

# When to Apply for an MBA Course: The Real Options Approach

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## Abstract

This paper examines when employees should apply for an MBA course in the situation where the dynamic of the potential to change careers is a continuous time stochastic process. The optimal time to apply for the course is when the value of an option on the potential to change careers is optimized. The employee should apply for the course at the time when the option value first hits the boundary conditions.

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## 1 Introduction

This paper examines when an employee should apply for an MBA course from the viewpoint of option pricing theory. The MBA course offers a means to have a successful career irrespective of the industry or profession that employees are in. Employees take MBA courses in order to improve the careers in their current companies or to acquire better jobs based on the degree of the

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course. The demand for the course influences and popularizes the establishment of MBA programs worldwide. Some universities in South Korea began offering MBA courses in 2006. The courses aim to generate future business professionals in Korea and worldwide. Since the Asian Financial Crisis, Korea has shown an interest in competing with developed as well as developing countries. It is conceivable that the competitive powers of developed countries constitute business professionals with the ability to lead economies and survive in the worldwide competition. It is doubtful whether the basic goals in starting MBA courses in Korea can be achieved because the world market for MBA courses has become highly competitive. Furthermore, MBA courses in Korea did not commence until as recently as 2006. Nowadays, managers of the courses are afraid that the basic aims are unattainable and that their courses will be unsuccessful in the market. These concerns may be reduced if it is possible to rationally determine the point at which employees apply for courses. From an applicant's perspective, an MBA course leads to a better job or promotions as well as involves some costs. The costs of an MBA course include direct costs, such as the tuition fee, and indirect costs. Indirect costs arise from the irreversibility of the decision to apply. The application decision may be derived from an option on the potential to replace the current career with a new one after the completion of the course. Thus, the employee is expected to apply for the course just before the option value is optimized. Based on Black and Scholes [1] and Merton [5], option pricing theories have been derived and applied to different fields. One of these theories is the real option approach, by which option pricing theories are applied to price, non-tradable assets, or in examining decision rules. To derive optimal investment rules, McDonald and Siegel [4] take Margrabe's [3] option pricing theory as an extension of the theories of Black and Scholes [1] and Merton [5] and apply it to investment decisions in the real world. The optimal rules of the investment decisions are at the point when the value of an option, the exercise of which is irreversible, is maximized. In line with McDonald and Siegel [4], we analyze when employee apply for an MBA course. The rule of the application decision is when the value of an option to apply for the course is optimized from an applicant's viewpoint.

The remainder of this paper is organized as follows. In section II, we describe the assumptions with respect to MBA application. In section III, we analyze an application rule based on these assumptions. In section IV, we simulate the results obtained in section III. Finally, section V concludes this paper with a summary of the findings.

## 2 Assumptions of the Model

In this section, we discuss a case where an employee decides whether he/she should apply for an MBA course. Let us assume that the employee obtains a current compensation rate of  $c$  and that he/she gains an improved compensation rate of  $c_N$ , where  $c_N > c$  upon completion of the course after a fixed period  $y$ . During the course, the employee requires funds corresponding to the current compensation. These funds are also available at a constant rate  $r$ . The potential  $S$  to change from the current career to a new one upon completing the course is risky such that the potential may evaporate.

In this case, the total value from the current career refers to the total value of the compensation  $c/r$  from the current career plus the value of an option  $W(S)$  on the potential. The option to apply is the same as an option to change from the current career to one after the completion of the course. Thus, irrespective of whether the value of the option improves, the total value has an affect on whether or not the employee applies for the course. In light of this, the employee would apply for the course when he/she expects to improve the compensation after the completion of the course; otherwise, the employee would defer the application for the course. The option to apply may be optimally exercised at a particular time. Exercising the option immediately pays nothing but improves compensation after the completion of the course. When, then, does the employee apply for the course?

To analyze the above case, we assume the following: The career market such as that in Black and Scholes [1] is so perfect that an employee in the market can freely change his/her career. The potential  $S$  to change from a current career to another one follows the geometric Brownian motion,  $dS = (\mu - \delta)Sdt + \sigma SdZ$ , where the instantaneous decay  $\delta$ , instantaneous drift  $\mu$ , and instantaneous volatility  $\sigma$  of the potential are constant parameters;  $Z$  is a standard Brownian motion. The employee freely borrows or lends the lump sum of the tuition fee  $I$  with a known interest rate  $r$  at the beginning of the course, where  $r \geq \mu \geq \delta \geq 0$  for our purpose. During the course, the employee needs some funds corresponding to the current compensation. These funds are also available at  $r$ . In following section, we derive the optimal exercise rule.

