International Journal of Applied Mathematics

Volume 35 No. 2 2022, 233-247

ISSN: 1311-1728 (printed version); ISSN: 1314-8060 (on-line version)

doi: http://dx.doi.org/10.12732/ijam.v35i2.3

PRICING EMPLOYEE STOCK OPTIONS WITH AN ASIAN STYLE USING A MODIFIED BINOMIAL METHOD: CASE STUDY FROM INDONESIAN ESO

E. Chendra[1 §], K.A. Sidarto[2], A. Sukmana[1], L. Chin[1]

[1]Department of Mathematics
Parahyangan Catholic University
Bandung, INDONESIA

[2]Department of Mathematics
Bandung Institute of Technology
Bandung, INDONESIA

Abstract: Employee stock options (ESOs) refer to call options which are granted by companies to their employees on the stock of the companies. Besides maintaining employees who have high motivation and potential, ESOs also encourage employees to improve the company's earning and management, and to adjust the employees' incentive in accordance with the shareholders' vision. As a form of non-cash compensation, ESO is a cost component which is efficient for small companies to compete with large companies. This paper discusses ESO with a partial average Asian style (average in the validity period of ESO), which is prevailing in Indonesia. The price of the ESO with Asian style is set using the modified binomial method to meet the ESO's additional characteristics. Numerical experiments are presented in this paper to examine the accuracy of the model and to analyze the sensitivity of the price toward model parameters.

AMS Subject Classification: 62P05, 91B25, 97M30

Key Words: employee stock options (ESOs), partial average Asian option, binomial method

Received: August 5, 2021

[§]Correspondence author

1. Introduction

Employee stock options (ESOs) are call options on the issuer's stock granted by an issuing company to its employees. Employees can exercise ESOs in part and may lose their unexercised options once they resign. Thus, ESOs are useful and popular financial instruments for a firm to retain key employees and motivate them to improve the company's performance. Different from usual options which can be traded by institutional or individual investors, ESOs of employees cannot be sold or transferred to other investors. To maintain employees' long-term incentives, an ESO usually has a long maturity which ranges from 5 to 15 years and it cannot be executed during the first few years of the option's life (called the vesting period). When an employee resigns from the company during that first few years of the option's life, his ESOs become worthless.

In 2004, the revised Statement of Financial Accounting Standards No. 123 requires issuers to estimate and recognize ESO's value by adjusting to option-pricing models, like the Black-Scholes-Merton formula or the binomial lattice method, unless the market values of similar instruments are available [11]. Many researchers argue that using adjusted Black-Scholes model will overprice ESOs. Hemmer et al. [13] provide evidence that simply substituting the expected exercise time horizon for the time to maturity of ESO in the Black-Scholes model tend to significantly overvalue the ESOs. To address this problem, they first estimate the Greek "Theta", the sensitivity of a European-style ESO's price to the change of the time to maturity. The fair ESO value is then estimated as the value of an otherwise identical European-style ESO matured at the end of the vesting period plus the product of negative Theta and the expected time horizon minus the length of vesting period. Carpenter et al. [5] conducted a comprehensive study of the optimal exercise policy of a risk-averse executive and its implications for firm cost. They compared the true option cost and their model's option value with the adjusted Black-Scholes and demonstrated that depending on the characteristics of a firm, the error can be large or small, positive or negative.

