EMPLOYEE STOCK OPTION VALUATION SOEF, EXIT RATE AND DURATION EXPLAINED

Sorin R. Straja, Ph.D., FRM Montgomery Investment Technology, Inc. 200 Federal Street Camden, NJ 08103 Phone: (610) 688-8111 <u>sorin.straja@fintools.com</u> <u>www.fintools.com</u>

The Option Lattice Exercise Behavior (EB) and Monte Carlo Suboptimal Exercise Behavior (SOEB) models require an input assumption regarding Exit Rate and Suboptimal Exercise Behavior. FAS 123R requires the calculation of the derived service period. The purpose of this paper is to describe and explain these requirements.

The **Exit Rates** are defined as annualized rates that quantify the turnover of employees. For example, suppose that a company had 1,000 employees at the beginning of the year, and that 50 of these employees left the company during the year. The Exit Rate is computed as 50/1,000 = 0.05 = 5%. For a given time interval T (in years), the probability for a given hypothetical employee to leave the company is $1 - (1 - \text{Exit Rate})^{T}$. For instance, if the Exit Rate is 5% then the probability for an employee to leave the company during the next week is $1 - (1 - 0.05)^{(1/52)} = 0.000986 = 0.0986\%$. For the FinTools models the Exit Rates may vary with time. However, the Exit Rates do not vary with the underlying stock. The Exit Rates should be estimated from the Human Resources data. Of course, historical estimates of the Exit Rates may be adjusted to reflect the expected future turnover of employees. Exit Rates for a given company may be estimated using historical data obtained from that particular company in conjunction with historical data from peer-group companies. The weighting in of the data collected from different companies is a matter of judgment that should be supported by economic analysis.

The **Suboptimal Early Exercise Factor** (**SOEF**) should be estimated using transactions data that exclude those transactions triggered by employee turnover. This approach requires the identification of the transactions performed by leaving employees. Of course, all transactions made on or after the separation date should be treated as transactions related to employee turnover. However, it is expected that employees may decide to exercise a few days before leaving the company. Therefore it is necessary to establish a lag-time interval (e.g., 90 days), and all transactions performed during this lag-time prior to the separation date should be viewed as transactions triggered by employee turnover. The lag-time should be assessed for each company separately after consulting the human-resources data. It should be noted that the lag-time estimation does not influence the estimates for the Exit Rates. However, the lag-time value may significantly affect the estimated SOEF. It should be noted that the SOEF may vary with time.

The methodology presented above for the estimation of the Exit Rates and SOEF is relatively simple. It should be noted that it is valid only as long as we assume exercise whenever the threshold barrier (corresponding to the SOEF) is reached. However, the estimation of the SOEF



becomes more complicated if we assume that once the threshold barrier (corresponding to the SOEF) is reached the option is exercised with a given probability (less than 100%).

The exercise behavior of the employee stock option holders is usually considered as suboptimal. This judgment is based on the fact that employees generally value a given option significantly less than financial institutions or usual investors. However, the "suboptimal" epithet may be viewed as arrogant and offensive. At least some of the employee stock option holders (e.g., CEOs, CFOs) have access to excellent financial engineers and therefore their behavior should not be viewed as "suboptimal." There is a reason why employees generally value a given option significantly less than a financial institution or a usual investor: the **restrictions** attached to the employee stock options. It should be noted that an employee cannot sell the option (without exercising it) while a bank can sell the option. Moreover, at least for some employees (e.g., CEOs), it is illegal to short-sell the stock of their company, while a bank can short-sell the underlying stock and therefore can hedge the option. These restrictions significantly reduce the value of an option. Therefore, the employee behavior should be assessed taking into account the different rules that apply to employee stock options and the corresponding factors.

At a first glance the employee behavior is very heterogeneous. However, classifying the employees based on Position in the Organization, Frequency of Awards, Size of Awards, Age, and Tenure of Employment may result in significantly more homogeneous groups. For all employees we should take into account their Personal Wealth including the stock they must keep in their own company (e.g., limited stock awards) together with their Risk Appetite (as quantified through the Relative Risk Aversion coefficient). This way we get a more realistic estimate for the employee stock options than using the usual models that rely only on Volatility, Interest Rate, and Dividends.

The **average** time is computed taking into account **all** Monte Carlo paths. For the **SOEB** model, the time elapsed from inception until exercise is computed as follows:

- 1. For a Monte Carlo path forfeited before vesting, it is equal to the vesting time;
- 2. For a Monte Carlo path forfeited after vesting, it is equal to the forfeiture time;
- 3. For a Monte Carlo path that was never exercised, it is equal to the time until expiration;
- 4. For an exercised Monte Carlo path, it is equal to the time until exercise.

For the **EB** model, the time elapsed from inception until exercise is computed as follows:

- 1. For a Monte Carlo path that was never exercised, it is equal to the time until expiration;
- 2. For an exercised Monte Carlo path, it is equal to the time until exercise.



For the **SOEF** model, the time elapsed from inception until exercise is computed as follows:

- 1. For a Monte Carlo path that was never exercised, it is equal to the time until expiration;
- 2. For an exercised Monte Carlo path, it is equal to the time until exercise.

The **duration** (median time) is computed **only for the successful** Monte Carlo paths. The following paths are not successful:

- 1. For the **SOEB** model, the "never exercised paths" and "forfeited paths;"
- 2. For the **EB** model, the "never exercised paths;"
- 3. For the **SOEF** model, the "never exercised paths."