## 3 When to Apply

In this section, we analyze when to apply for the course under the assumptions provided in the previous section. The total value of the current career from the employee's viewpoint is  $P(S) = c/r + W(S)$ , where  $c/r$  is the current value of the permanent compensation and  $W(S)$  is the value of the option to change from the current career to the future one after the completion of the course.

By Ito's lemma, the dynamics of the option to apply or to change careers is as follows:

$$dW = [\sigma^2 S^2 W''/2 + (\mu - \delta)W']dt + \sigma SW'dB \quad (1)$$

Since we assume that the opportunity cost is  $r$ , the instantaneous value of the option value must be  $dW = rWdt$ . Comparing (1) to the instantaneous value of the option value and rearranging, we obtain the following differential equation:

$$r = [\sigma^2 S^2 W''/2 + (\mu - \delta)W']/W \quad (2)$$

Rewriting (2), we obtain the following heat equation.

$$0 = \sigma^2 S^2 W''/2 + (\mu - \delta)W' - rW \quad (3)$$

In American option problems such as this, there exists an optimal value of the potential  $S_l$  where the option is optimized. Considering Merton [5] and Dixit and Pindyck [2], we obtain the following boundary conditions.

$$W(0) = 0 \quad (4)$$

$$W(S_l) = \frac{c_N}{r - (\mu - \delta)} S_l \exp[-(r - (\mu - \delta))y] - c/r - I \quad (5)$$

$$W'(S_l) = \frac{c_N}{r - (\mu - \delta)} \exp[-(r - (\mu - \delta))y] \quad (6)$$

where  $S_l$  is an optimal potential. Condition (4) means that 0 is the absorbing barrier; if the potential is perfectly useless, the option value stays at 0. The option to apply does not have value. Condition (5) is termed the value-matching condition; on applying for the course, the employee receives a net benefit  $W(S_l)$ . Condition (6) is called the smooth-pasting condition; the employee exercises the option when the marginal value of the option is equal to  $W'(S_l)$ .

Solving the equation with the boundary conditions given in (4), (5), and (6), we obtain the following.

$$W(S) = \frac{c/r + I}{\beta - 1} (S/S_l)^\beta \quad (7)$$

if  $S < S_l$ , where  $\beta = [-(\mu - \delta - \sigma^2/2) + \sqrt{(\mu - \delta - \sigma^2/2)^2 + 2r\sigma^2}]/\sigma^2 > 1$  and  $S_l \equiv (\frac{\beta}{\beta - 1})(\frac{r + \delta - \mu}{c_N})(c/r + I) \exp[(r + \delta - \mu)y]$ . If  $S \geq S_l$ ,

$$W(S) = \frac{c_N}{r + \delta - \mu} S \exp[-(r + \delta - \mu)y] - c/r - I \quad (8)$$

Thus, the employee applies for the course just before the overall cost exceeds the benefit. Following the above, we conclude the proposition below.

**Proposition** *The optimal application time,  $T_l = \inf\{t \geq 0 : S \leq S_l\}$ , is when the potential is  $S_l$ ; The optimal time depends on the interest rate, the instantaneous decay of the potential, instantaneous drift of the potential, instantaneous volatility of the potential, current compensation, after-course compensation, and the completion period of the course.*

## 4 Simulation

We now simulate the proposition made in section III. The simulation parameters (parameter values) are the current value of the potential  $S$  over  $(0, 4]$ , interest rate  $r$  (0.1), decay of the potential  $\delta$  (0), drift of the potential  $\mu$  (0.05), variance of the potential  $\sigma^2$  0.1 and 0.01, current compensation  $c_N$  (2), compensation based on the degree of the course  $c_{RE}$  (3 and 10), and the completion period of a course  $y$  (1), and the tuition fee  $I$  (3).

Figure 1 illustrates the option values and the boundary conditions under the simulation. When the option values of 3 and 10 on the potential to change careers through applying for MBA courses are equal to the boundary conditions, an employee applies for the course. Given  $\sigma^2 = 0.1$ , the employee enrolls for the course with  $c_{RE} = 3$  when the potential is 1.3759; when the potential is 0.4127, he/she applies for the course with  $c_{RE} = 10$ .