Recent papers analyze the behaviors of exercising ESOs and consider employees' desires to maximize their utilities, such as Lambert et al., Huddart, Kulatilaka and Marcus, Carpenter, Detemple and Sundaresan, and Hall and Murphy. Lambert et al. [19] employed certainty equivalence approach and defined the value of ESO as a lump-sum payment of employees' wealth, which is defined as ESO's payoff plus employees' other wealth, such that the employee is indifferent between receiving the payoff to exercise ESOs immediately and receiving future uncertain payoff by excising ESOs afterward, given the structure of the rest of his wealth. These payments are based on the employees' expected utility. Huddart [14] used the von Neumann-Morgenstern utility (power utility) function and assumed that the tax deduction rate for a company is constant over time. Kulatilaka and Marcus [18] modeled explicitly accounts for an early exercise feature and treated exercise as an all-or-nothing decision; it does not allow for partial execution. Carpenter [4] made a comparison of a simple extension of binomial method for the American option model, introducing random, exogenous exercise and forfeiture, with the utility maximizing model also including the employees' risk aversion; it excluded wealth and potential gain but ignored the presence of taxes. She concluded that a simple American option pricing model can describe actual option exercises just as well as a complex utility-based model. Detemple and Sundaresan's model in [10] relies on simple dynamic programming techniques and they assume that the employee also invests into a risky portfolio. Hall and Murphy [12] analyzed ESO values and early exercise decisions using a modified binomial approach with two major differences, i.e. based on CAPM expected returns and comparing the expected utility from exercising to the expected utility from holding the option for another period. They also ignored taxes so that the stock acquired through exercise is sold immediately, with the cash proceeds invested at the risk-free rate. The main disadvantage of using utility maximizing models is that risk aversion levels are unobserved. So, we need to calibrate utility maximizing models to the data. Besides that, it might be hard to determine the appropriate utility function that suits all employees. Because of that reason, we use the risk neutral valuation approach rather than the utility-based approach.

There are some papers that distinguish the ESO value for the employee (the subjective value) from the cost of ESO to the company (the objective value). For example, Ingersoll [17] used the constrained portfolio optimization method to solve the optimal portfolio of the undiversified manager and determine the employees' indirect utility function. The marginal utility is then used as a subjective state price density to value ESO. He found that the objective value lies between the subjective value and the market. However, if the objective value is larger than the subjective value, then the firm may give compensations directly instead of ESO. In this paper, we analyze the valuation of an ESO from the employees' perspective.

We modified the Cox, Ross, and Rubinstein binomial method [8] to price an ESO which is similar to Aboody, Hull and White, Ammann and Seiz, Brisley and Anderson, and Chendra and Sidarto. Aboody [1] used modified CRR model that accounted for unique characteristics of ESO, such as: employee exit rate, vesting period, and non-transferability. He also considered the tax deduction for the company, which is assumed to be constant. Hull and White [15] proposed enhanced FASB 123 model with binomial method that considers the vesting period, the possibility that employees will leave the company during the life of the option, and the sale restriction. They modeled the early exercise behavior by assuming that exercise takes place whenever the stock price reaches a constant multiple of the strike price and the option has vested. Ammann and Seiz [2] propose enhanced American model with binomial method. The model is similar to the American model which is adjusted for the exit rate and the vesting period. It incorporates the employee's early exercise policy explicitly. It is assumed that exercise takes place when there is a positive intrinsic value and the exercise value adjusted is bigger than the holding value. The adjustment factor in the exercise value (i.e. the adjusted strike price) is used only to determine the exercise policy, not to calculate the payoff of the ESO. Previous empirical research found that the stock price should be relatively high to induce voluntary exercise. Later, they will exercise at relatively low stock price close to the time to maturity. In relation to that, Brisley and Anderson [3] propose μ-model with the assumption that employees exercise voluntarily if the moneyness of the option has reached a fixed proportion, μ, of its remaining Black-Scholes value. Cvitanic et al. [9] introduce an ESO model that captures the early exercise feature and derive an analytic formula for the ESO's price. All of these papers set the exercise policy exogenously, assuming a single stock price boundary, to model the early exercise feature. Chendra and Sidarto [7] improve the Hull-White ESO model using Bino-Trinomial tree method and then modify a single psychological barrier with moving psychological barriers.

