LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
Department of Business Administration
Section of Accounting and Finance
Finance

PRICING OF EXECUTIVE OPTIONS

Bachelor's thesis

Riikka Tupala

TABLE OF CONTENTS

1 INTRODUCTION

Many large companies have an executive incentives programme. Probably the best known to public is the use of stock options as an incentive. Resent debate here in Finland has raised public's interest in executive incentives, especially in options. For example, partly government owned energy company Fortum Oyj's options have been criticized in media of being too vast and of giving the executives too much profit. In November 2005 Finland's Minister of Trade and Industry had to answer to accusations towards Fortum Oyj's options in the Parliament of Finland, and admitted that the options worth half a billion have been too much for the public to understand but unfortunately there is nothing to do to make the amount more reasonable. (Kauppalehti, 2005)

Even thought the value of the executive options from their receivers point of view is often calculated, the real market price of executive option is not so well documented or widely explored. The company having the executive options programme needs to know the possible market price of the executive options for its financial statement and the options price is useful information when deciding about option programmes.

The focus of the paper is to find out what executive options are, why they are used and how executive options could be priced. Since most executive options are exotic, their pricing is not as straightforward as of a standard option's would be.

The paper is structured as follows. The second section introduces the theoretical background of executive incentives, the reasons why they are used, a short view to executive incentives in general and critic towards executive incentives. The third section concentrates on options, what they are, how they are used as an incentive and what kind of options companies use as incentives. The fourth section is about pricing of executive options and the final section is for conclusions.

2 THEORETICAL BACKGROUND

2.1 Reasons for using incentives

2.1.1 Principal agent theory

According to principal agent theory, the principal (owner) and agent (managers at the firm) do not have the same objectives of how to run the company. Shareholders' wishes are that they get revenue for their investments. Managers' objective is to work in the best way for the company or just the best way for themselves. The best way for the company is not necessarily the best way for shareholders. Investments make revenue smaller, and short term owners do not want their company to invest even if investments are crucial for company's performance in the long run. The conflict between the principals and agents causes agency costs. One way to reduce agency costs is to offer managers some kind of incentives if they work in shareholders best interests. One of these incentives is stock options. (Brealey et al., 2006, p. 10, 25–26)

Principal agent theory[1] was introduced in 1970's by Ross (1973) and Jensen and Meckling (1976). In literature, the theory has been studied broadly since the 1970's, mostly focusing on the relationship of the principal and agent, and the problems in this relationship. There also has been attempt to find an optimal contract to govern the principal agent relationship. (Huang et al., 2006, p. 91–92)

According to principal agent theory, there is a trade-off between risk and incentives. This means that agent chooses either more risk or more incentives. That is why an efficient incentive contract aims at balancing this risk. The agent's risk preference is individual. Since the agent is probably less equipped to bear risk than the principal, there is an inherent cost in providing incentives and agent is not as risk taking as the company could be. (Rosenberg, 2004)

[1] Principal agent theory has a lot of names, which are often used as synonyms. For example; agent problem, agent theory, principal agent problem or theory.

Principal agent problem causes agency costs. They occur when the objectives of principals and agents do not come across. There are two ways to reduce the agency costs, either by monitoring the agents more closely or by giving the agents incentives. (Brealey et al., 2006, p. 10, 304–305)

Cumming (2005) lists six agency costs:

1. Moral hazard
2. Adverse selection
3. Hold-up
4. Free riding
5. Window dressing
6. Trilateral bargaining.

From these, the trilateral is bargaining more closely related to venture capital, and free-riding is more a problem to for example a company's board, where individual members can resign themselves from board's functions. Adverse selection is an aspect of the agency problem that refers to information asymmetry between principal and agent. Moral hazard occurs when managers, acting as agents for shareholders, behave in ways that reduce shareholder value (i.e., are against the principals' interests). (Cumming, 2005; Dahlstrom and Ingram, 2003; O'Connor et al. 2006)

2.1.2 Asymmetric information

Asymmetric information in general means that sides have different amount of knowledge of some particular facts or the knowledge of one party is better than the others. The phenomenon can occur in different kind of relationships, for example between an investor and the executives of a company, but also between otherwise similar investors, or between executives and 'blue-collar'-workers. (Bartow and Bodnar, 1996)

Asymmetric information is one part of the agency costs. There is a lot of information flow between agent and principal (Huang et al., 2006). Asymmetric information means that one group has better or more information than the other, in a company a typical situation is if the agents have more and better information of the company than the owners. The principal agent theory relies on the assumption that agents make the decisions concerning the company. The problem with asymmetric

information is that when the executives exploit the better information they have about the company it can lead to a conflict between agents and principals and that way lead to non-optimal e.g. capital allocation. (Copeland et al., 2004, p. 415)

Mäkinen (2001) sees asymmetric information as a reason for principal agent problem rather than a part of agency costs as it is usually proposed in literature (Copeland et al., 2004, p.415; Huang et al., 2006). In Finland, laws and regulations lessen the asymmetric information between company's interest groups such as shareholders and management. This is due to the obligatory financial information required by the law, but it does not remove all of asymmetric information because asymmetric information includes more than just financial reports. Information asymmetry is not an individual reason for the use of incentives, but it is closely related to principal agent theory regardless if it is considered a reason or a part of principal agent problem. Also Cummings (2005) and Rosenberg (2004) think that asymmetric information is more a reason for principal agent problem than a part of the costs accrued by it, i.e. asymmetric information is a reason for agency costs, not a part of them.

