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The CEO career horizon problem: the R&D expenditures perspective

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Abstract

Findings in recent executive career horizon literature are mixed. While the majority of authors find that CEOs with a shorter career horizon become increasingly risk-averse, Cazier (2011) suggests that these findings are the result of a cross-sectional bias. Using R&D expenditures as a proxy for risk, I test conventional career horizon hypotheses employing various study designs: an OLS controlling for industry effects, a firm fixed effects regression and a firm-CEO fixed effects regression. With each improvement in study design, results distance further from conventional literature, in line with Cazier (2011). Findings suggest an effect of CEO career horizon opposite to conventional literature, which in cross-sectional study designs gets shrouded by biases.

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1: INTRODUCTION

Conventional literature on the career horizon effect (Butler & Newman, 1989), which has a foundation in both agency theory and upper echelons theory (Hambrick & Mason, 1984; Jensen & Meckling, 1976), explains how CEOs with a shorter career horizon act differently from CEOs with a longer career horizon. The underlying mechanisms of this effect differ per article, depending on the dependent variable. Davidson et al. (2007) argue how compensation package design could incentivize CEOs to increase discretionary accruals. (Brickley et al., 1999) explain how post-retirement board positions could be a reason for CEOs to act differently, dependent on whether they are interested in a board position at their current or a different firm. Matta & Beamish (2008) find support for both wealth preservation and legacy conservation effects of CEOs nearing retirement, affecting risk-taking. These results show that CEOs may be incentivized to adapt their behavior and decision-making, dependent on their personal goals.

However, findings on the effect of career horizon are mixed. Cazier (2011) finds no effect of CEO career horizon in the high-risk context of research and development (R&D) expenditures. Cazier's (2011) explanation is that study design significantly affects the findings of a study on the effects of executive career horizon. Specifically, cross-sectional study design allows biases like survivorship bias and age bias in selection of CEOs by firms with high R&D expenditures to affect the significance of the results.

In this thesis, I develop conventional CEO career horizon hypotheses that are in line with prior studies, but in a different context. I test whether CEOs with a longer career horizon are incentivized to take more risk. The argumentation is in line with conventional career horizon literature, and based on both extrinsic (e.g. compensation package) and intrinsic (e.g. legacy conservation) incentives. By using research and development expenditures as a proxy for risk-

taking, I test the hypothesis. In hypotheses 2 and 3 I also test for moderating effects of extrinsic incentives on the effect of CEO career horizon on R&D expenditures. These moderators are CEO stock holdings and CEO stock option holdings, in line with Matta & Beamish (2008).

In order to improve understanding of the effects of study design, I employ multiple study designs. Using a dataset of 290 firms that were part of the S&P 500 between 2010 and 2020, I test all hypotheses using an OLS regression controlling for industry effects, a firm fixed effects regression, and a firm-CEO fixed effects regression in order to be able to compare the findings. I also run the regressions on a 'general model', which contains both moderator variables, and I employ a firm-CEO fixed effects regression with clustering for firms as a robustness test.

The findings of the different regressions are significantly different. The OLS regression controlling for industry effects provides support for both hypotheses 2 and 3. However, the results from the firm fixed effects regression provide no support for any of the hypotheses. The firm-CEO fixed effects regression shows a significant effect of research and development expenditures, but the direction is contrary to the hypothesis. Results are not in line with conventional executive career horizon literature. Rather, they are in line with Cazier (2011),who explains how biases in the data can affect the results of a cross-sectional study design. Additionally, the negative effect of career horizon on research and development expenditures is not only in line with Cazier (2011), but shows that the cross-sectional study design can even reverse the actual effect that seems to exist in the real world.

My findings contribute academically through increased understanding of the career horizon effect and of consequences of study design on the outcome of the study. Practically, my findings can be of value to shareholders that are in the process of CEO selection or compensation package design.

2: LITERATURE REVIEW

The CEO career horizon problem is an example of an agency problem. Agency theory, which is originated by (Jensen & Meckling, 1976),describes how conflicts of interest between the manager and the owner of a firm can lead to suboptimal results for the owner. The career horizon problem (Butler & Newman, 1989) explains why executives can make different decisions depending on how far the end of their career lies ahead of them. Butler & Newman (1989) explain how the CEO's behavior could be affected by the firms inability to penalize the executive after his departure, leading the CEO to act opportunistically in his final year at the firm.

Since the first paper on the CEO career horizon problem, various articles have been written on this topic. The authors of these articles test different mechanisms through which the executive's career horizon affects the firm, and test for distinctively different outcomes. Matta & Beamish, (2008) find that CEOs approaching retirement are affected by the agency problem through legacy conservation and wealth preservation. The desire for legacy conservation leads a CEO to adjust decision making away from a course that could negatively affect the CEO's legacy, regardless of whether the new line of decisions are optimal for firm performance. Wealth preservation explains how CEOs with wealth at risk are enquired to increasingly reduce the chance of the stock price being (negatively) affected, the closer they get to retirement (Matta & Beamish, 2008). The authors show that CEOs are less enquired to take risk when they are closer to their retirement, resulting in a statistically significantly lower amount of international mergers and acquisitions. Matta & Beamish, (2008) show moderating effects of equity holdings and in-the-money unexercised option holdings, which both further increase risk-aversity among CEOs nearing retirement.

Brickley et al. (1999) find more incentives for the CEO to be affected by the career horizon problem; positions on boards of their own and other firms after retirement. This means that a CEOs behavior is not only affected by the end of their career as an executive, but also by their post-retirement life. Brickley et al. (1999) find that the likelihood of post-retirement board service at the CEO's current firm mainly depends on stock returns, while the likelihood of post-retirement board service at other firms mainly depends on accounting returns. This indicates that there are numeral ways in which the CEO could be affected by his career horizon, and that there may also be ways of counteracting these effects. The findings suggest that post-retirement board service at the firm that the CEO serves could reduce horizon problems Brickley et al. (1999).

Davidson et al. (2007) test whether CEOs are more likely to manage earnings before turnover decisions. The authors argue that the career horizon effect could lead CEOs with a relatively large profit-based bonus to increase discretionary accruals in the year before the turnover. Davidson et al. (2007) find that firms that do base bonus mainly on net profit have larger discretionary accruals, but that including control variables in the analysis nullifies this effect. This is a clear sign of how important research design can be (in this career horizon research direction).

