CEO INCENTIVES AND INFORMATION TECHNOLOGY INVESTMENTS: AN EMPIRICAL INVESTIGATION

Research in Progress

T. Ravichandran, Rensselaer Polytechnic Institute, USA, ravit@rpi.edu.

Zhao, Liang, Rensselaer Polytechnic Institute, USA, zhaol11@rpi.edu.

Abstract

As digitization plays an increasingly important role in business success, CEOs are increasingly responsible for the digital strategy of their firms. However, limited studies have explored the antecedents of IT investment, an important aspect of a firm's digital strategy. Drawing on the behavioral agency theory, we propose that CEO incentives are key drivers of IT investment, and each equity pay element of a CEOs has a different effect on IT investment. Analysing longitudinal data of 477 U.S. firms from 1999 to 2006, we find that stock option granted is positively related to IT overinvestment, but restricted stock granted is negatively related to IT overinvestment. Furthermore, we posit and find that the effect of CEO incentives on IT overinvestment is contingent upon firm slack. Our results show that firm slack positively moderates the relationship between stock option granted and IT overinvestment, but negatively moderates the relationship between restricted stock granted and IT overinvestment. We discuss the theoretical and practical implications of our findings and draw guidelines for future research.

Keywords: IT investment, CEO incentives, equity pay elements, firm slack.

1 Introduction

Digitization has been a major technological phenomenon that has transformed businesses and industries over the last three decades. This has fuelled a growth in resources allotted to information technology (IT) by firms. At the macro level, IT investments grew at an annual rate of more than 20% throughout the 1990s, which is five times the growth of other industrial investments (Doms, 2004). At the firm level, IT investments as a proportion of firm revenues nearly doubled to 7.6% in 1999 from 4.2% in 1996 (Meta Group Research Report, 2002) and have remained around 3% after a decline in 2000. In 2011, the number increased from 3.6% to 4.9%, and remained over 5% until now (SIM IT Trend Study, 2017).

As digitization plays an increasingly important role in business success, senior executives such as CEOs are directly involved in and responsible for the digital strategy in firms (Bharadwaj et al. 2013). They oversee and direct IT resource allocation as this is a critical strategic lever to shape digital strategies. While the evolving technological landscape offers firms novel opportunities to leverage IT to compete, they also escalate the resources firms commit to IT. In fact, long-term trends suggest that IT has become the largest capital investments firms make each year, has in fact substituted for other investments such as R&D and plant and equipment (Mithas et al 2012).

A critical question facing executives is: how much resources to allocate towards IT? Some firms invest more intensively in IT than others with significant variance seen in the intensity with which even firms in the same industry invest in IT. Research exploring these differences have argued that IT investment decisions are influenced by institutional pressures (Ravichandran et al. 2009), which can vary across firms. Others have argued that IT investments are an interplay between environmental determinism and strategic choice where managerial interpretation of environmental demands influence the level of IT investments (Ravichandran and Liu 2011). However, these studies assume a rationalist perspective and do not account for agency issues in managerial decision making. When it is well established that R&D (Devers 2008, Wu and Tu 2007) and other capital investment decisions (Devers 2008) are influenced by agency problems, we should expect that IT investments would be subject to similar influences. In fact, given the risks associated with investing in IT (Dewan et al. 2007) and the time lags in realizing returns from investments (Brynjolfsson 1993) we could expect agency problems to have a more salient role in IT investment decisions. However, limited research has examined the effect of these internal factors on IT investment decisions. The pressures on CEOs to respond to technological opportunities have often led to over investments in IT in the past. To better align IT investment priorities with the long-term value for firms in the current wave of digitization characterized by analytics, IoT and artificial intelligence, one has to understand if and how the incentives for CEOs influence their IT resource allocation decisions.

In this study, we explore if and how CEOs incentives influence their IT resource allocation decisions. Specially, we examine how the various long-term CEO pay elements influence a firm's IT overinvestment. Behavioural agency scholars have argued that elements of a CEOs compensation package might entail differential risk properties, which might trigger dissimilar behaviour (Bryan et al. 2000, Sanders 2001, Devers et al. 2008). Hence, we examine how the different pay elements in CEOs compensation package influence their IT investing behaviour. In addition, the effect of CEO incentives on IT investment is contingent upon the extent to which organizational slack can buffer the downside risks. Therefore, we explore if and how organizational slack modulates the effects of CEO pay elements on IT investments. We empirically test our hypotheses using a longitudinal archival data of US firms. Our data spans from 1999 to 2006 and is an unbalanced panel of over 600 firm-year observations. We find that CEO stock option granted is positively associated with overinvestment in IT, while CEO restricted stock pay is negatively related to IT overinvestment. Furthermore, we find that firm slack positively moderates the relationship between CEO incentives and IT overinvestment.