2.2 Executive incentives in general

The reasons for using incentives are based on principal agent theory. Agents need some reward in order to do as the shareholders wish i.e. agents do not work in shareholder's best interest endogenously. This reward, however, embodies all the incentives the executive can receive.

There are different kinds of executive incentives. They can be divided into to three categories: salary, yearly bonuses and stock based incentives. There are also other possibilities, for example retirement plans, employment cars etc. (Jones et al., 2004)

Yearly bonuses are usually based on the figures in financial statements. The bonus might also be connected to the development of the company's stock. Bonus programmes differ a lot from company to other and do not have much in common. There are two main problems in using yearly bonuses. Bonuses encourage short-sighted investments which are good in the short run but considering longer time proves to be less profitable. The second problem is that yearly bonuses may lead to

a situation where executives manipulate financial figures by postponing investments or are performing frauds in order to make their bonus bigger. (Jones et al., 2004)

Stock-based incentives can be divided to two groups: stocks that are given directly to employees for example through stock emission and different kind of stock option plans, which can be put into effect various ways. Aimed emission is a situation where a selected group of people is offered stocks. The emission can be aimed for example for stock owners, executives etc. (Jones et al. 2004) The stocks are not given free, but usually sold with their namely price. The stocks sold can be totally new or owned by the company. The stock emission has similar effects as an incentive as options do. They will induce executives to get the stock price higher, since their own investment will gain profit as well. Actually, with emission, the agents become principals.

The general trend nowadays is towards to other than stock option incentives. This can be seen for example from (Ericson, 2003) and is suggested also by Muurling (2005). The trend has changed quite recently, since the gold time in Finland for options seemed to begin around year 2000 (Jones et al., 2004), but in USA, the trend was towards some other forms of incentives as early as in the end of 1990's (Frew, 1999).

2.3 Criticism against incentives

There has been criticism against using incentives. Denis et al. (2006) researched the likelihood of fraud allegations and the firm's compensation structure. They came into a conclusion that greater incentives from equity-based compensation are associated with an increased likelihood of fraudulent behaviour. They also found out, that if company's board of directors is vigilant, the likelihood might be decreased. This was mainly for the reason that an outside director's readiness to detect frauds is good. Denis et al. (2006) also found out that if owner structure consists of institutional owners and outside block holders the likelihood of fraudulent behaviour is increased. This is explained with the fact that these owners are more willing to fire executives if company's targets are not achieved and this creates an incentive for frauds.

Beer et al. (2003) made a survey among 205 executives from different countries. Even if option programmes are widely used, most executives in this study think that incentives improve performance only slightly. In the executives opinion the incentives are used mostly to attract and keep executives, not to award them for fair behaviour towards stockholders. The findings in this study suggest more use of continuous awarding, not awarding on unit performance and raise questions toward the use of more and more executive incentives. It also poses the dilemma which the planners of executive incentives face: they need to wrap up an incentive programme to compete for executive talent, even thought they know it will actually have very little effect on the executives' motivation and can rise dysfunctional behaviour. Ericson (2003) presents same kind of conclusions. The current incentive structure at most companies is based mainly on stock options and bonus plans, but this kind of approach does not unify the interests of executives with those of shareholders and at best, provides only weak link between performance and pay.

If incentives are not designed well there is a good chance that they will actually work the opposite way that was intended. Ericson (2003) proposes four typical problems from inefficient incentive plans:

1. Executives consistently favour short-term over long-term results. This can lead to a situation where good, but long investments are discarded and the value of the company starts to decrease over time.

2. Encourages executives to manage expectations for their performance more than delivering the best possible result.

3. Encourages talented people to do whatever is involved in moving up the career ladder to get to a point where he or she receives options which is not the same thing as making their best contributions in the roles they occupy.

4. Undermines shareholder value. If a stock option plan is vast, and the stocks options can be used to purchase are new, this automatically lowers the existing shareholders value by increasing the amount of stock in the market.

Ericson (2003) however points out, the even if the option plans usually affects the whole company, they cannot be blamed for everything that is wrong, and that well planned incentive programmes will not do any damage to the company whatsoever. He proposes few points which will benefit most companies. First he urges companies

to directly encourage every manager in the company to take a long-term view. Then he proposes that in the result of the executives' business decisions, there should be a clear and direct attraction. He advises to make the possible rewards very visible and that rewards should be given more of team performance while creating peer pressure and creating a situation where the contest of performance is real.

Of executive incentives options have been criticised the most. The defenders of option programmes argue that when succeeding, options can resolve the control problem associated with the relationship between principal and agent. The primary function of options is to focus the executive's attention to actions that increase the shareholder's value. However, it is not common to think that only money motivates the executives.[2]

Mäkinen (2001) also proposes one problem concerning the executives' ability to mark the options. The options are free, but in order to get the shares option owners are titled, the executives need capital to buy the shares. It is not certain, that the executives have the kind of money needed to purchase the stocks. This should be acknowledged when deciding about the options programmes, because if an executive has no capital to buy the shares to herself, the options are worth nothing to her.

[2] Taylor showed as early as in the 1900's that money motivates workers just to certain extent but after that it will it lose its appeal and other things come more important.