Cazier (2011) provides further evidence of the relevance of the research design on the effects that are found. He shows that a cross-sectional research design leads to conclusions in line with conventional career horizon literature. However, he also shows that tracking a CEO's behavior over time does not produce the same result. More specifically, Cazier (2011) shows that more R&D-intensive firms on average hire CEOs with a longer career horizon, which leads to a cross-sectional bias. Cazier (2011) acknowledges that his results do not rule out the existence of career horizon effects among executives. However, he argues for the significance of his findings

in terms of how important correct research design is, especially with regard to this topic in academic literature. Improper research design could wrongly attribute firm-level phenomena to CEO characteristics (Cazier, 2011).

In summary, there are several articles that show a variety of effects that executive career horizon can have on firm performance or outcome (Butler & Newman 1989; Matta & Beamish, 2008; Brickley et al. 1999), but there are also indications that incorrect research design could lead to false conclusions (Brickley et al., 1999; Cazier 2011). Matta & Beamish, (2008) find that stock and stock option holdings accentuate the career horizon effect through increased wealth preservation incentives. I test whether these effects hold in R&D expenditures, a context with different dynamics than international acquisitions, but a common aspect; risk. Both international acquisitions and R&D expenditures are considered relatively risky expenses that do not immediately result in increased firm performance or increases in stock price. Next to these moderating effects of stock and stock option holdings, I test for cross-sectional vs. time series effects of research design. For the cross-sectional design in particular there is reason to be careful in drawing conclusions, as a bias has been shown by Cazier (2011).

3: THEORETICAL FRAMEWORK AND HYPOTHESES

The career horizon problem (Butler & Newman, 1989), as stated, explains why executives can make different decisions depending on how far the end of their career lies ahead of them. A variety of ways in which executive career horizon affects many different firm outcomes has already been studied.

In this thesis, I study whether CEO career horizon affects research and development (R&D) expenditures. Research and development is a relatively high-risk expenditure: increases in R&D intensity have been linked to increases in systematic risk and stock price fluctuations (Ho et al., 2004) Therefore, in this thesis, I use R&D expenditures as a proxy for risk-taking, similar to the international mergers and acquisitions context of Matta & Beamish, (2008). However, the height of R&D expenditures is not only a proxy for risk. Contrary to e.g. the international mergers and acquisitions context of Matta & Beamish, (2008), the height of R&D expenditures is not a binary variable. Forcing or preventing an international acquisition from taking place is a relatively impactful feat, that would be difficult to realize by a single executive. Also, forcing or preventing an international acquisition from taking place would be a difficult way to affect e.g. accounting returns. As R&D expenditures is not a binary outcome with consequences of strategical importance that are as large as those of international acquisitions, it does not have to go through e.g. the extensive due diligence process that international acquisitions go through. Davidson et al. (2007) explain how the executive career horizon might affect earnings management. R&D expenses is a significantly easier and less consequential way for a CEO to affect accounting returns than forcing or preventing an international acquisition from taking place. Therefore, R&D expenditures in this thesis not only serves as a context for risk, but also as a proxy for how the CEO can affect accounting returns.

The career horizon problem (Butler & Newman, 1989), in which the executive acts in ways that may not best benefit the firm, is a product of two underlying theoretical concepts; upper echelons theory and agency theory. The various reasons recurring in academic literature that underlie the career horizon problem can all either be ascribed to upper echelons theory, agency theory, or both.

3.1 Upper echelons theory

Upper echelons theory, founded by Hambrick & Mason (1984), explains how firm outcome can be affected by characteristics of the 'upper echelons' of the firm. Proxies for the upper echelons of the firm in recent literature have varied widely, including but not limited to the CEO, the CFO, the chairman and the entire top management team (Matta & Beamish, 2008; Plöckinger et al., 2016; Amran et al., 2014; Bromiley & Rau, 2016). I study the CEO for multiple reasons. First, the CEO is generally considered the most powerful single member of the upper echelons of the firm (Jensen & Zajac, 2004). Logically, the most powerful member of the firm is able to affect firm outcome most. Therefore, CEO characteristics should have the most pronounced effects on the firm, maximizing the chance of finding a statistically significant effect. Second, because of their importance, large amounts of data are available on CEOs, increasing data availability and quality. Third, acquiring information about the effects of a CEO has practical relevance for shareholders, as a CEO can be changed or differently incentivized relatively fast.

Like background characteristics of the upper echelons can affect a variety of firm outcomes (Hambrick & Mason, 1984), characteristics of the CEO could affect a firm's expenditures. There is academical evidence that a manager increases in risk-aversity with age (Vroom, Pahl, 1971). A consequence of this could be that CEOs with a longer career horizon are

more inquired to take risk, as they are younger and therefore less risk-averse. This firmly in upper echelons theory nested consequence of age/career horizon is a first indication of the direction of the effect of CEO career horizon on R&D expenditures. However, career horizon in this case only functions as a proxy for age, which is far from its total explanatory value.

3.2 Agency theory

There are multiple articles showcasing that career horizon can not only be used as a proxy for age, but also as a direct cause of effects on firm outcome (Butler & Newman, 1989; Matta & Beamish, 2008; Brickley et al., 1999). In a significant part of career horizon literature, the effects of executive career horizon on firm outcome are considered the outcome of agency theory. Agency theory (Jensen & Meckling, 1976) is the mechanism that explains how in principal-agent problems, agents (in this case: CEOs) can act against the best interest of the principals (in this case: shareholders). Agency theory is a direction in academical literature about which many articles have been written and published. Agency problems are mainly caused by differences in incentives between the principal and the agent (Jensen & Meckling, 1976), and can be reduced by e.g. effective corporate governance (Chen et al., 2012). Thus, not only the way that career horizon affects the incentives of the CEO matters in predicting the existence and direction of an effect. The way career horizon affects the effectiveness of corporate governance matters as well.

3.3 Corporate governance

Butler & Newman (1989) explain how CEO career horizon could affect the effectiveness of corporate governance. The authors write that especially in the final years before retirement, the CEO is able to increasingly serve his own interest. As the CEO cannot be penalized for

suboptimal decision making after his retirement, the CEO is least at risk just before the end of his tenure at the firm. Therefore, CEO career horizon could increase the ability/willingness of the CEO to serve his own best interest especially in the final year(s) before retirement.

