OPTIONS MANUFACTURING

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When taxes and other fees are too small to be taken into account, the fair market value of a product designed to provide services can be estimated using either one of the two methods:

1. Manufacturing cost
2. Present value of expected services

For an economically viable product, the two methods should provide the same estimated fair market value. As long as the manufacturing cost exceeds the present value of future services, that manufacturing technology must be revised in order to make it competitive with the services provided. On the other hand, if the product is an innovation, then the services will have to become cheaper in order to remain competitive.

The fair market value of an option can be estimated using these approaches:

1. Black and Scholes (1973) described the "manufacturing" process for options in the context of a large-scale facility. The basic components used to "manufacture" (or synthesize) an option are:

   1.1. Delta shares of the underlying. The shares of underlying have the role to match exactly any change in the value of the option that is caused by changes in the value of the underlying. As long as there is no transaction fee, the very definition of the delta function for an option ensures that the shares used in the "manufacturing" process will match any option value change caused by any movement of the underlying. This fact is valid for any value of the rate of return of the underlying. Therefore, the rate of return of the underlying does not play any role in the valuation of an option.

   1.2. Cash. The required amount of cash is supposed to be available at the risk-free interest rate. This fact explains why the risk-free interest rate plays a role in the valuation of an option.

2. Boness (1964) valued an option by averaging the present value of potential future payoffs. The averaging was done based on the probability estimated for each given payoff. The discounting was done using the rate of return of the underlying. However, this discount rate is not financially acceptable: the risk accepted when investing in options is significantly higher than the risk accepted when investing in the

underlying. Galai (1978) corrected the Boness (1964) valuation using an appropriate discount rate (by far higher than the return rate of the underlying) that reconciles with the Black and Scholes (1973) valuation

The "manufacturing" process described by Black and Scholes (1973) represents the theoretical case, and the Black-Scholes value should be referred to as the theoretical option value. The main limitations assumed for the "manufacturing" process are:

1. Cash is available at the risk-free interest rate only for very large institutions like the U.S. Treasury. Usual banks, including large banks, do not have access to cash at the risk-free interest rate. Therefore, despite the fact that the theoretical option value is based on the risk-free interest rate, for real market application it is necessary to use the interest rate at which a particular financial institution has access to cash. Evidently, this interest rate is higher than the risk-free interest rate.

2. Even the U.S. Treasury has to pay a transaction fee. Leland (1985) is the first one to have addressed the problem of transaction costs. Estimating the option value without taking into account the transaction fee is just a simplification of the problem. This is equivalent to estimating the manufacturing cost for a car assuming that all components are bought at their production cost without any add-in for the sales people.

It should be noted that no assumption was made regarding the rate of return of the underlying. The delta number of shares completely bypasses this problem. It is incorrect to claim that Black and Scholes (1973) assumed or proved that the underlying grows at a rate of return equal to the risk-free interest rate. However, examining the Black-Scholes formula it can be concluded that we still get the correct result regarding the theoretical value of an option if:

1. Assuming the underlying grows at the risk-free interest rate; and
2. Discounting future payoffs to the present at the same risk-free interest rate.

This observation is the only justification for the risk-neutral approach. The risk-neutral approach should not be viewed as the corrected version of the Boness (1964) and Galai (1978) approach.

The valuation provided by Black and Scholes (1973) is valid for a rational investor, i.e. a large financial institution that "manufactures" a large number of options, and therefore can afford to lose money in a large number of cases as long as it will recoup these losses. An employee is a very small investor that does not fit the profile of the rational investor. Psychological factors significantly influence the behavior of the owner of employee-stock-options. Among these factors may figure the growth rate of the underlying. The irrational behavior of the owner of employee-stock-options will diminish, on the average, the value of these options. This loss of monetary value may be viewed as the equivalent of an insurance premium: large financial institutions may choose to be self-insured, but individuals should buy insurance due to their limited resources.

The presence of barriers should not affect psychologically the rational investor. However, it may significantly impact the behavior of the owner of employee-stock-options. The risk-aversion is a common feature that may dictate the small investors' decisions.

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