3 OPTIONS

3.1 What are options?

Option is a derivative instrument, whose owner possesses a right but not the obligation to buy or sell the underlying asset at a specified price called the exercise or strike price within a specified time called the time to maturity. The underlying can be almost anything; stocks, indices or even something real, like oil or fruits. If one has the right to buy an underlying, she owns a call option; if one has the right to sell an underlying she owns a put option. Normal call and put options can be called also plain vanilla or standard options. The most of executive stock options used in programmes are call options. (Sharpe et al., 1999, p. 601–603; Mitchell, 1998; Mäkinen, 2001)

Executives are given call options, which have value only if the price of the stock exceeds the exercise price of the option. When this happens, the executives have right to mark their employer's stocks directly from the company. This means, that either the stocks are new and or the company purchases its own stock from to market to cover the options. Which one is better, depends a lot of shareholder's intentions. In executives' stock options, the incentive effect is based on the stock's price during the option's maturity. Stock options usually are some kind of exotic options.[3] The exotic options are options, which are not European or American. Standard options e.g. European and American call and put options can be called the first generation options, all the non-standard options are second generation options. All exotic options are direct or indirect extensions of standard options in one way or another. For example a compound option is an option, where the underlying is another option and a barrier option has a level which the underlying's value has to exceed or the option is no longer valid. (Hull, 1999, p. 8 and 458; Mäkinen, 2001; Zhang, 1995)

[3] Options are classified to two types: European and American. European style option has a fixed maturity date and it can be exercised only on that particular date where as an American type option can be exercised at any time during its maturity. The exotic options are options, which are not European or American. (Hull, 1999, p. 8 and 458)

The value of a call option consists of two parts, basic value and time value. Basic value is options underlying's market prices and exercise prices difference. If option's exercise price is bigger than underlying's market price, the call option has no basic value, because now one would exercise the option in that situation. If exercise price is lower than the stock's market price the option has basic value. As basic value is connected to the price of the underlying, time value is connected to maturity, volatility and risk-free rate. Time value is always positive if option has maturity left, but steadily decreases as options maturity date draws closer. This decreasing is based on expectations. If the option has a long maturity, the underlying's value has a longer time and that way more possibilities to climb over the exercise price. From the whole value, the proportion of time value is highest at the point when the underlying's market price is the same as the options exercise price. (Mäkinen, 2001)

3.2 Options as incentives

Options as incentives were first introduced in USA, where they spread to Europe and Finland. Options as incentives were a rare phenomenon in Finland still in the late 1980's, but their amount started significantly grow in mid 1990's. (Vaihekoski 2000; Hansson et al., 2002, p. 14, 27) From Jones et al. (2004) can be seen, that from listed companies in the Helsinki Exchange main list about 2% had a stock option plan in 1987, but nearly 80% had a stock option plan in 2003. From this 80%, 46% of plans were to a selected group of persons, mostly executives and key personnel.

The purpose of an options programme is that executives try to get the price of the stock up and enhance the attractiveness of the company from the investors' point of view and also make the company's value rise. (Mäkinen, 2001)

From a shareholder's point of view the traditional call option plans are criticized to be too generous Hansson et al, 2002), so there has been effort to find a replacement to them. Johnson and Tian (2000) suggest six different types of options, which should reduce the risk of option becoming too generous to executives:

1. Premium stock option
2. Performance-vested stock option
3. Re-priceable stock option

4. Purchased stock option
5. Reload stock option
6. Indexed stock option.

The first one is a premium option where the options exercise price is put higher than the stock's value at the grant day is. This is supposed to encourage the executives to reach for a higher stock price. The second one has a similar effect as the first one, but the tool is that the options have barriers. If the price of the stock does not exceed the barriers given, the options can not be used. This type of option is known also as a barrier option. The third type is an option that can be re-priced if the stocks price plummets under a certain level. This kind of option is supposed to stop executives and personnel fleeing from the company, but actually works also as an incentive for the executives to try to lower the stock price under the re-pricing level.

In traditional stock option plans, the executives get the options free of charge. One way to make the options more inciting is to charge a price of them from the executives. This is based on an idea, that if the executives have to pay of the options, in the fear of loosing their own money they are willing to work harder to achieve their goal. This kind of option is called purchased stock option. The fifth option type is rechargeable options. The executives are given a possibility to exercise the options once during the plan and get in return new options with new exercise price. However, this can cost the company a lot and it is not even clear that this would actually work as intended. Options whose exercise price is tied to the success of a certain index are the sixth type. The idea is that the options are not related to what happens in the market, and that the options can be exercised only if the price of the stock exceeds the general development in the market. This works also if the general development in stock markets is downwards. A problem connected to this type is that it encourages to risky behaviour.

The decision leading to executive option plans should not be made half-heartedly. It has also been said, that options are not fully understood before they are distributed. This brings problems, because option programmes can be very difficult change or terminate afterwards. That is why the reasons behind option plans, like shareholder's objectives, the characteristics of managers and other elements of the decision-making setting should be fully understood by everyone making the option plan

decision. (Core et al., 2003) Mäkinen (2001) points out that options are not a free incentive to shareholder's even if the cost can be difficult to define. The cost is that shareholders divide their wealth with new shareholders i.e. the value of the company is divided into more pieces when the option holder's mark their stocks. This can be prevented with a procedure where the company buys its own stocks back and voids them.