Not only the ability of the firm to penalize the CEO seems to decline as the CEO gets closer to the end of his career. As a CEO gets closer to the end of his career while staying at the same firm, his tenure as executive increases as well. In recent literature, increases in CEO tenure have been associated with increases in bargaining power with e.g. the board of directors, resulting in higher compensation, increases in frequency of CEO-chairman duality, and lower board independence (Graham et al., 2017; Hill & Phan, 1991). Using career horizon as a proxy for tenure, the increase in bargaining power of the CEO affects the effectivity of the firm's corporate governance. This negatively affects the mechanism that should reduce or prevent the career horizon agency problem.

3.4 CEO incentives

As a CEO nears retirement, incentives change. Incentives that improve the position of the CEO, like salary increases, decrease in relative value as the end of the tenure in that position comes closer (Yim, 2013). Similarly, the value of financial incentives that affect retirement increase as retirement gets closer. However, not all incentives have to be of a financial nature in order for the CEO to act in a way that acquires or maximizes these incentives.

Vroom & Pahl (1971) administered a choice-dilemma test to managers from a wide variety of companies. They argue that there is a negative relation between manager age and the propensity to take risk. As CEOs get older, the incentives for career stability and security increase, even though these incentives may not be financial in nature.

Matta & Beamish (2008) explain how a CEO nearing the end of his career has increasing incentive to conserve his legacy. As the horizon becomes shorter, the dynamics affecting decision making begin to change. Retirement for many individuals is a moment at which a person's career and achievements can be considered and evaluated. For the CEO, who holds a highly competitive position, it is likely that this moment is of significant personal importance. In evaluation, it is likely that recent experiences (or performance) weigh heavier than earlier experiences (or performance) (Malmendier & Nagel, 2011). This means that a CEO can expect to mainly be evaluated on the later stages of his career. Therefore, a CEO has increased incentive to not take high-risk decisions in the final years of his career.

Prospect theory (Kahneman et al., 1979) explains how gains and losses are valued differently. Nested in behavioral finance, prospect theory is often used to explain how investors rate financial gains and losses. However, it is likely that the same mechanism works in terms of career evaluation; a CEO may value additional gains in terms of e.g. reputation lower than new losses, increasing risk-aversity in the later stages of the CEO's career. Adding to this effect is the mechanism explained by (Kahneman & Lovallo, 2019), that explains how risk-taking is affected by how far away evaluation lies for the decision maker. Since evaluation is closer nearing the end of a career, there is further incentive to become increasingly risk-averse. Furthermore, the CEO cannot undo the effects of wrong decision that was made in the final stage of his career. The inability to undo the effects of a regretted decision adds further risk-aversity in decision making (Josephs et al., 1992). All these effects can be expected to increase risk-aversity as the career horizon becomes shorter, further affecting the propensity to make relatively high-risk investments in areas like research and development.

3.5 Post-retirement incentives

As stated, Josephs et al. (1992) describe how the inability to undo the effects of a regretted decision adds further risk-aversity in decision making. This inability, which increases as the CEO's career horizon becomes shorter, has another consequence of significant importance. Brickley et al. (1999) find that the likelihood of post-retirement board service at the CEO's current firm mainly depends on stock returns, while the likelihood of post-retirement board service at other firms mainly depends on accounting returns. Increases in R&D intensity have been linked to increases in systematic risk and stock price fluctuations (Ho et al., 2004), which increase stock return risk. This means that investing heavily in high-risk areas like R&D could reduce the chance of acquiring a post-retirement board position. Similarly, investing heavily in research that may only return profits after one or multiple years negatively affects accounting returns in the final year(s) of the CEO's tenure. This means that research and development expenditures in the final years of a CEO's tenure could reduce the chance of him acquiring a post-retirement board position on either his current or a different firm. Next to reducing the chance of acquiring a post-retirement board position, investments in research and development further negatively affect CEO evaluation in general, because of the delay between the investment and the payoff that it is expected to deliver.

Combining both corporate governance and the person, financial and non-financial incentives, personal and career consequences, and upper echelons and agency theory, I develop hypothesis 1:

Hypothesis 1: CEOs with a longer career horizon positively affect R&D expenditures.

3.6 CEO wealth preservation

As explained for hypothesis one, CEOs have both intrinsic and extrinsic motivation to reduce risk-taking in the final stages of their careers. At risk for the CEO is not only his reputation and evaluation, but also extrinsic 'rewards' like board positions Brickley et al. (1999). However, these indirect financial incentives are not the only incentives for CEOs to reduce risk-taking and improve accounting returns in the final stages of their careers.

Matta & Beamish, (2008) explain how CEOs nearing retirement not only display legacy conservation behavior, but are also incentivized to preserve their own wealth. A significant portion of the CEO's total income comes from non-salary components of the total compensation package. Components like equity awards and stock options make up a significant share of the total compensation package. While the majority of option grants matures at 5 or 10 years (Hall, 2000), CEO retirement can affect how these incentives are set up, and how they affect the CEO's behavior. Retirement for the CEO is the moment in which the majority of grants and (in-the-money) stock options are converted to cash and shares. This means that the horizon for these grants and options only goes as far as that of the CEO's career. Next to compensation components that can be 'cashed out' at the end of a CEO's tenure, many CEOs have significant stock holdings of the firm that they work at. This means that a significant portion of the CEO's wealth is dependent on both the stock performance (e.g. for stock holdings and stock option holdings) and the accounting returns (e.g. for a bonus component based on accounting returns).

This dependency on firm performance has multiple effects. First, CEOs that have stock holdings and stock option holdings of the firm at which they are employed generally severely lack diversification in their portfolio. This means that they are overdependent on the stock returns of the firm at which they are employed, increasing the incentive to act in a manner that

maximizes stock return during their careers. While this generally is in line with the goal of stock and stock option grants, this mechanism has disadvantages in the final stages of a CEOs career. After all, retirement is a moment at which the CEO 'cashes out'. This means that the CEO is incentivized to maximize the stock price at the moment of his retirement, rather than in the years past his retirement. The same effect can be expected for accounting returns: if a CEO's bonus is determined at the moment of his retirement, then he is incentivized to maximize accounting returns in the final year before his retirement.

