terms of amortising their cost. The population of option holders can be considered homogenous in terms of their attrition (although it seems that, for example, those whose options are near vesting would be less likely to resign, all other factors being equal, than those far from vesting). ■

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Graeme West obtained the doctoral degree in mathematics in 1993 and worked in academia until the end of 1997. He held a position in 1998 in Risk Management at Investec, and from 1999 until 2003 at Gensec Bank. In March 2003 he left Gensec to form Financial Modelling Agency. This consultancy is dedicated to building, training on, and verification of, derivative financial models. Recurring themes are employee stock option valuations, BEE transaction valuations, curve and surface building, derivative valuations, and risk measurement problems.

Graeme has had several MSc students at the University of the Witwatersrand, and also lectures at the University of Cape Town. He is active in academic research; main interests are yield curve calibration issues, volatility skews, employee stock option valuations, and risk measurement issues.

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