2 Theoretical Framework and Hypothesis

2.1 Theoretical Background

We draw from behavioural agency theory to develop our research model. According to agency theory, the goals of executives and shareholders and the risk to achieve them might be different. While shareholders seek to maximize the returns on their investments and the overall firm valuation, executives might have more instrumental goals focused on their personal and professional development. A large body of work in corporate governance has explored how to align the goals of the executives with those of the shareholders. The primary focus of this stream of research has been on compensation structure that can shape managerial behaviours by aligning their incentives to shareholder goals (Jensen and Meckling 1976).

2.2 Agency Conflicts in IT Investment

When it comes to IT investing, the agency problems manifest in two ways: shirking and over investing. Since monitoring managers' behaviours is costly due to information asymmetry, it is not uncommon that both types of agency problems exist in the contexts of strategic decisions such as resource allocation towards IT.

IT investment involves risk, which vary based on the nature of the investment. Infrastructural and transactional IT investment might entail lower risks compared to strategic and information IT investments (Aral and Weill, 2007). In particular, investment in emerging technologies in pursuit of innovative business models involves significant risks as these technologies are likely to be immature, costly, and uncertainties about their likelihood of becoming well established exists. On the other hand, proactive investment in emerging technologies allows firms to gain first mover advantages. Similarly, while infrastructural investments are less risky, their payoff may not be quick and firms could easily overspend without concomitant returns.

CEOs face the daunting task of allocating scarce resources among competing priorities. Given the higher risk inherent in IT investments, there would a natural tendency to underinvest to minimize the risk exposure (Christensen, 1981; Holmstrom and Weiss, 1985; Lambert, 1986; Hirshleifer and Suh, 1992). Such shirking behaviors while beneficial in the short run could be detrimental in building IT capabilities that could be a source of competitive advantage.

Moreover, strategic IT investments take time to pay off and studies have found that minimum time lags of three to five years have to be expected for IT investment to manifest in performance outcomes for firms (Brynjolfsson 1993, Anderson et al. 2003). In the short run, the negative cash flow could deter CEOs to shirk and under invest in IT. Finally, IT initiatives are prone to failures. Examples of firms going bankrupt because of failed ERP implementation highlight the distinct possibility of firms facing disruptions in their business because of IT project failures. Such failures do get wide coverage in the press and can affect a CEOs reputation. This can also lead to shirking and underinvesting in IT.

On the other hand, CEOs may also overinvest in IT. IT investments have been found to positively impact firm profitability more than other expenditures such as those in plant and equipment and R&D (Mithas 2012). Other findings that suggest that IT investments allows firms to mitigate the diseconomies of scale and address diminishing returns to scale (Ravichandran et al., 2017) also provides a strong motivation to allocate significant resources towards IT. These findings and others could lead to a certain level of overconfidence among executives and thereby lead to excessive resource allocation towards IT.

Furthermore, IT investment decisions could also be driven by institutional pressure from stakeholders (Ravichandran et al. 2009). Firms that do not invest in IT, might be delegitimized by its stakeholders and, such pressures could lead CEOs to allocate resources towards IT, irrespective of the whether such investments align with firm needs or not.

2.3 CEO Pay Elements and IT investment

Increasingly CEOs play an important role in developing the digital strategy of their firms and in allocating resources towards IT (Ravichandran and Liu 2011). While CEOs may not be directly involved in specific investment processes, it is often their responsibility to determine the level of IT spending and how intensely the firms want to pursue digitization. As discussed above, this resource allocation decision might be subject agency conflicts.

One solution to this agency cost is to align the incentives for the CEO with that of the shareholders by structuring their long-term compensation packages (Jensen and Meckling, 1976; Jensen and Murphy, 1990). However, the long-term compensation contracts are complex. While some researchers have argued that the pay elements in the long-term contract are substitutable incentives (Agrawal and Mandelker 1987, Jensen and Murphy 1990, Mehran 1995), other scholars also found that equity pay elements affect risk behaviour differently. For example, Bryan et al. (2000) demonstrated that whereas stock options are efficient incentives, restricted stock seems to increase CEO's risk aversion. However, Bebchuk and Fried (2003) find that stock options might stimulate CEOs to take too much risks and lead to an overinvestment problem. The different influence of equity pay elements implies that combining the pay elements into long-term packages may generate unclear effects on CEO's IT investment behaviour. These findings also question the traditional agency theory-based practice that use a single measure of incentive pay (Devers et al. 2008). Accordingly, we extend the traditional approaches by examining the relationship between different pay elements and IT investment. Our conceptual model is depicted in Figure 1.