Naturally, the degree to which CEOs are incentivized to maximize stock performance depends on the wealth that is at stake for them. Matta & Beamish, (2008) test whether CEOs with larger amounts of wealth at risk are more inclined to preserve that wealth. While Matta & Beamish, (2008)test this in a different context (international mergers and acquisitions), the dynamics underlying the effect are similar; CEOs nearing retirement are inclined to preserve their wealth by reducing risk in the final stages of their career. The reasoning is in line with the reasons mentioned for hypothesis 1; if CEOs are unable to undo the effects of a high-risk decision, possibly resulting in them ending up with negative results before the moment they cash out, they are more likely to not end up choosing those high-risk options. Combining this with the behavioral finance perspective of prospect theory, this effect can be substantial. Also, investments in research and development can take years to return net positive results, which the CEO will not benefit from as these returns will take place post-retirement.

It is therefore not surprising that Matta & Beamish, (2008) find that CEO stock option holdings moderate the effect of CEO career horizon on international mergers and acquisitions. Assuming similar dynamics in a high-risk investment context, I develop hypothesis 2:

Hypothesis 2: CEO stock holdings positively moderate the positive effect of CEO career horizon on R&D expenditures.

Stock holdings are not the only wealth at risk for CEOs in their final years. While changes in the stock price always affect the wealth of the CEO in a very direct way, the dynamics behind stock options valuation differ, both financially and from a behavioral finance perspective. Due to endowment (Thaler, 1980), people tend to value what they already own higher than what they could own. This means that how CEOs perceive the value of their stock options may depend on whether they are in-the-money, as out-of-the-money stock options have no value that can be 'lost'. An exception is the 'loss' of the stock price falling further below the strike price, but that seems closer to losing possible gains than to losing 'endowed wealth' (Thaler, 1980). Next to whether options are in-the-money or not, the value of these options to the CEO is dependent on the time to maturity. Like with stock holdings, retirement is generally a moment at which CEOs 'cash out': as the employment is terminated, CEOs are incentivized to exercise all exercisable (in-the-money) stock options. This means that contrary to stock holdings, which could be (partially) kept after retirement, stock options may have an even more defined evaluation date; the moment at which the CEO retires. Next to the perceived value of stock options being affected by these dynamics, retirement is also the last moment of the CEOs career, so the stock options can be the final contribution to a CEOs post-retirement wealth. While CEOs are relatively wealthy, successful people, the concept of a 'final opportunity' (to increase post-retirement wealth) does not differ for them. Once again, the effect of not being able to undo regretted decisions (Josephs et al., 1992) can strengthen these dynamics, further incentivizing the CEO to make increasingly risk-averse decisions as retirement comes closer.

Next to the previously mentioned effects, most of the argumentation for hypothesis 2 (increased incentive due to low diversification, wealth preservation, and the delay between R&D investments and returns) is also applicable to stock options. Combining career horizon effects with the retirement dynamics of stock options, and endowment and prospect theory (Thaler, 1980; Kahneman et al., 1979) in the risk-related context of R&D investments, I develop hypothesis 3:

Hypothesis 3: CEO in-the-money option holdings positively moderate the positive effect of CEO career horizon on R&D expenditures.

4: METHODOLOGY

In this section of the thesis, I provide the formulas that I use to test the hypotheses and elaborate on the setup of the analysis. I explain which variables I use in the regression and the data sources that I gather the data from. Lastly, I explain which methodology and regressions I employ to produce the statistical results that I draw conclusions from.

4.1 Data and variables

I test the hypotheses using a dataset consisting of 290 firms that were part of the S&P 500 between 2010 and 2020. The amount of firms is similar to Matta & Beamish, (2008), who use a dataset of 293 firms. Which of the S&P 500 firms I include is dependent on data availability for both the firm annuals and the CEO's age and compensation package. The firms come from a variety of industries, but firms active in financial services and utilities were excluded. Data sources in data gathering include COMPUSTAT, ExecuComp, CRSP and the U.S. Treasury Department. However, I only use COMPUSTAT and ExecuComp data in the final regressions due to having to use a dummy variable for CEO stock options holdings, as a consequence of CEO compensation package data availability.

4.2 Equations and variables

In testing the hypotheses, I make use of four different equations. The first equation is developed to test hypothesis 1 (H1), the second equation for hypothesis 2 (H2), and the third for hypothesis 3 (H3). In the first three equations, the hypotheses are tested individually, without the moderator variables from other hypotheses. The fourth equation is the general model, in which the moderator variables of both H2 and H3 are included:

H1: RDEXPit = A + B1*CEOCHit + B6*FSit + B7*FPit-1 + B8*TENit + B9*SALit + B10*BONit + B11*SICit + εit

H2: RDEXPit = A s+ B1*CEOCHit + B2*CEOCHit*STHOLit + B4*STHOLit + B6*FSit + B7*FPit-1 + B8*TENit + B9*SALit + B10*BONit + B11*BDUMit + B12*SICit + εit

H3: RDEXPit = A + B1*CEOCHit + B3*CEOCHit*OPDUMit + B5*OPDUMit + B6*FSit + B7*FPit-1 + B8*TENit + B9*SALit + B10*BONit + B11*BDUMit + B12*SICit + εit

General model: RDEXPit = A + B1*CEOCHit + B2*CEOCHit*STHOLit + B3*CEOCHit*OPDUMit + B4*STHOLit + B5*OPDUMit + B6*FSit + B7*FPit-1 + B8*TENit + B9*SALit + B10*BONit + B11*BDUMit + B12*SICit + εit

RDEXP = Research and development expenditures (logged)

CEOCH = CEO career horizon (inverted, logged)

STHOL = CEO stock holdings

OPDUM = CEO options held dummy

FS = Firm size (logged)

FP = Firm performance

TEN = CEO tenure (logged)

SAL = CEO salary

BON = CEO bonus

BDUM = CEO bonus dummy

SIC = Firm one-digit SIC code

4.3 Dependent variables

Research and development expenditures

The total reported expenditures on research and development in a given year. I gather data from COMPUSTAT.

Research and development expenditures reported (dummy)

This dummy variable measures whether a firm reported its R&D expenditures in a given year. I gather data from COMPUSTAT.