Figure 2 illustrates the option values and boundary conditions under the simulation. When the option values of 3 and 10 on the potential to change careers through applying for the MBA course are equal to the boundary conditions, an employee applies for the course. If the other parameters are equal but  $c_{RE}$  is 3 and 10, then given  $\sigma^2$  is 0.01, the potential at optimal time will be 1.3759 and 0.4127, respectively.

Thus, an employee does not apply simply if the potential is good, but if it is optimal from the viewpoint of the option pricing theory, that is, when the option on the potential to change careers is optimized.

## 5 Conclusion

Our conclusions are as follows. First, in applying for an MBA course, an employee exercises an American option on the potential to change careers. Second, the exercising time depends on the current potential, interest rate, drift of the potential, decay of the potential, variance rate of the potential, current compensation, compensation based on the degree of the course, and the completion period of the MBA course. These parameters affect the decision on when to apply for an MBA course.

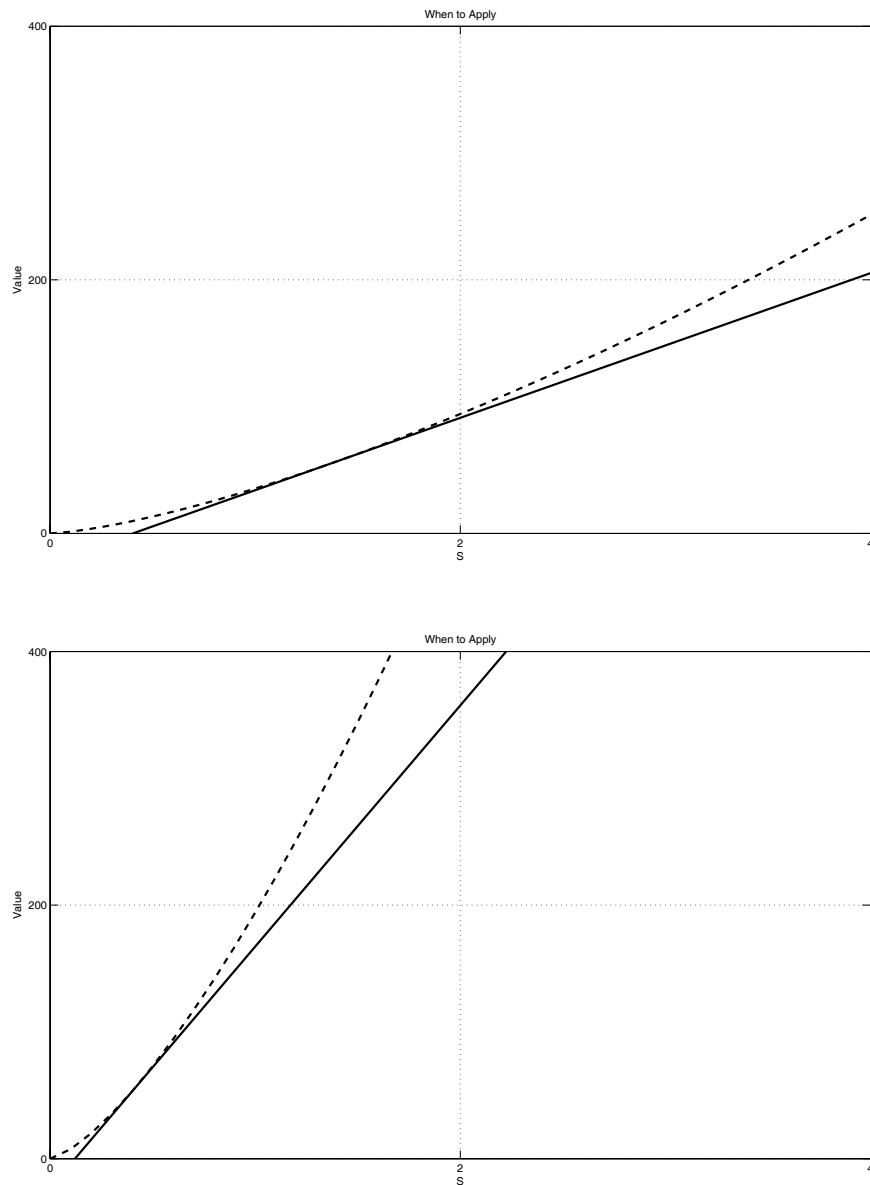


Figure 1. The figures represent the simulation results of the proposition in this paper. The simulation parameters (parameter values) are the potentials over  $(0, 4]$ , interest rate (0.1), decay of the potential (0), drift of the potential (0.05), variance of the potential (0.1), current compensation (2), compensation based on the degree of the MBA course (3 and 10), the completion period of the course (1), and the tuition fee (3). The dot and dashed lines represent the option values and boundary conditions, respectively. If the after-course compensation is 3 and 10, the potential at an optimal time will be 1.3759 and 0.41277, respectively. When an option value is equal to the boundary conditions, the employee applies for an MBA course.