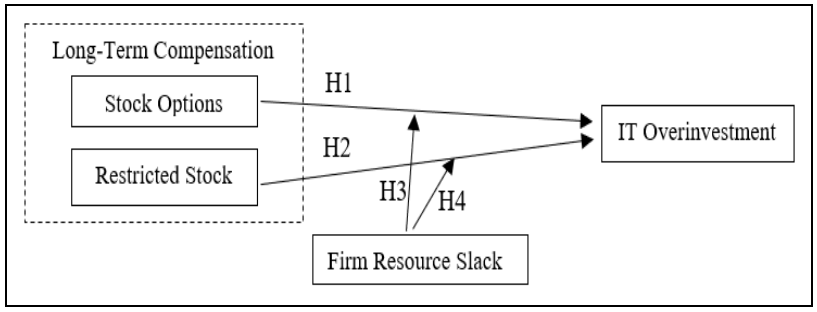

Figure 1. Conceptual Model

Stock option is one of the individual pay elements in a long-term compensation package. The stock options in CEO's compensation package provide CEO the right, but not the obligation, to purchase a certain number of firm shares (Murphy 1990). A stock option is "in the money" when the stock price is above the exercise price, and "out of money" when the stock price is below the exercise price. A CEO doesn't have any obligation when the option is out of money, and nearly have zero cost to acquire a stock option. Stock options provide holders with the opportunities to earn the potential wealth but limit the risk of losing current wealth (Lawler 2000, Sanders 2001). Therefore, we argue that CEO stock options is likely to cause an overinvestment. First, a stock option is only "in the money" when the stock price is over the exercise price (Lawler 2000, Sanders 2001). CEOs have to show positive signals to boost the stock price. Investment in IT aims to increase both effectiveness and efficiency of firm operation, and firms that invest more in IT tend to have higher profitability (Mithas 2012). Hence, CEOs with high stock option pay may have the incentive to allocate more resources to IT. Second, stock options provide upside wealth potential but limited downside risks and, hence entrenched CEOs are stimulated to take more risks. At the same time, the limited downside risks result in inefficient use of resources and incur empire building. Hence, we propose the following hypothesis:

> ***Hypothesis 1:*** *CEO stock option granted will be positively associated with the level of IT overinvestment.*

Restricted stock is another pay element in a long-term payment package. Restricted stock, grants CEOs a specific number of shares without an exercise price (Milkovich and Newman 2002). The value of equity ownership is readily accessible, and the CEO may value the wealth already in the pocket more highly. Hence, the CEO has both upside potential and downside risks (Parrino et al. 2005).

Previous research based on agency theory posits that stock holdings are positively associated with long-term investments (e.g., Mehran 1995). However, according to the behavioural agency theory, researchers argue that stock holdings may initiate risk aversion and are negatively related to risky expenditures (e.g. R&D, Devers et al. 2008). The finding of Hall and Murphy (2002) suggests that CEOs value restricted stick more highly than stock options. Moreover, Bryan et al. (2000) found that fast growing firms intend to use stock options instead restricted stock to stimulate CEOs. These findings suggest that CEO may become more risk averse when holding higher value of restricted stock. Thus, we predict that restricted stock pay is likely to have a negative effect on IT overinvestment.

> ***Hypothesis 2:*** *CEO restricted stock granted will be negatively associated with the level of IT overinvestment.*

2.4 Moderating Effects of Firm Slack

The discussion above suggests that CEO stock option pay positively affect overinvestment in IT, while CEO restricted stock has a negative effect on IT overinvestment. However, our paper argues that IT investment behaviour is more than a simple function of compensation incentives and is contingent upon other contextual factors such as organizational slack. The literature about organizational slack provides two opposite perspectives on the effect of slack resources on risk-taking behaviour: the buffer argument and the waste argument (Nohria and Gulati 1996). The buffer argument believes that the accumulation of organizational slack is the result of prior good performance and offers the potential resources for innovative behaviours (Bourgeois, 1981). Hence, there is a positive relationship between firm slack and IT investment. On the other side, some scholars argue that organizational slack might be a waste. The waste argument believes that slack resources will increase managerial self-interest (Child 1972, Leibenstein 1966, Nohria and Gulati 1996). Managers will be less disciplined in terms of valuation with excessive slack resources (Nohria and Gulati 1996). Therefore, it may increase the risk of wasting the buffer with inefficient resource allocation. This view indicates a negative relationship between firm slack and IT investment return. However, from an IT input perspective, excess slack will enable expenditure no matter whether the project will generate net present values or not. Therefore, both the buffer argument and the waste argument anticipate a positive relationship between firm slack and IT spending. The existence of slack provides incentivized CEOs with more resources to invest in IT. Moreover, slack can cushion the firm from downside risks and potential losses because of risks inherent in IT investments. Therefore, we hypothesize:

> ***Hypothesis 3:*** *CEO stock option granted will be more positively associated with IT overinvestment when firm slack is higher.*
>
> ***Hypothesis 4:*** *CEO restricted stock granted will be less negatively associated with IT overinvestment when firm slack is higher.*

3 Methods

Our data for this research was compiled from three primary resources, *InformationWeek (IW)*, *EXECUCOMP*, and *COMPUSTAT*. First, we obtained a proxy for the level of IT investment from *InformationWeek*, a leading and widely circulated IT publication in the United States. The survey tracks information about strategies, investments, and administrative practices of IT at firm level. The *InformationWeek* data has been used extensively in prior research (Bharadwaj et al. 1999, Mithas and Rust 2016). Second, we collected CEO compensation data from *EXECUCOMP* database. Third, we obtained firm-level measures from the *COMPUSTAT* database, which contains 10-K report data for all publicly traded corporations. Our final data set consists of 477 firms for which complete data on key variables of interest were available from 1999 to 2006. The total number of observations is 610 because we do not have data on all firms over each of the six years in our study.

3.1 Dependent Variable

IT overinvestment measures the level of resource allocated to IT that is above (or below) typical norms for a firm. We measure IT overinvestment as the difference between the actual IT spending and a predicted value for IT spending for each firm. Predicted value is determined as follows:

$$\widehat{IT\ investment}_t = \alpha_0 + \alpha_1 CF_t + \alpha_2 Q_{t-1} + \alpha_3 IT\ investment_{t-1} + \alpha_4 IT\ Industry\ Investment_t$$

$$IT\ Overinvestment_t = (Actual\ IT\ Investment_t - Predicted\ IT\ Investment_t)^1$$

3.2 Independent Variables

In measuring long-term compensation, we measured both option granted and restricted stock granted. Two equity-based variables are included in our model: the value of stock option granted and the value of restricted stock granted. These two variables are measured as the nature log of their cash value as reported in the firm's proxy statement. We use unabsorbed slack because unlike absorbed slack, unabsorbed slack is more flexible, which is critical for supporting investments.

	Mean	Std.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Difference	0.2253	3.7203	1.0000																
Overinvestment	0.4701	0.4994	0.8813	1.0000															
CEO Gender	0.9927	0.0854	-0.0218	-0.0273	1.0000														
Industry IT Investment	2.7553	0.8348	0.0778	0.1011	-0.0330	1.0000													
Firm Age	69.4712	47.4300	0.0145	0.0123	-0.0355	0.0871	1.0000												
Firm Size	2.9529	1.2132	0.1889	0.2060	-0.0453	-0.0632	0.1006	1.0000											
Firm Diversification	0.0245	0.0563	0.0601	0.0843	0.0125	-0.3418	-0.0542	0.4064	1.0000										
Sarbanes-Oxley Act	0.4009	0.4902	-0.0967	-0.1157	-0.0759	0.0155	0.0095	0.0055	-0.0506	1.0000									
Sales Growth	10.3485	25.5851	-0.0429	-0.0072	0.0381	0.0058	-0.1096	-0.0135	0.0654	-0.1792	1.0000								
Salary	6.5884	0.8347	0.0883	0.1132	-0.0322	0.1156	0.0849	0.2550	0.1033	0.0753	0.0288	1.0000							
Bonus	6.7611	0.9574	0.0537	0.0918	-0.0397	0.1485	0.0810	0.3223	0.1357	0.1078	0.1357	0.3533	1.0000						
Option Held	8.7490	1.9152	0.0787	0.1073	0.0150	0.1235	-0.0483	0.2304	0.1533	-0.0511	0.1895	0.0934	0.4343	1.0000					
Restricted Stock Held	2.6200	4.5832	-0.0213	0.0248	-0.0834	0.0415	0.2134	0.1784	0.0333	0.0594	-0.0615	0.1690	0.1756	0.0076	1.0000				
Option Granted	7.7490	1.2654	0.0863	0.1157	-0.0057	0.1882	-0.1302	0.3334	0.1101	0.0940	0.1193	0.1545	0.4451	0.5462	0.0472	1.0000			
Restricted Stock Granted	2.3886	3.1394	-0.0277	-0.0095	-0.0630	0.0077	0.1183	0.1240	0.0439	0.0689	-0.0511	0.1190	0.1893	0.0103	0.5584	0.0833	1.0000		
Free Cash Flow/Asset	0.0311	0.0757	-0.0552	-0.0586	-0.0051	0.0649	-0.0697	-0.0690	-0.0686	0.1580	-0.0429	-0.0538	0.0414	0.1967	-0.0394	0.1078	-0.0021	1.0000	
DE Ratio	4.2828	43.6233	0.0874	0.0582	0.0202	0.0521	-0.0019	0.0476	-0.0011	-0.0151	0.0117	-0.0053	0.0062	0.0054	-0.0020	0.0111	-0.0017	-0.0321	1.0000