4.4 Independent variables

CEO career horizon

In line with Matta & Beamish, (2008), I calculate the CEO career horizon as the age of 70 minus the age of CEO. CEOs aged over 70 are assigned a score of 0. I invert this variable (highest becomes lowest) to improve readability of the tables. I gather data from ExecuComp.

CEO stock holdings

CEO stock holdings is calculated by multiplying the total amount of shares owned by the share price at the end of the year. I use total CEO stock holdings as an indication of the wealth at risk, in line with Matta & Beamish, (2008). I gather data from ExecuComp.

CEO options held (dummy)

This dummy variable indicates whether a CEO has stock options of the firm in a given year. I gather data from ExecuComp.

4.5 Control variables

Firm size

In line with Matta & Beamish, (2008), I control for firm size through the natural logarithm of the number of employees. I do so because firm size can affect R&D expenditures and a CEO's ability to affect R&D expenditures. I gather data from COMPUSTAT.

Firm performance

In line with Matta & Beamish, (2008), I control for firm performance through the return on assets (ROA) of the previous year. Benartzi & Thaler (1999) show that prior performance can affect risk assessment in decision makers. I gather data from COMPUSTAT.

CEO tenure

I control for CEO tenure to control for the difference between career horizon and tenure effects. Also, tenured CEOs can have more bargaining power through e.g. entrenchment. I measure tenure as the number of years that the CEO has served in his position as a CEO. I gather data from ExecuComp.

CEO salary

In line with Matta & Beamish, (2008), I control for CEO salary in order to control for the wealth of the CEO, as wealth may influence risk-related decision making (Benartzi & Thaler, 1999). I use the natural log of the salary of the CEO. I gather data from ExecuComp.

CEO bonus

In line with Matta & Beamish, (2008), I control for CEO bonus in order to control for the wealth of the CEO, as wealth may affect risk-related decision making (Benartzi & Thaler, 1999). I use the natural logarithm of the bonus of the CEO. I gather data from ExecuComp.

CEO bonus (dummy)

This dummy variable indicates whether a CEO receives a bonus in a given year. I gather data from ExecuComp.

Firm SIC

I control for the firm industry to control for industry effects that can affect R&D expenditures and the CEO's ability to affect R&D expenditures. I control for firm industry based on the firm's one-digit SIC code. I gather data from ExecuComp.

4.6 Analyses and robustness tests

Contrary to Matta & Beamish, (2008), I study a non-binary dependent variable. This means that the logistic regression is not suitable for the research and development expenditures context. More importantly, Cazier (2011) explains how cross-sectional studies on career horizon can lead to incorrect conclusions. In order to not only contribute to understanding on the effects of executive career horizon, but also to the consequences of study design choices, I run four regressions on all four equations/models: an ordinary least squares (OLS) regression controlling for industry effects, a firm fixed effects regression, a firm-CEO fixed effects regression, and for robustness I run a firm-CEO fixed effects regression with clustering for firms.

I do so only after cleaning the data and running probit regressions on the general model for the OLS, the firm fixed effects and the firm-CEO fixed effects designs. I run these probit regressions in order to be able to draw conclusions about potential biases in research and development expenditures reporting.

Before running the probit regressions, OLS and fixed effects regressions, I clean the dataset. Analyzing the variance inflation factor allows me to draw conclusions about multicollinearity. Using a two-digit SIC code results in unacceptably high VIF-values, requiring me to use single-digit SIC codes to control for industry effects. Where required, I center or standardize the data. I perform a Breusch-Pagan test to test for potential heterogeneity. After cleaning the data, I create an RVF plot, which I visually inspect for biases and heterogeneity. I conclude that the dataset after cleaning and adapting where necessary is suitable for the regressions that I run.

5: RESULTS

5.1 Probit regressions

I show the results of the various regressions and elaborate on the tables in which they are summarized in order of the analysis. Table 1 shows the probit regressions. The probit regression with firm fixed effects regresses 537 firms and the firm-CEO fixed effects probit regression regresses 958 unique firm-CEO combinations. As can be derived from the table, (firms with) older CEOs tend to less frequently report research and development expenditures. For the probit regression without fixed effects, and the probit regression with firm-CEO fixed effects, this effect is highly statistically significant ($p < 0.000$), and for the firm fixed effects probit regression, results are less but still significant ($p < 0.10$). This indicates a potential bias that the data might have due to firms choosing to (not) report research and development expenditures.

5.2 OLS regression

The results in Table 2 of the OLS regression with industry fixed effects (at the one-digit SIC code level) without clustering shows no support for hypothesis 1. I find highly statistically significant support for hypothesis 2 in the H2 model. The interaction variable of career horizon and stock holdings stays statistically significant in the general model, which means that the CEO options holdings dummy does not affect the significance of the support for hypothesis 2. While I do find significant support for hypothesis 3 in the H3 model, the statistical significance of the moderator variable disappears in the general model, where the CEO stock holdings moderator variable is present. This loss of significance may be caused by having to use a dummy variable for CEO stock option holdings due to data availability. Overall, I find support for hypotheses 2 and 3 in the OLS, in line with wealth preservation reasoning of Matta & Beamish, (2008).

Table 1. Probit regressions: research and development expenditures reporting (dummy)

	No FE	Firm FE	Firm-CEO FE
CEO career horizon (inverted, logged)	-0.175***	-0.229*	-0.683***
	(0.000)	(0.086)	(0.000)
CEO salary	-0.000	-0.000	-0.000
	(0.256)	(0.880)	(0.856)
CEO bonus	0.000	-0.000	-0.001**
	(0.813)	(0.242)	(0.029)
CEO bonus dummy	0.101	0.162	-0.224
	(0.363)	(0.742)	(0.675)
CEO tenure (logged)	0.001	0.215	0.082
	(0.979)	(0.173)	(0.723)
CEO stock holdings (logged)	0.100***	-0.184	0.073
	(0.003)	(0.218)	(0.739)
Firm size (logged)	0.076***	0.190	0.268
	(0.001)	(0.123)	(0.139)
Firm performance	2.329***	-0.775	4.020*
	(0.000)	(0.691)	(0.069)
CEO options held (dummy)	0.071**	0.092	0.163
	(0.021)	(0.524)	(0.338)
SIC 2	1.603***	17.248***	16.412***
	(0.000)	(0.000)	(0.000)
SIC 3	2.357***	19.093***	18.411***
	(0.000)	(0.000)	(0.000)
SIC 4	-1.355***	-2.363***	-3.864***
	(0.000)	(0.008)	(0.000)
SIC 5	-1.018***	-1.910**	-3.374***
	(0.000)	(0.016)	(0.000)
SIC 6	-0.050	-0.747	-1.470
	(0.762)	(0.519)	(0.219)
SIC 7	0.744***	8.610***	8.969***
	(0.000)	(0.000)	(0.000)
SIC 8	-0.929***	-1.858*	-2.978**
	(0.000)	(0.086)	(0.029)
CEO career horizon (inverted, logged) x CEO stock holdings (logged)	-0.065**	-0.058	-0.119
	(0.012)	(0.589)	(0.428)
CEO career horizon (inverted, logged) x CEO options held (dummy)	0.013	-0.126	-0.123
	(0.657)	(0.338)	(0.430)
Pseudo R-squared	0.5224		
Number of observations	4371	4361	4371

