Executive turnover and the valuation of stock options ☆

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A R T I C L E   I N F O

A B S T R A C T

This paper develops a model for the valuation of executive stock options (ESOs) considering two sources of early exercise: forced exercise due to executive turnover and voluntary exercise due to personal considerations. Using data of about 4000 US executives, I estimate separate hazard rate factor models for both sources of early exercise. In a second step, I combine both conditional hazard exercise models for the valuation of a representative ESO in a Monte Carlo simulation. Analysis of the individual valuation impact of each source of early exercise shows that turnover induced exercises are responsible for most of the valuation discount of ESOs to market traded options. This result is important as most of the current literature on ESOs concentrates solely on voluntary exercises. I further find that the common practice valuation approach suggested by the Financial Accounting Standards Board (FASB) consistently underestimates ESO values.

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1. Introduction

Early exercise is an important factor for the valuation of American options and as such also for the valuation of executive stock options (ESOs). Forced exercises (due to executive turnover) and frequent voluntary exercises motivate a valuation discount of ESOs to market traded options. While the empirical literature on ESO valuation focuses on explaining voluntary exercises, this paper estimates conditional empirical models on both sources of ESO early exercise. For further analysis, I combine and apply the two separately estimated hazard models for the valuation of a representative stock option by Monte Carlo simulation. I show that turnover induced exercises are responsible for most of the ESO valuation discount. Issuer firms estimating their compensation expenses should thus properly take into account turnover risk for ESO valuation.

In case of turnover, ESOs forfeit unless the executive exercises them within a short time period. I thus consider turnover induced exercises as forced. Unvested options forfeit in any case because exercise is simply not allowed. Executives should also let forfeit vested but out-of-the-money options as exercise does not pay off. Apart from forced exercise, voluntary exercise is the only possibility to cash in option value before maturity because ESOs cannot be sold and direct hedging is not allowed by

firm's governance rules.[1] Voluntary exercises are thus subject to individual preferences and characteristics of the option holder concerning diversification, liquidity (consumption), and behavioral biases.

This paper uses an empirical valuation model to evaluate the relative importance of both sources of early exercise. In particular, I use the empirically estimated hazard models for turnover (forced exercise) and voluntary exercise as inputs for a Monte Carlo simulation. While the turnover rate depends on employment tenure and factors such as firm performance, the voluntary exercise rate depends on time since vesting and most notably the time value of the option package. The two hazard rates thus combine to an overall exercise probability in the simulation that is both time and stock price dependent. This resulting overall exercise probability is crucial for the calculation of expected future pay-offs. Thus, estimating the turnover rate empirically hugely improves the precision of ESO valuation, compared to deterministic exit rates.

First the application of a valuation model allows me to analyze the effect of often unobserved forced exercises on ESO values. Forced exercises do not have to be reported if they occur when the manager is no longer employed by the firm. So, data on exercised options is often not available in that case. In addition, although the two hazard models are estimated independently of each other, the two exercise reasons can interact in the valuation model as the exercise for one reason prevents exercise for the other. I identify executive turnover induced exercise (or forfeiture) to account for most of the discount of an ESO in relation to a market traded option. Turnover induced exercise (or forfeiture) occurs with a higher probability and also destroys more option value. The destruction of option value is most severe if executive turnover triggers forfeiture of unvested or out-of-the-money options. Voluntary early exercise destroys less value because it usually occurs if the time value is low which holds for options that are deep in the the money or close to maturity.[2]

Firms expense ESOs proportionately over time based on their initial valuation. There is no mark to market valuation (see SFAS 123, Appendix A2) and, therefore, potential valuation errors cannot be ironed out over the expense period, which makes obtaining correct initial valuation even more critical. I further find that the valuation approach suggested by the Financial Accounting Standards Board (FASB) consistently underestimates ESO values. My results could thus affect the structure of executive compensation as soon as shareholders become aware of the higher cost of option compensation. In addition, underestimating compensation costs biases firm values upward, especially in growth firms with an emphasis on option compensation. The FASB model implicitly assumes that ESOs are exercised or forfeit at a distinct point in time. This assumption causes massive value destruction in cases when the option is close to the money at this point in time. Conversely, in my approach early exercise and forfeiture are flexible in time and occur relatively more likely when options are further in the money or further out of the money. I find voluntary exercise to be more likely when the option is far in the money and the forfeited time value is comparably low. Turnover induced exercise (forfeiture) is more likely after poor past performance when the option is possibly far out of the money and worth little. Less value destruction in my approach leads to higher ESO values than the corresponding FASB value.

To build the ESO valuation model, I analyze a data set with 41,361 option packages held by 4001 executives in 1378 firms for the years 1996 to 2008. I collect data on executive tenure and turnover from ExecuComp and data about option grants and exercises from the Insider Filing Data Feed (IFDF) of ThomsonReuters. The estimation part of this paper shows for both sources of early exercise that executives time their exercises as to save option value. As such, they seem to defer voluntary turnover if they own a valuable portfolio of unvested options that otherwise would forfeit. Further, voluntary exercises are more likely the lower is the loss in time value (gap between option value and proceeds of exercise).

To the best of my knowledge, Armstrong et al. (2007) is the first empirical paper to apply hazard analysis for the purpose of ESO valuation and is probably the closest paper to mine. They also treat turnover induced forced exercises and voluntary exercises symmetrically in their estimation approach, but they estimate company specific models using data for broad based option plans of 10 companies mostly from the technology sector. Moreover, their hand collected employee data set lacks direct data on turnover.[3] This paper uses a more robust hazard approach and analyzes data both on voluntary exercises and executive turnovers in a broad base of firms. It applies the modular structure of the valuation model to estimate the relative importance of both sources of early exercise in a representative data set. The results of the analysis further support theoretical predictions of Cuny and Jorion (1995) concerning the effect of turnover on ESO valuation. Cuny and Jorion (1995) show that negative correlation of the turnover rate with the stock price increases the ESO value compared to a model with a constant turnover rate. My findings suggest that future research on ESO valuation should pay more attention to turnover induced forced exercise.

The paper is structured as follows. Section 2 positions the paper in the existing literature. Section 3 describes the construction of the data set. Section 4 explains the applied methodology. Section 5 estimates the turnover model and Section 6 the model for voluntary early exercise. Section 7 contains the core of the analysis. It performs Monte Carlo simulations for ESO valuation in which probabilities of exercise and forfeiture are estimated according to the hazard models for turnover and voluntary exercise from Sections 5 and 6. It relates the calculated ESO values to the FASB approximation and discusses the impact of either source

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[1] Bettis et al. (2001) find that individual corporate insiders still use collar transactions and equity swaps to reduce their effective ownership positions. Carpenter et al. (2010) also argue that executives could partially hedge their exposure by trading a correlated asset.

[2] The market value of an option can be divided into intrinsic value and time value. The intrinsic value can be cashed in by immediate option exercise. It is zero for options that are not exercisable or out of the money. The time value is the residual option value. It arises from the asymmetric payoff structure (limited loss potential, unlimited gain potential). By this definition, out-of-the-money options, unvested options or European options fully consist of time value.

[3] The authors do not observe employment terminations directly but through option cancellations. On turnover, vested in-the-money options are rather exercised than canceled (without payoff). As a result, turnovers of employees, who have only options of this style, remain unobserved, potentially biasing the turnover rate downward.