Note. if cor ⩾ 0.044 then p < 0.01; if cor ⩾ 0.054, then p < 0.05

Table 1. Descriptive Statistics and Correlation Matrix

Several variables are included in our model to control for CEO, firm, and industrial characteristics. First, to control for possible individual level effects, we account for CEO age and gender as both have been shown to affect risk preference in prior research (MacCrimmon and Wehrung 1986). Second, we control for the CEO wealth held by including option held and restricted stock held. Both are calculated using the Black–Scholes Model. Third, we include three firm level control variables: firm age, firm size, and firm diversification. Firm size is measured using log number of employees, and the firm diversification is obtained by calculating the *Herfindahl* index. We also took a natural log of all the compensation measures to control for the skewness problem, including CEO stock option pay, CEO restricted stock, and CEO short-term salary. In addition, we controlled for the firm's past year IT investment, sales growth and dummies to account for the instruction of the Sarbanes-Oxley Act and industry dummies. All independent and control variables were lagged 1 year behind the dependent variable. *Table 1* presents the descriptive statistics and correlation matrix among the variables in our model.

3.3 Empirical Considerations

Several issues can lead to biased and inconsistent results when panel data models are estimated with ordinary least squares (OLS) regression. First, our aim to examine the effects of incentives on IT investment may cause endogeneity issue. It is quite likely that option pay is partly determined by IT investment strategy and firm performance. In order to control for the endogeneity, we use two-stage least squares (2SLS) in our paper. The estimated value of option granted is calculated by regressing

[1] Negative values indicate underinvestment

CEO stock option pay and restricted stock in $t-1$ on firm and executive characteristic in $t-1$ and on industry and year dummies. We write our first stage regressions with instrumental variables as follows:

$$\widehat{Option\ Granted}_{t-1} = \beta_0 + \beta_1 age_{t-1} + \beta_2 Tenure_{t-1} + \beta_2 Duality_{t-1} + \beta_4 Stock\ Volatility_{t-2}$$

$$\widehat{Restricted\ Stock\ Granted}_{t-1} = \beta_0 + \beta_1 age_{t-1} + \beta_2 Tenure_{t-1} + \beta_2 Duality_{t-1} + \beta_4 Stock\ Volatility_{t-2}$$

In addition, Heteroskedastic error terms and autocorrelation can also bias estimates (Certo and Semadeni 2006). Hence, fixed-or random-effects models are used in panel data. Results from a Hausman (1978) specification test indicated that the random-effects model is the comparatively appropriate choice for our data ($\chi 2 = 24.38$, $p < 0.001$), which is consistent with past studies that have examined other strategic decisions (Beckman 2006, Beckman et al. 2004, Gulati 1995, Lavie and Rosenkopf 2006, Sanders and Hambrick 2007). Fixed-effects models reduce the degrees of freedom, can be biased for panels over short time periods (Hsiao 1986, Chintagunta et al. 1991), such as our data and limit the use of time-independent control variables, such as industry sectors. In addition, random-effects models are preferred, if X_{it} and X_{it-1} are correlated (Johnston and DiNardo, 1997). For these reasons, we use random effects models in our analysis.

4 Results

We ran two regression models, one with the level of overinvestment (underinvestment) as the dependent variable and the other a logit using a dummy to indicate if the firm overinvested or not. *Table 2*. presents the results from both these models. In general, our control variables behave as expected. Female executives are more prudent than male executives in IT investing. Firm age exhibits a positive association with overinvestment and Sarbanes-Oxley Act negatively affects the IT overinvestment.

Hypothesis 1 predicts a positive relationship between stock option granted and overinvestment. Consistent with our prediction, the base term for the value of stock option granted is positive ($p < 0.05$) in our random-effects model and logit model. By contrast, Hypothesis 2 predicts a negative effect of restricted stocks pay on overinvestment. In our model, the value of restricted stock granted has a significant negative relationship ($p < 0.05$). Thus, Hypothesis 2 is supported. Hypothesis 3 posits that firm slack will positively moderate the association between the value of stock option pay and IT overinvestment. The interaction between unabsorbed slack and stock option granted is positive but not significant in our random-effects model. However, the interaction between unabsorbed slack as measured by the debt to equity ratio and stock option granted is significant at 10% level. Hence, our result provides partial support for Hypothesis 3. Finally, we find that unabsorbed slack measured using the debt to equity ratio is ($p < 0.05$) positively moderate the relationship between restricted stock and overinvestment. Therefore, Hypothesis 4 is partially supported.