In Indonesia, there are several companies that give ESO to their employees, such as PT Bank Rakyat Indonesia, PT Kobexindo Tractors Tbk, and PT Bhakti Investama Tbk. In recent years, the reporting of ESO values in the company's balance sheet has changed from rights to obligations. Based on the Jakarta Stock Exchange director's decree No. Kep-305/BEJ/07-2004 concerning Listing of Shares and Equities Other than Shares Issued by Listed Companies, the listing of shares which derive from the exercise of warrants, convertible bonds, and ESOs must be conducted by Pre-Listing. The Pre-Listing refers to the approval of the listing plan given by the stock exchange before the shares were issued. These shares are effectively listed and traded on the exchange after the issuance of new shares. In addition, Paragraph 1 of the Statement of Financial Accounting Standards (PSAK) No. 53 (revised 2010) [16] concerning Share-Based Payments explains that the statement requires entities to present the effects of stock-based payment transactions, including costs related to transactions of providing ESOs to employees, in the income statement and financial position statement. Therefore, accurate calculation of the ESO's value plays an important role in financial mathematics. Risks for companies that issue OSK for their employees can be minimized by dynamic hedging of the 'fair' value of ESO. The Indonesian ESO has unique characteristics in terms of additional regulations that affect the valuation of the Indonesian ESO. The execution period of Indonesian ESO is carried out at most twice a year and determined within a period of at least 5 exchange days and as much as 30 exchange days. The strike price of the Indonesian ESO is 90% of the average closing price of the listed companies' shares during the 25 consecutive exchange days on the market regular before reporting to the exchange. Hence, an Indonesian ESO has a partial average Asian style (average over a part of the option life) which is more complicated. To price this ESO, the current method used in Indonesia is the Black-Scholes-Merton formula. In this paper, we propose the binomial method modified to meet the additional characteristics for pricing an ESO with a partial average Asian style, developed by Chendra et al. [6].

The remaining of the paper is organized as follows. The Hull-White ESO model is discussed in Section 2. Section 3 outlines the ESO model with partial average Asian style, which is a special feature of the Indonesian ESO. Section 4 examines the robustness of our numerical method and analyzes the properties of ESO with Asian style. Section 5 concludes the paper and discusses possible future extensions.

2. The Hull-White ESO Model

Assume that the underlying stock price at time t, S_t, is assumed to follow the Geometric Brownian Motion (GBM) as follows:

$$S_{t+dt} = S_t e^{(r-0.5\sigma^2)dt+\sigma dW_t}, \tag{1}$$

where W_t denotes a standard Wiener process, r is a riskless interest rate, and σ is the volatility of the stock price. This paper models the stock price process with the CRR binomial lattice method (see [8]). It equally divides the lifespan of ESOs into n discrete time steps and the length of a time step $\Delta t = \frac{T}{n}$. The node index (i, j) denotes the j-th node (calculated from the bottom) at time step i (or at time $i\Delta t$). The initial stock price at the root node $(0, 0)$ is denoted by S_0. It can either go up to S_0u with probability $p = \frac{e^{r\Delta t}-d}{u-d}$ or go down to S_0d with probability $1 - p$, where $u = e^{\sigma\sqrt{\Delta t}}$ and $d = \frac{1}{u}$. Similarly, each stock price can either move up or down at subsequent time steps; therefore, the stock price at node (i, j), $S_{i,j}$, is $S_0u^jd^{i-j}$. Note that the price process modeled by the CRR binomial lattice converges to the lognormal stock price process in equation 1 as the number of time steps n of the lattice increases.

Like other exchange-traded stock options, an ESO holder can also exercise the option to purchase the underlying stock with the strike price K prior to the maturity date. Usually, the strike price is the prevailing price of the underlying stock (i.e. the initial stock price) at the issuance date. For convenience, an ESO is assumed to be issued at time 0 and mature at time T. The longer the maturity date, the ESO holder has a greater opportunity to exercise it. Most ESO contracts do not allow holders to immediately exercise ESOs until the end of the vesting period. If ESO holders resign during the period of vesting period, they will lose their unvested ESO. Further, ESO holders could be required to exercise their unexercised but vested ESOs upon leaving the company. In 2004, a binomial model in valuing ESOs was proposed by Hull and White [15]. It assumes that ESO's holders face a single barrier to exercise their options. Within the period between the expiration of the vesting period and the maturity date, if the stock price is higher than M time the exercise price, the option will be executed. However, if the employee resign during this period, he will execute the option if the stock price is in-the-money. In addition, ESO holders may be forced to execute their unexercised but vested ESOs upon leaving the company. To consider these phenomena, much ESO evaluation literatures [2, 3, 9] model the employee turnover rate, λ, by Poisson processes. At time step Δt, the probability of the employee leaves the company is $1 - e^{-\lambda\Delta t}$ before or after vesting period.