*Correlation is significant at the 0.10 level
**Correlation is significant at the 0.05 level
***Correlation is significant the 0.01 level

Table 2. OLS regression: research and development expenditures

	H1	H2	H3	General model
CEO career horizon (inverted, logged)	-0.001 (0.980)	0.023 (0.464)	-0.019 (0.545)	0.008 (0.794)
CEO salary	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
CEO bonus	0.000 (0.153)	0.000 (0.157)	0.000 (0.189)	0.000 (0.183)
CEO bonus dummy	0.091 (0.439)	0.063 (0.591)	0.082 (0.485)	0.058 (0.622)
CEO tenure (logged)	-0.162*** (0.000)	-0.169*** (0.000)	-0.161*** (0.000)	-0.168*** (0.000)
CEO stock holdings (logged)	0.409*** (0.000)	0.393*** (0.000)	0.407*** (0.000)	0.392*** (0.000)
Firm size (logged)	0.403*** (0.000)	0.399*** (0.000)	0.402*** (0.000)	0.398*** (0.000)
Firm performance	0.697 (0.120)	0.869* (0.052)	0.735 (0.101)	0.890** (0.047)
CEO options held (dummy)	-0.031 (0.332)	-0.032 (0.311)	-0.032 (0.314)	-0.033 (0.299)
SIC 2	0.710*** (0.000)	0.682*** (0.000)	0.720*** (0.000)	0.690*** (0.000)
SIC 3	1.203*** (0.000)	1.190*** (0.000)	1.208*** (0.000)	1.194*** (0.000)
SIC 4	0.602 (0.137)	0.640 (0.112)	0.613 (0.130)	0.646 (0.109)
SIC 5	0.122 (0.671)	0.009 (0.976)	0.098 (0.733)	-0.004 (0.988)
SIC 6	-0.256 (0.450)	-0.242 (0.472)	-0.232 (0.494)	-0.225 (0.504)
SIC 7	1.835*** (0.000)	1.783*** (0.000)	1.841*** (0.000)	1.789*** (0.000)
SIC 8	0.565 (0.243)	0.541 (0.261)	0.558 (0.249)	0.536 (0.265)
SIC 9	1.386*** (0.000)	1.349*** (0.001)	1.397*** (0.000)	1.358*** (0.001)
CEO career horizon (inverted, logged) x CEO stock holdings (logged)		-0.139*** (0.000)		-0.134*** (0.000)
CEO career horizon (inverted, logged) x CEO options held (dummy)			-0.076** (0.026)	-0.055 (0.109)
R-squared	0.3195	0.3272	0.3209	0.3279
Adj. R-squared	0.3145	0.3220	0.3156	0.3224
Number of observations	2337	2337	2337	2337

*Correlation is significant at the 0.10 level
**Correlation is significant at the 0.05 level
***Correlation is significant the 0.01 level

5.3 Firm fixed effects regressions

While the OLS regression (controlling for industry effects) provides support for hypothesis 2 as well as hypothesis 3, the firm fixed effects regression results in Table 3 do not. Controlling for the fixed effects of the firm, I still find no statistically significant effect of CEO career horizon, but also do not find support for hypothesis 2 and hypothesis 3 anymore. As no other changes were made, the results are in line with Cazier (2011), who states that findings on the effects of executive career horizon may be highly dependent on study design. As the firm fixed effects regression is better equipped to accurately regress the effects of the CEO on research and development expenditures, I consider the findings in Table 3 more reliable than in Table 2.

5.4 Firm-CEO fixed effects regression

The firm-CEO fixed effects regression has additional explanatory power over the firm fixed effects regression, as the CEO is the topic of this thesis. It is therefore of significant importance to also control for the fixed effects of the CEO. Like the firm fixed effects regression, the firm-CEO fixed effects regression (Table 4) also does not provide support for hypothesis 2 and hypothesis 3. The firm-CEO fixed effects regression does produce a highly statistically significant effect of CEO career horizon on research and development expenditures. However, the direction of the effect is contrary to the hypothesized effect, and to comparable effects in conventional executive career horizon literature. Results are in line with Cazier (2011) who states that findings on the effects of executive career horizon may be highly dependent on study design. Additionally, the regression results indicate an even more significant mechanism: incorrect cross-sectional study design could not only lead to false positives, but even to statistically significant results in the opposite direction from the ‘real’ effect. Considering the

Table 3. Firm FE regression: research and development expenditures

	H1	H2	H3	General model
CEO career horizon (inverted, logged)	0.016	0.016	0.017	0.017
	(0.366)	(0.366)	(0.337)	(0.334)
CEO salary	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
CEO bonus	-0.000	-0.000	-0.000	-0.000
	(0.491)	(0.489)	(0.495)	(0.494)
CEO bonus dummy	0.100**	0.100**	0.100**	0.100**
	(0.047)	(0.047)	(0.046)	(0.047)
CEO tenure (logged)	-0.051***	-0.051***	-0.051***	-0.051***
	(0.002)	(0.002)	(0.002)	(0.002)
CEO stock holdings (logged)	0.042**	0.042**	0.042**	0.042**
	(0.012)	(0.013)	(0.013)	(0.013)
Firm size (logged)	0.919***	0.919***	0.920***	0.919***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm performance	0.027	0.027	0.026	0.027
	(0.878)	(0.875)	(0.880)	(0.878)
CEO options held (dummy)	0.014	0.014	0.014	0.014
	(0.251)	(0.252)	(0.253)	(0.253)
CEO career horizon (inverted, logged) x CEO stock holdings (logged)		0.001		0.001
		(0.916)		(0.916)
CEO career horizon (inverted, logged) x CEO options held (dummy)			0.005	0.005
			(0.636)	(0.634)
R-squared (within)	0.6416	0.6416	0.6417	0.6417
Adj. R-squared	0.6402	0.6400	0.6401	0.6400
Number of observations	2327	2327	2327	2327
Number of firms	290	290	290	290