5 Discussion

This study offers several findings that contribute to our understanding of the influence of executive incentives on IT spending. Although the antecedents of IT investment and digital strategies are enduring topics in IS literatures (Mithas et al. 2013, Ravichandran et al. 2009, Ravichandran and Liu. 2011), few research focuses on how CEO incentives may help explain variation in IT investments in organizations. Our study sheds light on how and why CEO incentives may impact IT investment decisions, especially overinvestment. Furthermore, we also show that the links between CEO incentives and IT investment are contingent upon the firm slack. Several key implications emerge from our results.

	Overinvestment	Overinvestment	Overinvestment Dummy	Overinvestment Dummy
CEO Gender	-2.467***	-2.688***	-1.109	-1.256
	(0.767)	(0.893)	(0.800)	(0.799)
Industry IT Investment	-2.059	-2.071	-1.305	-1.367
	(1.815)	(1.749)	(0.832)	(0.841)
Firm Age	0.0156***	0.0158***	0.0126***	0.0126***
	(0.00202)	(0.00215)	(0.00293)	(0.00295)
Firm Size	-0.0413	-0.0886	-0.0783	-0.101
	(0.164)	(0.139)	(0.157)	(0.162)
Firm Diversification	5.448	6.281	5.801	6.274
	(6.833)	(5.976)	(4.585)	(4.675)
Sarbanes-Oxley Act	-1.754***	-1.762***	-1.193***	-1.226***
	(0.201)	(0.189)	(0.395)	(0.401)
Sales Growth	-0.0187*	-0.0196**	-0.0112**	-0.0121**
	(0.00958)	(0.00962)	(0.00473)	(0.00485)
Salary	-0.927	-1.165	-0.817	-0.995*
	(1.027)	(0.957)	(0.545)	(0.557)
Bonus	-0.879***	-0.942***	-0.627***	-0.645***
	(0.219)	(0.246)	(0.204)	(0.211)
Option Held	-0.0563	-0.0545	-0.0450	-0.0422
	(0.104)	(0.104)	(0.0585)	(0.0584)
Restricted Stock Held	0.00299	0.00579	0.0302	0.0338
	(0.0177)	(0.0185)	(0.0263)	(0.0266)
Option Granted	2.803***	3.111***	2.137***	2.413***
	(0.576)	(0.529)	(0.452)	(0.497)
Restricted Stock Granted	-0.0721*	-0.0649	-0.0635*	-0.0634
	(0.0397)	(0.0623)	(0.0353)	(0.0406)
Free Cash Flow/Asset	-3.484*	12.38	-2.847*	2.123
	(1.855)	(20.37)	(1.551)	(13.00)
DE Ratio	0.0170**	0.258	-0.0113	0.478*
	(0.00821)	(0.279)	(0.0139)	(0.253)
Option Granted × FCF/A		-2.211		-0.807
		(2.530)		(1.673)
Option Granted × DE		-0.0260		-0.0588*
		(0.0355)		(0.0310)
Restricted Stock Granted × FCF/A		0.385		0.378
		(1.009)		(0.441)
Restricted Stock Granted ×DE		-0.00742*		-0.00563
		(0.00447)		(0.00546)
Constant	-4.716	-4.873	-4.775	-5.440*
	(5.163)	(5.857)	(2.907)	(2.951)
Model	Random Effects	Random Effects	Logit	Logit
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Observations	610	610	610	610
R-Squared	0.1919	0.1947		

DV: We took log on IT Overinvestment, and negative values indicate underinvestment.
For negative values of IT Overinvestment, we took log on its absolute value and multiplied by (-1).
*Robust standard errors in parentheses. Significant at *10%, **5% and ***1% level.*
Industry dummies were also included but in interest of space, their estimates are not shown.

Table 2. Effects on Overinvestment

First, not all the equity-based pay has the same effect on IT investment. In concert with our theoretical arguments, we find evidence that different equity-pay elements have distinct impact on IT expenditures. In particular, our results demonstrate that the higher value of stock option granted has a positive relationship with IT overinvestment. This finding suggests that as the option pay increases, the risk aversion (shirking) will be reduced. However, it increases the risk of empire building. In contrast to stock options granted, our results show a negative association between the value of restricted stock pay and IT overinvestment. According to the general agency theory, the interest of CEO will be aligned with shareholders through equity ownership, and restricted stock pay will encourage risk taking behaviour. However, our finding indicates that restricted stock granted will increase the risk aversion, rather than incentivize risk taking behaviour. Our result implies that there is a trade-off between option granted and restricted stock pay when it comes to their effects on IT investing behaviours and call for a more nuanced view.