An important question concerning options is that how should the exercise price be determined. According to financial theory, the value added with executive's actions shows in the development of the stock over the market development corrected with risk sensitivity. The risk sensitivity is also known as beta. In a situation like this, the exercise price should be a function of the market development multiplied by beta. If the exercise price is determined this way, the executives have a possibility to get recognition even if the stock markets in general are going down and they don't benefit if the company's stock just rises along with markets. (Vaihekoski, 2000)

Rosenberg (2004) proposes two main design attributes of stock option plans. The first is the scope of stock option plans and second the exercise price of stock options. These should be the main considerations when the shareholder's of the company are evaluating and approving compensation proposals.

3.3 Types of executive options

Before pricing executive options, has to be known what features the options have. Companies in Finland have to give a lot of financial information in their financial statements, including information about their options programmes and also how they have valued options in financial statements.

For example Fortum Oyj's financial statement from year 2005 (Fortum Oyj, 2005) mentions five different incentive programmes, which includes three option programmes from years 1999 to 2002. In a statement of the valuing the option programmes the company informs that they are using binomial model to calculate the values. The option programmes differ from each other.

The latest option programme from year 2002 is for key employees of the company. It consists of two different options, A and B. Both A and B have a restricted time when they can be executed. A has an solid price, where B's exercise price is calculated with a formula which includes for example a mean from certain years, amount of dividends etc. In programme A it is notable that according to the financial statement, the executing of the options is not bind to the price of the Fortum's stock in the stock markets in anyway. The programme from year 2001 has few barriers. All the options fall through if the stocks price development in Helsinki Exchange in years 2001-2004 does not exceed the development of Dow Jones STOXX 600 Utilities index in the same time period and if the company's earnings per share ratio for four years in a row after 1.1.2001 is not 105% compared to the mean of earnings per share ratio in years 1998-2000.

According to Zhang (1995, p. 89, 94) the 2002 options programme can be defined to be consistent with the definition of Bermudan options. The options are European before the start of exercising period, their maturity ending at the point where the exercising period begins and American from that point on. The 2001 programme could be considered consisting of barrier options, since the options have no value if the stock does not reach the set aims or Bermudan since it has features from both European and American options. It could also be named indexed option (Hansson et al., 2002; Johnson and Tian, 2000).

4 PRICING OF EXECUTIVE OPTIONS

4.1 Background for valuing incentive options

In European Union, companies which are listed in stock exchanges, have to make their financial statement according to International Financial Reporting Standards (later on IFRS) if they are obligated to make financial statement of consolidated company. In Finland, all listed companies must produce a financial statement using IFRS. (Deloitte, 2005; KPMG, 2006)

The executive incentives programme is considered a wage to the employee from the work he or she has done. Since some of the executive incentives are used as a bonus rather than normal wage, it is very hard to value the cost of the incentive to the firm.

In the IFRS 2, it is said that incentives programmes must be valued in the company's financial statement by reference to the fair value of the equity instruments granted. (IFRS 2). In IFRS it is also said that the value of the equity instruments shall be measured at grant date (the date the equities are granted) and paragraph 16 describes the valuation of such assets: 'For transactions measured by reference to the fair value of the equity instruments granted, an entity shall measure the fair value of equity instruments granted at the measurement date, based on market prices if available, taking into account the terms and conditions upon which those equity instruments were granted.' If market prices are not available, the price of the equities should be valuated with a valuation technique which is consistent with generally accepted valuation methodologies for pricing financial instruments, using all factors and assumptions a market participant would consider in setting the price (IFRS 2). This sets a problem for many companies. The values of executive options have to be calculated, but since executive options are mostly exotic, the pricing can be difficult. The reason for executive option valuing is mostly to make the financial statements more transparent in listed companies and make it easier to investors get information about them. This is one reason why the use of IFRS is in Finland centralized to

Financial Supervision, which supervises also other regulations concerning listed companies.

In USA it is not obligatory to recognize stock option costs in income statements but some companies do it anyway. However, accounting regulations obligate to inform in financial statement's notes an estimate about the effects of executive options have on net income and earning per share ratio. Also, it is obligatory to use either Black-Scholes, a formula based on Black-Scholes or binomial model while calculating the values (Mäkinen, 2001).

Brandes et al. (2006) argue that agents are against recognizing the options costs because it increases the firm's expenses and that way reduces net income. There has also been proof, that if the agents think that markets will response positively to the news of company's stock option costs been recognized they will advocate the expensing. Management may oppose expensing because it makes the relationship between performance and compensation more transparent thus leading to lower levels of asymmetric information and because missing earnings estimates can result in lower stock prices and reduce their incentives. Shareholders' views depend on what is their situation. Institutional owners may oppose the recognizing because decreased earnings are bad for both the agent and principal. There is also a difference between long-term and shot-term ownership. Long-term owners usually are for recognizing the stock options cost because it reduces asymmetric information and in the long run is good for the company. Short-term owner's interests' are to oppose the recognizing since it will affect negatively to company's value in the short run. Brandes et al. (2006) claim that short-term owner's behaviour depends also on are they institutional or not and are the costs of recognizing the stock option cost's how large. Institutional investors are more willing to accept the recognizing even if the costs are large, where as an individual investor would oppose in the same situation.