*Correlation is significant at the 0.10 level
**Correlation is significant at the 0.05 level
***Correlation is significant the 0.01 level

Table 4. Firm-CEO FE regression: research and development expenditures

	H1	H2	H3	General model
CEO career horizon (inverted, logged)	0.105***	0.108***	0.105***	0.109***
	(0.002)	(0.007)	(0.002)	(0.005)
CEO salary	0.000***	0.000***	0.000***	0.000***
	(0.005)	(0.005)	(0.005)	(0.005)
CEO bonus	-0.000	-0.000	-0.000	-0.000
	(0.658)	(0.651)	(0.664)	(0.655)
CEO bonus dummy	0.047	0.047	0.047	0.047
	(0.198)	(0.196)	(0.201)	(0.199)
CEO tenure (logged)	-0.013	-0.015	-0.012	-0.015
	(0.546)	(0.505)	(0.569)	(0.506)
CEO stock holdings (logged)	0.028	0.028	0.029	0.027
	(0.149)	(0.187)	(0.148)	(0.187)
Firm size (logged)	0.885***	0.886***	0.886***	0.886***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm performance	-0.057	-0.058	-0.057	-0.058
	(0.696)	(0.692)	(0.698)	(0.694)
CEO options held (dummy)	-0.005	-0.004	-0.005	-0.005
	(0.605)	(0.608)	(0.596)	(0.601)
CEO career horizon (inverted, logged) x CEO stock holdings (logged)		-0.003		-0.004
		(0.840)		(0.792)
CEO career horizon (inverted, logged) x CEO options held (dummy)			0.005	0.005
			(0.637)	(0.607)
R-squared (within)	0.6686	0.6686	0.6687	0.6687
Adj. R-squared	0.6673	0.6672	0.6673	0.6672
Number of observations	2337	2337	2337	2337
Number of firm-CEO combinations	517	517	517	517

*Correlation is significant at the 0.10 level
**Correlation is significant at the 0.05 level
***Correlation is significant the 0.01 level

additional explanatory power of the firm-CEO fixed effects regression over the firm fixed effects regression, there is reason to reconsider not only the validity of prior research on this topic, but also of the direction of possible effects found in these earlier studies.

5.5 The consequences of research design

From the OLS to the firm-CEO fixed effects regression: every improvement of the study design drives results further away from the conventional career horizon hypotheses. While the cross-sectional research design provides support for hypotheses 2 and 3, the firm fixed effects regression does not. Even more striking, is that further improvement of the research design by running a firm-CEO fixed effects regression even provides support for an effect in the opposite direction of hypothesis 1. As a robustness test, I run a firm-CEO fixed effects regression with clustering for firms (Appendix, Table 1) to see if further development of the study design provides more explanatory power. Results do not significantly differ from the firm-CEO fixed effects regression. The developments in these regression results are in line with Cazier (2011), with the additions that study design seems to only be improve up to a certain level of accuracy (firm-CEO fixed effects), and that incorrect research design may not only cause false positives, but even effects opposite to the 'real' world effects.

5.6 Discussion

From the regressions, I draw two relevant conclusions about study design and career horizon literature: the found effects are highly dependent on research design and CEO career horizon may not have the effect and direction that prior literature makes it out to have.

The explanation for the dependency on research design is clear, as results are in line with Cazier (2011). The improvements of the study design remove flaws like survivorship bias and age bias in selection of CEOs by firms with e.g. high research and development expenditures. Adding to Cazier (2011), not only cross-sectional study design is flawed for career horizon literature, but which fixed effects are controlled for is of significant effect as well.

There are multiple possible explanations for the results found in the firm-CEO fixed effects regression on the effect of CEO career horizon on research and development expenditures, which turned out contrary to what was hypothesized. A first reason for why there does not seem to be a negative effect, could be that many of the mentioned reasons for the hypothesized direction of the effect mainly affect CEOs close to retirement age. Incentives like a board position may only play a role in e.g. the age 60+ group, as younger CEOs might be too far from retirement to be concerned with a board position. The risk appetite reducing effect of the inability to undo the effects of a wrong decision may not play a role for younger CEOs yet. Also, the 'cash out' nature of retirement will likely not incentivize younger CEOs to try to affect accounting and stock price returns as they are not rewarded and evaluated a year later. It might therefore be interesting to see whether there is an effect for CEOs aged e.g. 62-65.

However, that does not explain the increase in R&D expenditures by CEOs with a shorter career horizon. A possible explanation is that shareholders are able to design CEO compensation packages for CEOs close to retirement in such a way that the CEO is incentivized to maximize long-term stock return effectively. By developing a compensation package that is affected by the years after a CEOs retirement, a CEO could be incentivized to increase expenditures in research and development if he considers that in the long term best interest of the firm. Reduced ability to penalize the CEO for error could enable the CEO to take this higher-risk approach.

6: CONCLUSION

The CEO career horizon effect is nested in upper echelons theory and agency theory (Hambrick & Mason, 1984; Jensen & Meckling, 1976). Prior academical literature focuses on the effects of wealth preservation and legacy conservation, and on the effects of incentives like post-retirement board positions (Matta & Beamish, 2008; Brickley et al. (1999). Next to financial, career and legacy incentives, the career horizon effect can also be explained by career horizon being a proxy for age, and thus propensity to take risk.

However, Cazier (2011) notes that the results of prior literature may be highly dependent on study design. Cross-sectional study design may cause false positives that wrongly provide support for CEOs with a shorter career horizon adopting lower-risk strategies. I combine a conventional CEO career horizon hypothesis (expecting a positive effect of CEO career horizon on R&D expenditures) with two moderator variables (stock holdings and stock option holdings). In the high-risk investment setting of research and development expenditures, I test the hypotheses using increasingly elaborate study designs. By combining additional moderator variables to the research and development expenditures context with a variety of study designs, I contribute to both our understanding of the (perceived) effects of executive career horizon and to our understanding of the consequences of study design. The practical contribution of this thesis is that shareholders will be better able to judge whether they should take CEO career horizon into account when selecting a CEO or deciding on executive compensation.