Our second implication is that the impact of CEO incentives on IT overinvestment can be influenced by factors outside the compensation contract, such as firm slack. Although CEO incentives appear to affect firm's IT expenditures, the resources a firm holds might also moderate the relationship between individual equity-based pay and IT overspending, suggesting firm slack plays an important role in IT investment decision making. In general, we argue that resource slack will positively moderate the association between CEO incentives and IT overinvestment.

In conclusion, understanding the antecedents of IT investment decisions is critical in IT business value research. Our study provides the insights on the interplay between IT investment and CEO pay elements. We shed light on the complexity inherent in CEO long-term compensation and highlight how the link between CEO pay and IT spending is contingent on other factors such as firm slack. Taken together, we believe that our findings provide significant implication for scholars and practitioners on how to drive IT investment via CEO compensation as a mechanism.

References

Agrawal, A. and Mandelker, G.N. (1987). Managerial incentives and corporate investment and financing decisions. The journal of finance, 42(4), 823-837.

Anderson, M., Banker, R. and Hu, N. (2003). The impact of information technology spending on future performance. ICIS 2003 Proceedings, 47.

Ang, S. and Straub, D.W. (1998). Production and transaction economies and IS outsourcing: a study of the US banking industry. MIS quarterly, 535-552.

Aral, S. and Weill, P., 2007. IT assets, organizational capabilities, and firm performance: How resource allocations and organizational differences explain performance variation. Organization Science, 18(5), pp.763-780.

Bebchuk, L.A. and Fried, J.M., 2003. Executive compensation as an agency problem. Journal of economic perspectives, 17(3), pp.71-92.

Beckman, C. M. (2006). The influence of founding team company affiliations on firm behaviour. Academy of Management Journal, 49: 741–758.

Beckman, C. M., Haunschild, P. R., and Phillips, D. J. (2004). Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. Organization Science, 15: 259–275.

Bharadwaj, A.S., Bharadwaj, S.G. and Konsynski, B.R. (1999). Information technology effects on firm performance as measured by Tobin's q. Management science, 45(7), 1008-1024.

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A. and Venkatraman, N.V. (2013). Digital business strategy: toward a next generation of insights.

Bourgeois, L.J. (1981). On the measurement of organizational slack. Academy of Management review, 6(1), 29-39.

Bryan, S., Hwang, L. and Lilien, S. (2000). CEO Stock ‐ based Compensation: An empirical analysis of incentive ‐ intensity, relative mix, and economic determinants. The Journal of Business, 73(4), 661-693.

Brynjolfsson, E. (1993). The productivity paradox of information technology. Communications of the ACM, 36(12), 66-77.

Brynjolfsson, E. and Hitt, L. (1996). Paradox lost? Firm-level evidence on the returns to information systems spending. Management science, 42(4), 541-558.

Brynjolfsson, E. J., Malone, T., Gurbaxani, V., and Kambil, A. (1994). Does information technology lead to smaller firms? Management Science, 40(2), 1628–1644.

Certo, S.T. and Semadeni, M. (2006). Strategy research and panel data: Evidence and implications. Journal of Management, 32(3), 449-471.

Child, J. (1972). Organizational structure, environment and performance: The role of strategic choice. sociology, 6(1), 1-22.

Chintagunta, P.K., Jain, D.C. and Vilcassim, N.J. (1991). Investigating heterogeneity in brand preferences in logit models for panel data. Journal of Marketing Research, 417-428.

Christensen, J. (1981). Communication in agencies. Bell Journal of Economics, 12, 661-674.

Dewan, S., Shi, C., and Gurbaxani, V. (2007). Investigating the risk–return relationship of information technology investment: Firm-level empirical analysis. Management science, 53(12), 1829-1842.

Dewan, S., and Ren, F. (2007). Risk and return of information technology initiatives: Evidence from electronic commerce announcements. Information Systems Research, 18(4), 370-394.

Devers, C.E., McNamara, G., Wiseman, R.M. and Arrfelt, M. (2008). Moving closer to the action: Examining compensation design effects on firm risk. Organization Science, 19(4), 548-566.

Doms, M. (2004). The boom and bust in information technology investment. FRBSF Economic Review, 19–34.

Eisenhardt, K.M. (1989). Agency theory: An assessment and review. Academy of management review, 14(1), 57-74.

Fama, E.F. (1980). Agency Problems and the Theory of the Firm. Journal of political economy, 88(2), 288-307.

Gulati, R. (1995). Social structure and alliance formation patterns: A longitudinal analysis. Administrative Science Quarterly, 40: 619–652.