The reason for pricing the executive options is the need to include their market value to companies' financial statement, more particularly income statement, where the options value affects the company's net income. The need to include the executive options costs is either regulated by standards and laws or is an endogenous process

in the company. In coming years it is very likely that also in USA the executive options costs are obligated in the financial statements (Ericson, 2003). This is due to the process where European Union and USA are trying to standardize their laws and regulations concerning accounting and financial statements to be consistent with each other. First European Union has to make the laws and regulations consistent inside the European Union, because excluding the companies obligated to use IFRS, the accounting standards vary from country to country. The aim is to make it easier to investors to compare the financial information about companies and make investments also to foreign countries.

A notable fact is that in the IFRS standards is listed how the valuation should be done, but in the USA there is a regulation which actually prohibits using any other than binomial model, Black-Scholes or a model based on Black-Scholes. IFRS however has no direct regulation of what pricing model should be used. IFRS states that market price should be used, or if that is not available, a valuation technique which is consistent with generally accepted valuation methodologies, leaving the decision to the company. In this case, the regulation in USA is better from investors' point of view since this way it is easier to compare the financial information between companies. For someone who does not have knowledge of option pricing, understanding the differences between pricing models can be an overwhelming task.

4.2 Pricing with Black-Scholes

Black–Scholes is an analytical pricing formula for a European option. It was introduced by Black and Scholes and Merton in the beginning of the 1970's. It has a form for both call and put options and it also can be used to value options whose underlying pays dividend. When using Black-Scholes the returns of the underlying should be in logarithmic form[4]. With Black-Scholes one can calculate the premium of an option if maturity, options exercise price, underlying's market value, interest rate in continuous form and underlying's volatility are known. The value of the executive option calculated with Black-Scholes is less than its value really would be because a European option has only one specified moment it can be exercised, where as a Bermudan option is a combination of European and American options and after that

[4] This can be achieved by taking a natural logarithm of underlyings percentage returns.

specified moment where the European option ends, it can be exercised when it's owner desires. When option has a longer exercise time, it raises options value and that is why Black-Scholes gives too low premium. (Hull, 2000, p. 237–259; Schoutens and Symens, 2003; Vaihekoski, 2000; Vaihekoski 2004, p. 318–319)

Black-Scholes, however, is not useless while pricing executive options. The value it gives can be considered as a guideline of what the options price is, and also can be considered the lowest possible price the option should have. Also, it can be used to determine a part of the options price. Executive options are usually Bermudan thus can be divided into to two options, one is European style, with maturity *T*, while the other is American style with maturity t_n. The price of the European style option can be calculated using Black-Scholes and use some other method to the American part.

The Black-Scholes' formula for call and put options are the following:

$$C = N(d_1)S_0 - \frac{E}{e^{rT}}N(d_2) \tag{1}$$

and

$$P = \frac{E}{e^{rT}}N(-d_2) - S_0N(-d_1) \tag{2}$$

where

$$d_1 = \frac{\ln(\frac{S_0}{E}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{\ln(\frac{S_0}{E}) + (r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} = d_1 - \sigma\sqrt{T}$$

and *N(x)* is the cumulative probability distribution function for variable that is normally distributed with a mean of zero and a standard deviation of 1. S_0 is the stock price at time zero, *E* is the exercise price, *r* is the continuously compounded risk-free rate, σ is the stock return volatility, and *T* is the time to maturity of the option. (Hull, 2000, p. 250)

There is also some critic against the Black-Scholes model in general. The Black-Scholes model relies on the fact that a variable has a lognormal distribution if the natural logarithm of the variable is normally distributed and the price process of the underlying is given by the geometric Brownian motion[5]. This is true, but the problem is that it is known that the logarithmic returns of most financial assets are asymmetrically, not normally distributed and have an actual kurtosis[6] that is higher than that of the Normal distribution i.e. they are not following the normal distribution. The Black-Scholes is thus a very poor model to describe stock price dynamics. The problem is bigger when pricing exotic options with Black-Scholes and there has been effort to correct this in some way. In real markets, dealers use a volatility smile adjustment, but that has no guarantee that it will help when pricing exotic options. In order to deal with the non-Gaussian character of the log-returns, new models that based on more sophisticated distributions were proposed. (Hull, 2000, p. 237–259; Schoutens and Symens, 2003)

There are six different assumptions to Black-Scholes:

1. The short selling of securities with full use of proceeds is permitted.
2. There are no transaction costs or taxes. All securities are perfectly divisible.
3. There are no dividends during the life of the derivative.
4. There are no arbitrage opportunities without risk.
5. Security trading is continuous.
6. The risk-free rate of interest is constant and the same for all maturities.

Some of these assumptions can be released (Hull, 2000, p. 245), but there is still room for criticism. Black-Scholes is a theoretical model and it gives a relatively good estimate of the price of the option, but while using Black-Scholes should one understand the assumptions lying behind the model. Some of these can be filled easily, for example constant risk-free rate of interest is easy to calculate from discontinuous rates and short selling is not even allowed everywhere. Mäkinen (2001) points out, that the assumption of volatility and possible dividends being constant during the option's maturity is more problematic while pricing executive options. In a normal situation, where the maturity is measured in months, this

[5] Brownian motion is a geometrical motion used in modelling stochastic processes.
[6] Kurtosis measures if the distribution in question is wider or slimmer compared to Normal Distribution. A slim distribution has a positive kurtosis.