Assume that the ESO price when the stock price $S_{i,j}$ is $V_{i,j}$ and v is the time when the vesting period end. At the expiration date ($i = N$), the ESO payoffs are

$$V_{N,j} = \max\left(S_{N,j} - K, 0\right)$$

for each node at the end of the binomial tree stock price. Other nodes at the binomial tree with $0 \leq i \leq N - 1$ are given as follows:

- Before the vesting period ($i\Delta t < v$), the ESO value is:

$$V_{i,j} = (e^{-\lambda\Delta t})e^{-r\Delta t}[pV_{i+1,j+1} + (1-p)V_{i+1,j}].$$

- After the vesting period ($i\Delta t \geq v$), if $S_{i,j} \geq MK$ then the ESO value is

$$V_{i,j} = S_{i,j} - K,$$

  but if $S_{i,j} < MK$ then the ESO value is

$$V_{i,j} = (1 - e^{-\lambda\Delta t})\max(S_{i,j} - K, 0) + (e^{-\lambda\Delta t})e^{-r\Delta t}$$

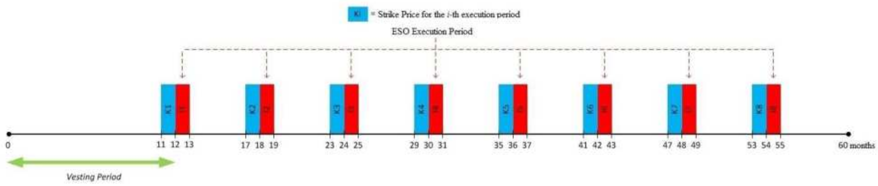

Figure 1: The Indonesian ESO Model Illustration

$$\times[pV_{i+1,j+1} + (1-p)V_{i+1,j}].$$

3. The ESO Model with Partial Average Asian Style

As explained in the introduction, one of the characteristics of the Indonesian ESO model is that the strike price of the ESO is 90% of the average closing price of the listed companies' shares during the 25 consecutive exchange days on the market regular before reporting to the exchange. In other words, the Indonesian ESO model contains Asian style, especially Asian with a partial average. The partial average is the arithmetic average of the stock price for 25 days before the execution period. Besides, the execution period of Indonesian ESO is carried out at most twice a year and is determined within a period of at least 5 exchange days and as much as 30 exchange days. Figure 1 illustrates the ESO model applicable in Indonesia. For example, it is assumed that the ESO has 5 years (60 months) maturity and 1 year (12 months) vesting period. Assume that there are two execution periods every year after the vesting period ends, namely every day during the 1$^{\text{st}}$ month and 7$^{\text{th}}$ month.

To simplify the calculation, assume that there are 25 exchange days every month, so that there are 300 exchange days (= 12 × 25 exchange days) every year. First, we simulate the daily stock prices using the CRR binomial lattice method. Since the last execution period (the 8$^{\text{th}}$ execution period) is in the 55$^{\text{th}}$ month or 1375$^{\text{th}}$ day (= 25 × 55), the daily stock price simulation using the CRR binomial lattice method starts from now (day 0) up to the 8$^{\text{th}}$ execution period (the 1375$^{\text{th}}$ day). Next, the ESO execution period will be determined based on the assumptions as shown in Figure 1. Note that the 1$^{\text{st}}$ execution period is in the 13$^{\text{th}}$ month or the $301^{\text{st}}, 302^{\text{nd}}, ..., 325^{\text{th}}$ days. Denote I_l as the l-th execution period ($l = 1, 2, ..., 8$), then

$$I_1 = 301, 302, ..., 325 = 12 \times 25 + 1, 12 \times 25 + 2, ..., 12 \times 25 + 25.$$