The OLS controlling for industry effects (Table 2) provides support for hypothesis 2 and hypothesis 3, which combine CEO career horizon with stock holdings and stock option holdings, respectively. The results of this regression are statistically significant, and in the hypothesized direction. Results are also in line with Matta & Beamish, (2008), who test for the moderating

effects of stock holdings and stock options holdings in the international acquisitions context. Improving the explanatory power of the study by using a firm fixed effects regression (Table 3), I find no support for hypotheses 1, 2 or 3. The disappearance of the support is in line with Cazier (2011), who explains that survivorship bias and age bias in CEO selection by highly R&D intensive firms cause a bias in the cross-sectional study design.

Further improving the explanatory power of the study design by using a firm-CEO fixed effects regression (Table 4), I find an effect of CEO career horizon on research and development expenditures. However, the direction of this statistically significant effect is contrary to what is hypothesized based on 'conventional' career horizon literature. An explanation is that Cazier (2011) was not only right about the cross-sectional study design causing false positives in prior literature, but that cross-sectional study design may even reverse the direction of the real-world effect due to the size and significance of the underlying biases. Further developing the study design, for example by combining the firm-CEO fixed effects regression with firm clustering (Appendix, Table 1), does not produce significantly different results from the firm-CEO fixed effects regression.

The implications of this thesis are twofold. First, a significant portion of prior academical literature requires reconsideration not only for whether the study design is cross-sectional or not, but also for whether the fixed effects of the CEO at a given firm where controlled for. This could affect the academical understanding on the effects of executive career horizon. Second, the results from the firm-CEO fixed effects regression indicate that there is no reason to believe that CEOs with a shorter career horizon curtail research and development expenditures. Rather, the opposite seems to be true. Additionally, I find no reason to believe that stock holdings or stock option holdings affect the effect of CEO career horizon on R&D expenditures.

7: LIMITATIONS

This thesis has several methodological limitations. First, the sample consists of S&P 500 firms in the years 2010-2020. The sample therefore only includes U.S. firms, and only a period in which the U.S. economy (proxied by e.g. GDP growth) was in almost uninterrupted upturn. The sample therefore reduces generalizability of the thesis. Also, the CEO is only one member of the firm, and often is an extreme in terms of compensation package. Therefore, the findings cannot be directly translated to e.g. other members of the top management team or middle management. Like Matta & Beamish, (2008) I control for tenure and salary, but additional CEO characteristics that affect the propensity to take risk like the need for achievement (Papadakis et al., 1998) could increase the explanatory power of the study. Also, the probit regressions indicate that the data contains a bias, as CEO career horizon seems to affect whether research and development expenditures are reported. Lastly, due to data availability, I am forced to use a dummy variable for stock option holdings, which in this study I consider suboptimal compared to a continuous variable like the value of the options held by the CEO. This could affect the results found in e.g. the OLS regression, where the significance of the stock options moderator variable is nullified in the general model. While the OLS regression is the study design with the least explanatory power, an improvement in the analysis on this moderator variable would be valuable in comparing the different study designs.

8: SUGGESTIONS FOR FURTHER RESEARCH

While I find results that are in line with Cazier (2011), it is no certainty that the effects that have been found in prior academical literature do not really exist. While it seems that the majority of the discovered effects may be caused by data biases that the cross-sectional study design cannot remove, a positive effect of executive career horizon on risk-taking may still exist. There is evidence that CEOs in the retirement age (62-65) group are more likely to sell the firm (Jenter & Lewellen, 2015). A suggestion for further research would be to look at career horizon effects of CEOs in this age range, as it is closest to retirement. For this group, wealth preservation and legacy conservation incentives would be strongest. Similarly, the design of the compensation package of CEOs nearing retirement could be studied by looking at whether certain compensation packages are better suited to incentivize CEOs to focus on long term stock returns.

Also, replicating and adjusting the prior studies on executive career horizon that employ a cross-sectional design could lead to relevant insights. By replicating these studies, but changing the study design to one where CEOs are tracked over time, insight into whether the originally discovered results truly are a result of biases in the data and incorrect study design can be gained.

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10: APPENDIX

Appendix A:
Firm-CEO FE regression with firm clustering: research and development expenditures

	H1	H2	H3	General model
CEO career horizon (inverted, logged)	0.105***	0.108***	0.105***	0.109***
	(0.002)	(0.007)	(0.002)	(0.006)
CEO salary	0.000***	0.000***	0.000***	0.000***
	(0.005)	(0.005)	(0.005)	(0.005)
CEO bonus	-0.000	-0.000	-0.000	-0.000
	(0.657)	(0.650)	(0.662)	(0.654)
CEO bonus dummy	0.047	0.047	0.047	0.047
	(0.204)	(0.202)	(0.207)	(0.204)
CEO tenure (logged)	-0.013	-0.015	-0.012	-0.015
	(0.553)	(0.517)	(0.576)	(0.518)
CEO stock holdings (logged)	0.028	0.028	0.029	0.027
	(0.152)	(0.191)	(0.151)	(0.192)
Firm size (logged)	0.885***	0.886***	0.886***	0.886***
	(0.000)	(0.000)	(0.000)	(0.000)
Firm performance	-0.057	-0.058	-0.057	-0.058
	(0.700)	(0.697)	(0.703)	(0.699)
CEO options held (dummy)	-0.005	-0.004	-0.005	-0.005
	(0.607)	(0.610)	(0.597)	(0.603)
CEO career horizon (inverted, logged) x CEO stock holdings (logged)		-0.003		-0.004
		(0.842)		(0.794)
CEO career horizon (inverted, logged) x CEO options held (dummy)			0.005	0.005
			(0.639)	(0.610)
R-squared (within)	0.6686	0.6686	0.6687	0.6687
Adj. R-squared	0.6673	0.6672	0.6673	0.6672
Number of observations	2337	2337	2337	2337
Number of firm-CEO combinations	517	517	517	517

*Correlation is significant at the 0.10 level
**Correlation is significant at the 0.05 level
***Correlation is significant the 0.01 level