assumption can be endured, but executive options can have maturity of many years and underlying's volatility is going to change in that time. Assumption about dividends can be fixed by decreasing the present value of all the dividends paid during the life of the option from the current value of the underlying stock. (Hull, 2000, p. 258)

A related issue to pricing with Black-Scholes is the method which is used to calculate the volatility used in the formula. Usually is used historical volatility, which is calculated from the underlying's historical values. A problem with historical volatility is that it is not so easy to determine the time period of which the volatility will be calculated. The longer the period, the more accurate the volatility is, but on the other hand volatility changes over time and too long time period can include data which is out of date or in some other way not relevant. A rule of thumb is that the data is collected from daily closing prices from a period as long as the maturity of the option. (Hull, 2000, p. 242) In the case of executive options this may not be the best way. If the maturity is years, the problem of irrelevant data rises. If a company has suffered for example a financial crisis during this period, its volatility will probably be too high compared to the situation today. Since this is known one solution might be that the data is collected only from a time period from today to history where occurs no large changes in debt-structure, fusions or other similar events.

The other way is implied volatility. Implied volatility can be calculated by marking the Black-Scholes to a value a similar option gets in the market, and iterate with different volatilities *ceteris paribus* and find out what volatility gives the market price. (Hull, 2000, p. 242) However, this method is not suitable for executive options, since they are rarely similar to options in the market and determining the price for implied volatility is too complicated.[7] Also, as executive options are not purely European, Black-Scholes will give them a too low price and that way implied volatility will also be wrong.

[7] Actually the price should be determined first with some other pricing method and then calculate the implied volatility.

4.3 Pricing with binominal model

Binominal model or a decision tree is a technique which can be used to price options. It is a diagram representing different possible paths that might be followed by the stock price over the life of the option. The binomial tree gets its name from its appearance. Binomial trees assume that in each short time interval a stock price either moves up or down by a proportional amount. Figure 1 shows an example of a two step tree.[8] (Hull, 1999, p. 201–215, p. 388–406)

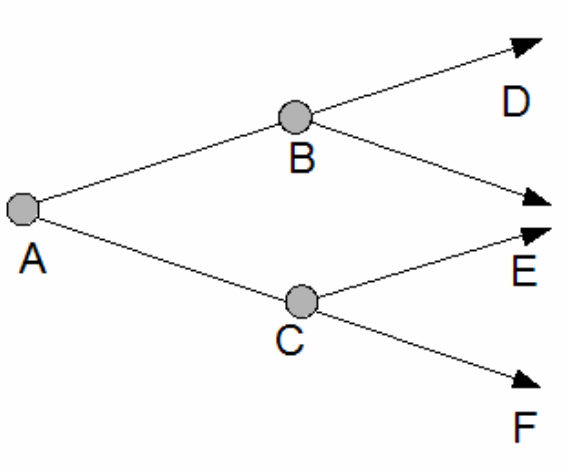

Figure 1 A two step binomial tree. (Adapting Hull, 1999, p. 207)

The starting point in the Figure 1 is A, where the underlying's value is for example S, and options price is X. The idea is that when the price of the underlying's falls or rises for example by 20% the tree can be used to calculate the value of the option. In point B the value of the underlying would be 20% higher and in C lower. In the point D the value is 20% higher than in point B, in point E the value is 20% lower than in B and 20% higher than in point C. In point F the price is 20% lower than in point C.

The new value of the option is calculated in points B-F. In points B and C the value of the option is the weighted average of the later points, and in A the weighted average of B and C, so option price is calculated by starting at the end of the tree and working backwards. The binomial tree composed like this is unrealistically simple for solving the value of an option and is actually under the assumption that world is risk neutral.

[8] A numeric example can be found in for example in Hull (1999) or Sharpe et al. (1999).

It can give a rough estimation of the options price, but a simple binominal tree is not the best way to valuate complicated options. However, binominal trees can be very complicated when the number of steps is increased and the more complicated tree the more accurate is the price of the option it gives. (Hull, 1999, p. 201–215, p. 388–406)

When calculating with binominal model, the probability of the stock's price going up or down has to be defined first. This can be done with the following formula, which is in the form of probability for up movement:

$$p = \frac{a - d}{u - d} \tag{3}$$

where,

$$u = e^{\sigma\sqrt{\Delta t}} \tag{4}$$

$$d = e^{-\sigma\sqrt{\Delta t}} \tag{5}$$

$$a = e^{r\Delta t} \tag{6}$$

where ***a*** is the growth rate, *u* is the up movement, ***d*** is the down movement, *r* is the risk-free rate of interest, ***Δt*** length of the time interval (the time between points) and ***σ*** the volatility of the stock. The probability for down movement is $1 - p$. When the probabilities are clear, the options price in the last point is calculated with any suitable method for option pricing, for example Black-Scholes. After this, the value of each point can be calculated. For example in point B the value of the option is:

$$(p_u \times D + p_d \times E)e^{-r\Delta t} \tag{7}$$

where p_u is the probability of an up movement, p_d of a down movement, *D* is the value of the option in point D and *E* in point E, *r* is the risk-free rate of interest and ***Δt***

is the length of the time interval. After this can the value of the whole tree be calculated. (Hull, 1999, p. 201–215, p. 388–406)

There is also some critic against the use of binominal model in executive option pricing. With a certain kind of binominal model, the difference with the highest and lowest price the model gives could be even 100% (Mäkinen, 2001).