The 2nd execution period is in the 19th month, so

$$I_2 = 18 \times 25 + 1, 18 \times 25 + 2, ..., 18 \times 25 + 25,$$

or

$$I_2 = (12 + 6) \times 25 + 1, (12 + 6) \times 25 + 2, ..., (12 + 6) \times 25 + 25.$$

While the 3rd execution period is in the 25th month, so

$$I_3 = 24 \times 25 + 1, 24 \times 25 + 2, ..., 24 \times 25 + 25,$$

or

$$I_3 = \{(12 + 2 \times 6) \times 25 + 1, (12 + 2 \times 6) \times 25 + 2, ..., (12 + 2 \times 6) \times 25 + 25\}.$$

Generally, the l-th execution period is

$$I_l = i_l + 1, i_l + 2, \ldots, i_l + 25$$

with $i_l = [12 + (l - 1) \times 6] \times 25$ and $l = 1, 2, ..., 8$.

In the Indonesian ESO model, it is also assumed that employees will execute their ESO during the execution period if the stock price reaches a constant multiplication of the strike price (as described in the Hull-White ESO model). In addition, the probability for employees to leave the company is assumed to follow the Poisson Process. To determine the Indonesian ESO price, a modification of the CRR binomial lattice method will be used for the partial-average Asian options [6]. They use some representative averages by searching the trajectory that produces maximum and minimum partial-averages for each node to price partial-average Asian options.

Assume that $a^k_{i,j}$ denote the k-th representative average at node (i, j). The maximum and minimum averages at node (i, j) are given by:

$$a^{\max}_{i,j} = \frac{1}{i+1}\left[S_0 \frac{u^{j+1} - 1}{u - 1} + S_0 u^j d \frac{1 - d^{i-j}}{1 - d}\right]$$

and

$$a^{\min}_{i,j} = \frac{1}{i+1}\left[S_0 \frac{1 - d^{i-j+1}}{1 - d} + S_0 d^{i-j} u \frac{u^j - 1}{u - 1}\right],$$

respectively. The other representative averages are obtained by

$$a^k_{i,j} = a^{\min}_{i,j} + \frac{k}{j(i-j)}\left(a^{\max}_{i,j} - a^{\min}_{i,j}\right)$$

with $k = 0, 1, ..., j(i-j)$. At the end of the 8-th execution period ($i = 1375$), for each j ($j = 0, 1, 2, ..., i$), the ESO payoff is

$$V_{1375,j} = \max\left(S_{1375,j} - K_8, 0\right)$$

with $K_8 = 0.9 \times a^k_{1375,j}$. The k-th representative average at node $(1375, j)$ is calculated using stock price from $i = 1325 = (12 + 7 \times 6) \times 25 - 25$ to $i = 1350 = (12 + 7 \times 6) \times 25$. For other nodes at the binomial tree with $0 \leq i \leq 1374$ are given as follows:

1. If $i \notin I_l$ then the ESO value is

$$V_{i,j} = (e^{-\lambda\Delta t})e^{-r\Delta t}[pV_{i+1,j+1} + (1-p)V_{i+1,j}].$$

2. If $i \in I_l$ and
   - $S_{i,j} \geq MK_l$ then the ESO value is

   $$V_{i,j} = S_{i,j} - K_l$$

   - $S_{i,j} < MK_l$ then the ESO value is

   $$V_{i,j} = (1 - e^{-\lambda\Delta t})\max(S_{i,j} - K_l, 0) + (e^{-\lambda\Delta t})e^{-r\Delta t}$$
   $$[pV_{i+1,j+1} + (1-p)V_{i+1,j}].$$

   with $K_l = 0.9 \times a^k_{i,j}$ and $a^k_{i,j}$ is calculated using stock price from $i = [12 + (l-1) \times 6] \times 25 - 25$ to $i = [12 + (l-1) \times 6] \times 25$.