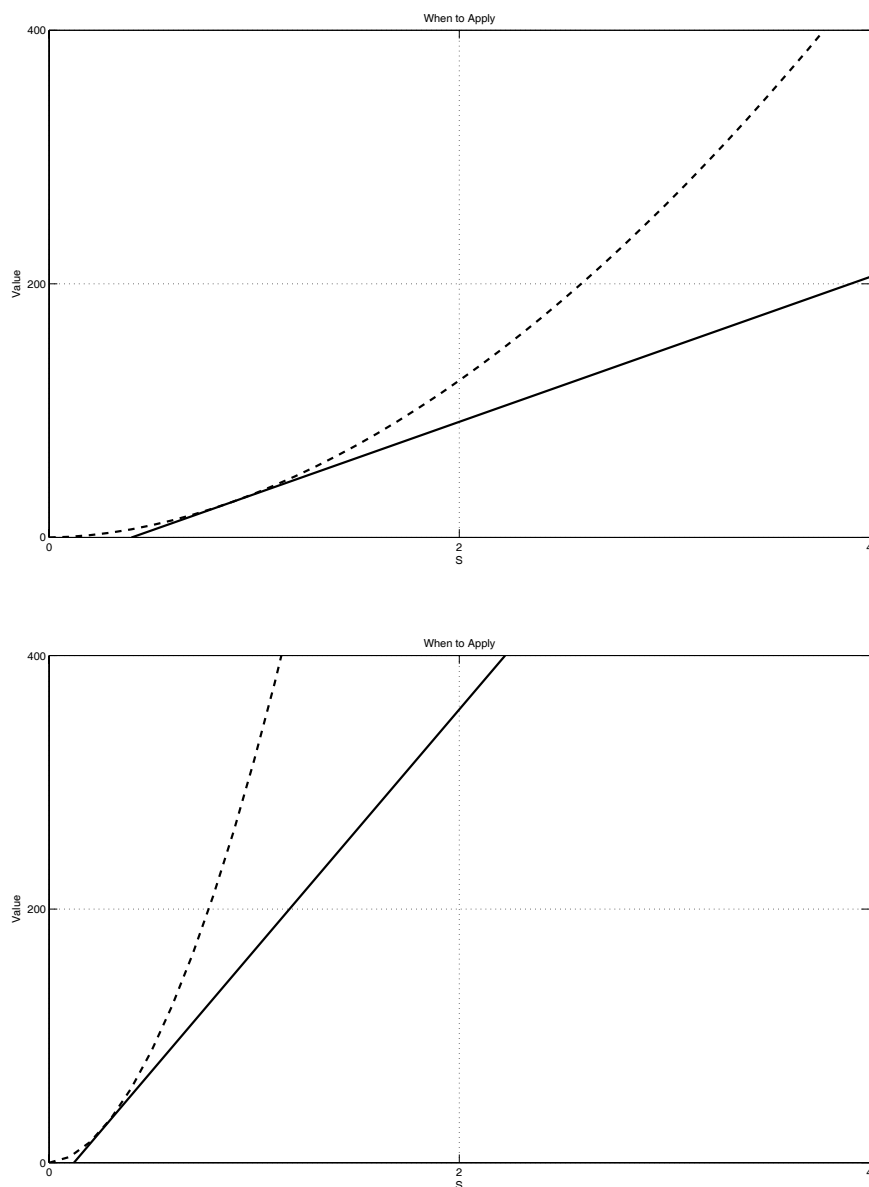


figure 2. the subfigures represent the simulation results of the proposition in this paper. the simulation parameters (parameter values) are the potentials over  $(0, 4]$ , interest rate (0.1), decay of the potential (0), drift of the potential (0.05), variance of the potential (0.01), current compensation (2), the completion period of the course (1), and the tuition fee (3). The dot and dashed lines represent the option values and boundary conditions, respectively. if the after-course compensation is 3 and 10, the potential at an optimal time will be 0.8803 and 0.26409, respectively. when an option value is equal to the boundary conditions, the employee applies for an mba course.

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