4.4 Pricing with simulation

Due to their characteristics, exotic options' prices are usually calculated with either simulation or binomial model. Sensitivity analysis is a technique where the different outcomes of a situation are produced by changing one variable *ceteris paribus*. That way a limited amount of plausible combinations of variables can be achieved. When using Monte Carlo simulation, it enables one to use all the possible combinations of variables. It gets its name of a gambling problem. It is impossible to calculate without simulation all the possible outcomes in a roulette game and get a reliable probability prediction. With Monte Carlo simulation and a computer this is possible, even if the amount of data is big. (Brealey et al. 2006, p. 255)

Monte Carlo simulation involves using random numbers to sample many different paths that the variables underlying the derivative would follow in a risk-neutral world. For each path, the payoff is calculated and discounted at the risk-free rate of interest. The arithmetic average of the discounted payoffs is the estimated value of the derivative. Monte Carlo simulation is however primarily used for derivatives where the payoff is dependent on the history of the underlying variable or where there are several underlying variables. This does not mean that other types of options could not be valuated with Monte Carlo simulation (Hull, 1999, p. 388).

The Monte Carlo simulation becomes advisable compared to other pricing models, when the pricing task becomes more complicated. It also has an advantage of being very flexible and easily modified. In the modern world with effective computers, its use has become significantly easier compared to when the model was first introduced in the 1970's. (Boyle et al., 1997)

Boyle et al. (1997) present the Monte Carlo method to be consisting of three steps:

1. Simulate sample paths of the underlying variables over the relevant time horizon. Simulate these according to the risk-neutral measure.

2. Evaluate the discounted cash flows of a security on each sample path, as determined by the structure of the security in question.

3. Average the discounted cash flows over sample paths.

In a mathematical sense, the Monte Carlo simulation computes a multi-dimensional integral which is the expected value of the discounted payouts over the space of sample paths.

5 CONCLUSIONS

The theoretical background for using executive incentives is in principal agent theory. According to principal agent theory, principals need something to make the agent work as the principal prefers. The problem arises, when the needs of principals differ from those of the agents. Executive incentives are designed for solving the principal agent problem and are based on the idea that if agents work for the benefit of the principals, they also will benefit from for example the rise of the company's stock value in case the incentive is stock-based.

Recently the criticism towards options and other equity-based incentives has been rising. It is true, that some of the executive option plans are too open-handed and almost impossible to change after they have gone in to motion, and that is why there has been effort to design the plans better so that they would be more reasonable and flexible.

Shareholders' or the company's board make the decisions of executive option plans. It is important that the decision makers understand wholly the effects of their decisions for example the exercise price of the options or the scope of the plan.

There are few reasons why to price the executive options to the value they would be in the market. In Europe, listed companies are obligated to use IFRS, and according to IFRS equity-based instruments have to be valued at their market price in income statement. In USA this is not obligatory, but there companies have to represent the affect of stock options to net income and earnings per share ratio in the notes of financial statement. Some companies however present the effect also in their income statement to further the transparency and decrease asymmetric information.

Most executive options are exotic and rarely noted in the markets due to being an incentive which is not tradeable instrument. This means in practise that their correct market value is difficult to determine. There is three possible ways to price an executive option, Black-Scholes model, Binomial model and simulation. Black-Scholes model tends to give a too high price to the option, a simple binomial model

can give only a rough estimate and simulation as a method is not necessarily approved by accounting laws and regulations. There is no way to tell which of these presented pricing methods is theoretically the best. However, there are direct flaws in the Black-Scholes model when valuating exotic options. The binominal model or Monte Carlo simulation would probably be more recommendable.

Possible future research from this field is to compare all the valuation models in practise to see which performs best. For a mathematically advanced person, the developing of a model especially made for executive options could be possible further research.

REFERENCES

Bartow, E. and Bodnar, G.: “Alternative Accounting Methods, Information Asymmetry and Liquidity: Theory and Evidence”. *The Accounting Review*, 1996, Vol. 71, No 3, p. 397–418.

Beer, M. and Katz, N.: “Do Incentives Work? The Perceptions of a Worldwide Sample of Senior Executives”. *Human Resource Planning,* 2003, Vol. 26, No 3, p. 30–44.

Boyle, P., Broadie, M. and Glasserman, P.: “Monte Carlo Methods for Security Pricing”. *Journal of Economics Dynamics and Control,* 1997, Vol. 21, No 8–9, p. 1267–1321.

Brandes, P., Hadani, M. and Goranova, M.: “Stock Options Expensing: An Examination of Agency and Institutional Theory”. *Journal of Business Research,* 2006, Vol. 59, No 5, p. 595–603.

Brealey, R., Myers, S. and Allen, F.: *Corporate Finance*, 8th edition. USA: McGraw-Hill/Irwin, 2006.

Connor, J., Priem, R., Coombs, J. and Gilley, K.: “Do CEO Stock Options Prevent or Promote Fraudulent Financial Reporting?” *Academy of Management Journal*, 2006, Vol. 49, No 3, p. 483–500.

Copeland, T., Weston, J., and Shastri, K.: *Financial Theory and Corporate Theory*, 4th edition. USA: Pearson Education, 2005.

Core, J., Guay, W. and Larcker, D.: “Executive Equity Compensation and Incentives: A Survey”. *Economic Policy Review,* 2003, Vol. 9, No 1, p. 27–50.