Hence, the Indonesian ESO price is given by $V_{0,0}$.

4. Numerical Results

First, to build the algorithm, we modify the Indonesian ESO model which assume that the maturity date is $T = \frac{13}{12}$ years. Hence, there is only one execution period i.e. I_1 with

$$I_1 = 301, 302, ..., 325 = 12 \times 25 + 1, 12 \times 25 + 2, ..., 12 \times 25 + 25$$

and the strike price, K_1, is the average of the stock price from the 275$^{\text{th}}$ day to the 300$^{\text{th}}$ day. We called this model as IESO-1 model (see Figure 2).

Figure 2: IESO-1 Model

Next, the IESO-1 model was developed into the IESO-2 model which assumes that the ESO has maturity date at $T = \frac{19}{12}$ years. Hence, there are two execution periods, namely

$$I_1 = 301, 302, ..., 325 = 12 \times 25 + 1, 12 \times 25 + 2, ..., 12 \times 25 + 25$$

and

$$I_2 = 451, 452, ..., 475 = 18 \times 25 + 1, 18 \times 25 + 2, ..., 18 \times 25 + 25.$$

The strike price K_1 is the average of the stock price from 275^{th} day to 300^{th} day, while the strike price K_2 is the average of the stock price from 425^{th} day to 450^{th} day (see Figure 3).

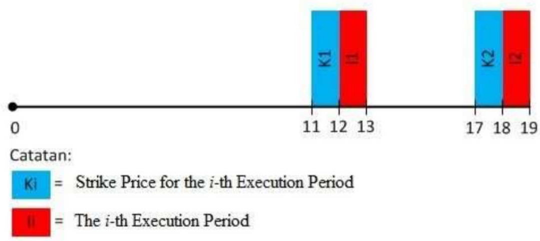

Figure 3: IESO-2 Model

Furthermore, the IESO-2 model was developed into the IESO-3 model, and so on until we have the IESO-8 model or the Indonesian ESO model as illustrated in Figure 1. Assume that $S_0 = 5000$, $r = 5\%$, $\sigma = 30\%$, $D = 2.5\%$, $\lambda = 6\%$, and $M = 1$, Table 1 compares the price of IESO-1, IESO-2 and the

Table 1: The IESO-1, IESO-2, and IESO-8 Price

Model	Price	
	Modified Binomial Method	Monte Carlo Method [95% Confidence Interval]
IESO-1	442.4257	429.6843
		[301.1841 591.7947]
IESO-2	539.4177	438.6708
		[312.9096 596.1992]
IESO-8	539.815	448.8783
		[301.0099 592.0849]

Indonesian ESO with the modified CRR binomial method and the Monte Carlo method.

From Table 1, we can see that the price of the IESO-2 model with two periods of execution and the price of Indonesian ESO (IESO-8 model) with eight periods of execution are not too much different. So, it can be said that the more execution periods in the Indonesian ESO do not make a significant difference to the price of ESO. This is because the ESO's strike price is at least 90% of the average closing price of the company's shares during the 25-th day exchange period. In other words, the Indonesian ESO model is less attractive in terms of benefits to be received by employees.

The sensitivity of the ESO price was also analyzed with respect to the stock price volatility, the risk-free interest rate, the employee turnover rate, and the initial stock price. Figures 4,5,6 and 7 present the result.

From Figure 4, we can see that the Indonesian ESO prices have not changed for volatility ranging from 1% to 5%. However, if the stock price volatility is greater (starting at 6%), the Indonesian ESO prices become more expensive. Likewise, increases in the interest rate and the initial stock price result in an increase in the Indonesian ESO price (see Figure 5 and Figure 7). On the contrary, from Figure 6 we can see that if the employee turnover rate gets higher, the price of Indonesian ESO is getting cheaper.