Cumming, D.: “Agency Costs, Institutions, Learning and Taxation in Venture Capital Contracting”. *Journal of Business Venturing*, 2005, Vol. 20, No 5, p. 573–622.

Dahlstrom, R. and Ingram, R.: “Social Networks and the Adverse Selection Problem in Agency Relationships”. *Journal of Business Research,* 2003, Vol. 56, No 9, p. 767–775.

Deloitte. “IFRS Ydinkohdat” (in Finnish), 2005, [e-document], from http://www.iasplus.com/dttpubs/2005pocketfinnish.pdf, retrieved November 11, 2006.

Denis, D., Hanouna, P. and Sarin, A.: “Is There a Dark Side to Incentive Compensation?” *Journal of Corporate Finance*, 2005, Vol. 12, No 3, p. 467–488.

Ericson, R.: “Value Rules: Senior Management Incentives in the Post-option Era”. *Benefits Quarterly*, 2003, Vol. 20, No 1, p. 23–29.

Fortum Oyj. Tilinpäätös 2005 (in Finnish), 2006, [e-document], from http://www.fortum.com/gallery/Investors%202006/Annual_Report_05/Financial_Statement_05_fi.pdf, retrieved November 14, 2006.

Frew, S.: “Stock Options Continue to Be Used for Executive Incentives”. *Chemical Market Reporter*, 1999, Vol. 7, No 256, p. 10.

Hansson, M., Liljeblom, E., Löflund, A., Maury, B., Pasternack, D. and Rosenberg, M.: ”Kannustinjärjestelmät sekä niiden toimivuus suomalaisissa valtionyhtiöissä ja valtion osakkuusyhtiöissä” (in Finnish). *Kauppa- ja teollisuusministeriön tutkimuksia ja raportteja, 2/2002*, 2002. Helsinki: Kauppa- ja teollisuusministeriö.

Huang, G-W., Chang, H-C. and Yu, C-H.: “A Comprehensive Study on Information Asymmetry Phenomenon of Agency Relationship in the Banking Industry”. *The Journal of American Academy of Business, Cambridge*, 2006, Vol. 8, No 2, p. 91–97.

Hull, J.: Options*, Futures and Other Derivatives*, 4th edition. Upper Saddle River, USA: Prentice Hall, 1999.

International Financial Reporting Standards 2, Share-based payment. [e-document], from http://ec.europa.eu/internal_market/accounting/docs/arc/ifrs2/ifrs2_en.pdf, retrieved November 11, 2006.

Jensen, M. and Meckling, W.: “Theory of the Firm: Managerial Behaviour, Agency Costs and Capital Structure”. First published: *Journal of Financial Economics*, 1976, Vol. 3, No 4, p. 305–360.

Johnson, S. and Tian, Y.: “The Value and Incentive Effects of Non-traditional Executive Stock Option Plans”. *Journal of Financial Economics*, 2000, Vol. 57, No 1, p. 3–34.

Jones, D., Kalmi, P., and Mäkinen, M.: “The Determinants of Stock Option Compensation: Evidence from Finland”. *ETLA, series A, 957, Discussion papers*. Helsinki: ETLA (Elinkeinoelämän tutkimuslaitos). 2004.

Kauppalehti. 2005. “Pekkarinen: Fortumin optiot koettelevat oikeustajua” (in Finnish). *Kauppalehti* 23.11.2005, p. 8.

KPMG, 2006, [e-document], from: http://www.kpmg.fi/alikansionavi.aspx?Section=2143, retrieved October 27, 2006.

Mitchell, P.: “Comparing and Valuing Long-term Executive Incentives”. *Real Estate Review*, 1998, Vol. 27, No 3, p. 89–92.

Muurling, R.: ”Stock Option Plans in EuroStoxx 50 Companies”. *Managerial Finance*, 2005, Vol. 31, No 7, p. 54–89.

Mäkinen, M.: ”Optiot - suomalaisjohtajien uusi kannustin” (in Finnish). *ETLA, series B, 182.* Helsinki: ETLA (Elinkeinoelämän tutkimuslaitos). 2001.

Rosenberg, M.: *Essays on Stock Option Compensation and the Role of Incentives and Risk.* Helsinki: Swedish School of Economics and Business Administration, 2004.

Ross, S.: “The Economic Theory of Agency: The Principal’s Problem.” First published: *American Economic Review*, 1973, Vol. 63, p. 134–139.

Schoutens, W. and Symens, S.: “The Pricing of Exotic Options by Monte-Carlo Simulations in a Lévy Market with Stochastic Volatility”. *International Journal of Theoretical and Applied Finance*, 2003, Vol. 6, No 8, p. 839–864.

Sharpe, W., Alexander, G. and Bailey, J.: *Investments,* 6th edition. Upper Saddle River, USA: Prentice Hall, 1999.

Vaihekoski, M.: “Optiot johdon tulospakkauksessa” (in Finnish). 2000, [e-document], from: http://www2.lut.fi/~vaihekos/pdf/johd_opt.pdf, retrieved November 11, 2006.

Vaihekoski, M.: *Rahoitusalan sovellukset ja Excel* (in Finnish). Vantaa: WSOY, 2004.

Zhang, P.: ”Professional Forum: An Introduction to Exotic Options”. *European Financial Management*, 1995, Vol. 1, No 1, p. 87–95.