5. Conclusions

Although ESO is useful for a firm to retain key employees and motivate them to improve the company's performance, the Indonesian ESO model is less attractive in terms of benefits to be received by employees. The more execution

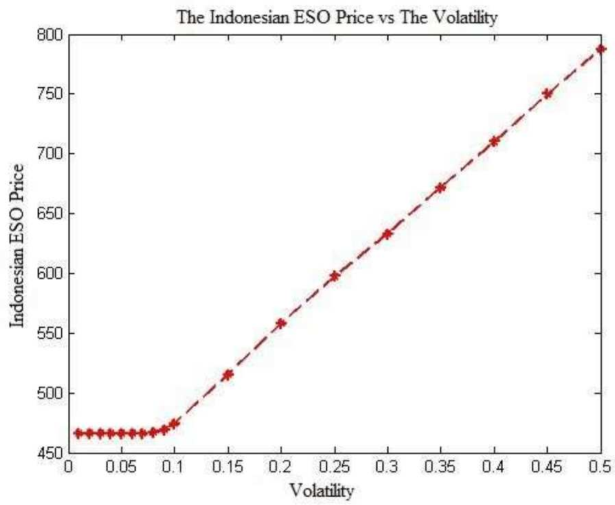

Figure 4: The Indonesian ESO Price vs The Volatility

periods in the Indonesian ESO do not make a significant difference to its price. We can see that the Indonesian ESO's characteristics make it more complex in term of models, but do not become a source of income for employees in Indonesia, unlike other countries.

References

[1] D. Aboody, Market valuation of employee stock options, *Journal of Accounting and Economics*, **22** (1996), 357-391.

[2] M. Ammann, R. Seiz, Valuing employee stock options: does the model matter?, *Financial Analysts Journal*, **60**, No 5 (2004), 21-37.

[3] N. Brisley, C.K. Anderson, Employee stock option valuation: modeling the voluntary early exercise boundary, *Financial Analysts Journal*, **64**, No 5 (2008), 88-100.

[4] J.N. Carpenter, The exercise and valuation of executive stock options, *Journal of Financial Economics*, **48** (1998), 127-158.

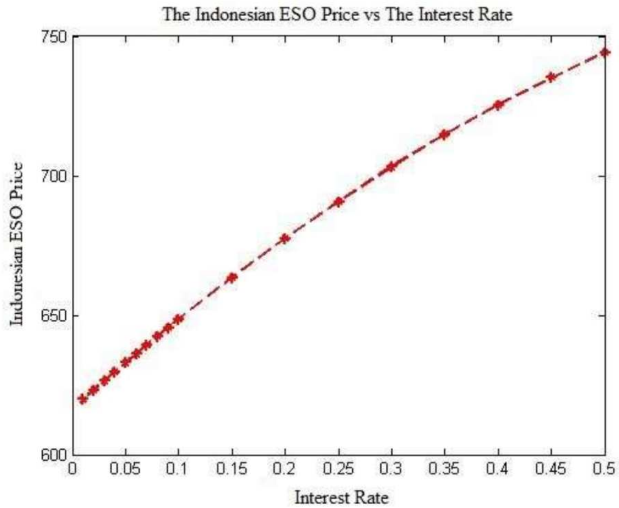

Figure 5: The Indonesian ESO Price vs The Interest Rate

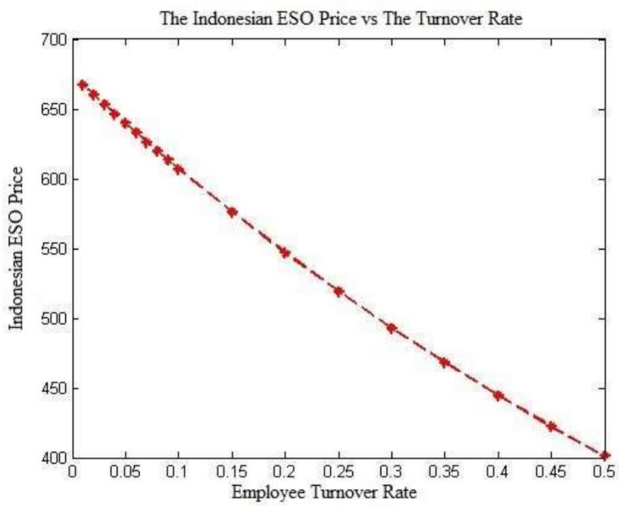

Figure 6: The Indonesian ESO Price vs The Turnover Rate

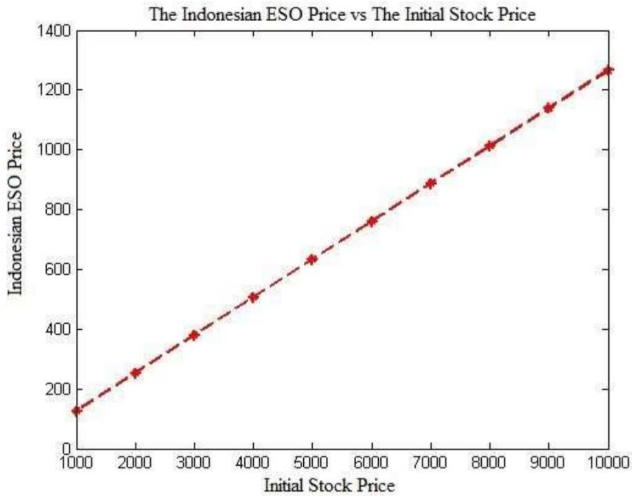

Figure 7: The Indonesian ESO Price vs The Initial Stock Price

[5] J.N. Carpenter, R. Stanton and N. Wallace, Optimal exercise of executive stock options and implications for firm cost, *Journal of Financial Economics*, **98** (2010), 315-337.

[6] E. Chendra, K.A. Sidarto, M. Syamsuddin and D. Puspita, Pricing 'partial-average' Asian options with the binomial method, *International Journal of Banking, Accounting and Finance*, **10**, No 1 (2019), 101-116.

[7] E. Chendra, K.A. Sidarto, An improved of Hull-White model for valuing employee stock options (ESOs), *Review of Quantitative Finance and Accounting*, **54**, No 2 (2020), 651–669.

[8] J. Cox, S. Ross and M. Rubinstein, Option pricing: a simplified approach, *Journal of Financial Economics*, **7** (1979), 229-264.

[9] J. Cvitanic, Z. Wiener and F. Zapatero, Analytic pricing of employee stock options, *Review of Financial Studies*, **21** (2008), 683-724.

[10] J. Detemple, S. Sundaresan, Non-traded asset valuation with portfolio constraints: a binomial approach, *Review of Financial Studies*, **12** (1999), 835-572.

[11] Financial Accounting Standards Board (FSAB), *Statement of Financial Accounting Standard no. 123 (revised): Share-based Payment* (2004).

[12] B.J. Hall, K.J. Murphy, Stock options for undiversified executives, *Journal of Accounting and Economics*, **33** (2002), 3-42.

[13] T. Hemmer, S. Matsunaga and T. Shevlin, Estimating the “fair value” of employee stock options with expected early exercise, *Accounting Horizons*, **8** (1994), 23-42.

[14] S. Huddart, Employee stock options, *Journal of Accounting and Economics*, **18** (1994), 207-231.

[15] J. Hull, A. White, How to value employee stock options, *Financial Analysts Journal*, **60** (2004), 114-119.

[16] Indonesian Financial Accounting Standards Board (IFSAB), *Statement of Financial Accounting Standard (PSAK) No. 53 (Revised 2010)* (2010).

[17] J.E. Ingersoll, The subjective and objective evaluation of incentive stock options, *The Journal of Business*, **79** (2006), 453-487.

[18] N. Kulatilaka, A.J. Marcus, Valuing employee stock options, *Financial Analyst Journal*, **50**, No 6 (1994), 46-56.

[19] R. Lambert, D. Larcker and R. Verrecchia, Portfolio considerations in valuing executive compensation, *Journal of Accounting Research*, **29** (1991), 128-149.