Hall, B.J. and Murphy, K.J. (2002). Stock options for undiversified executives. Journal of accounting and economics, 33(1), 3-42.

Han, S. and Ravichandran, T. (2006). Does IT impact firm innovativeness: An empirical examination of complementary and direct effects. AMCIS 2006 Proceedings, 91.

Hausman, J.A. 1978. Specification tests in econometrics. Econometrica: Journal of the Econometric Society, 1251-1271.

Hirshleifer, D and A Thakor. (1992). Managerial conservatism, project choice and debt. Review of Financial Studies, 5, 437-50.

Hirshleifer, D and Y Suh (1992). Risk, managerial effort, and project choice. Journal of Financial Intermediation, 2, 308-345.

Hsiao, C. (1986). Analysis of Panel Data, Econometric Society Monograph No. 11.

Holmstrom, B and L Weiss., 1985. Managerial incentives, investment and aggregate implications. Review of Economic Studies, 52, 403-426.

Im, K. S., Dow, K. E., and Grover, V. (2001). Research report: A re-examination of IT investment and the market value of the firm—an event study methodology. Information Systems Research, 12(1), 103–117.

Jensen, M.C. and Meckling, W.H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of financial economics, 3(4), 305-360.

Jensen MC. and Murphy KJ. (1990). CEO incentives: it's not how much you pay, but how. Harvard Bus Rev, 68:138–53.

Jensen, M.C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. The American economic review, 76(2), 323-329.

Johnston, J., and DiNardo, J. (1997). Econometric methods (4th ed.): New York: McGraw Hill.

Lambert, R. 1986. Executive effort and selection of risky projects. Rand Journal of Economics, 17, 77-88.

Lawler III, E.E. (2000). Rewarding excellence: Pay strategies for the new economy. Jossey-Bass.

Lavie, D. and Rosenkopf, L. (2006). Balancing exploration and exploitation in alliance formation. Academy of Management Journal, 49(4), 797-818.

Leibenstein, H. (1966). Allocative efficiency vs." X-efficiency". The American Economic Review, 392-415.

Loveman, G.W. (1994). An assessment of the productivity impact of information technologies. Information technology and the corporation of the 1990s: Research studies, 84-110.

Mehran, H. (1995). Executive compensation structure, ownership, and firm performance. Journal of financial economics, 38(2), 163-184.

Meta Group Research Report. (2002). *Worldwide IT Benchmark Report 2003*. Stanford, CT: Meta Group.

Milkovich, G. T., J. M. Newman. (2002). Compensation, 7th ed. McGraw-Hill, Irwin, Boston.

Mithas, S. and Rust, R.T. (2016). How Information Technology Strategy and Investments Influence Firm Performance: Conjecture and Empirical Evidence. MIS Quarterly, 40(1), 223-245.

Mithas, S., Tafti, A., Bardhan, I. and Goh, J.M. (2012). Information Technology and Firm Profitability: Mechanisms and Empirical Evidence. MIS Quarterly, 36(1), 205-224.

Mithas, S., Tafti, A., Bardhan, I. and Goh, J.M. (2012). The impact of IT investments on profits. MIT Sloan Management Review, 53(3), 15.

Murphy, K. J. (1999). Executive compensation. O. Ashenfelter, D. Card, eds. Handbook of Labor Economics, Vol. III. North Holland, New York.

Nohria, N. and Gulati, R. (1996). Is slack good or bad for innovation? Academy of management Journal, 39(5), 1245-1264.

Parrino, R., A. M. Poteshman, and M. S. Weisbach. (2005). Measuring investment distortions when risk-averse managers decide whether to undertake risky projects. Financial Management, 21–60.

Rai, A., Patnayakuni, R. and Patnayakuni, N. (1997). Technology investment and business performance. Communications of the ACM, 40(7), 89-97.

Ravichandran, T. and Liu, Y. (2011). Environmental factors, managerial processes, and information technology investment strategies. Decision Sciences, 42(3), 537-574.

Ravichandran, T., Han, S. and Hasan, I. (2009). Effects of institutional pressures on information technology investments: An empirical investigation. IEEE Transactions on Engineering Management, 56(4), 677-691.

Ravichandran, T., and Lertwongsatien, C. (2005). Effect of information systems resources and capabilities on firm performance: A resource-based perspective. Journal of management information systems, 21(4), 237-276.

Ravichandran, T., Han, S., & Mithas, S. (2017). Mitigating diminishing returns to R&D: The role of information technology in innovation. Information Systems Research.

Richardson, V. J., and Waegelein, J. F. (2002). "The Influence of Long-Term Performance Plans on Earnings Management and Firm Performance," Review of Quantitative Finance and Accounting (18:2), 161-183.

Sanders WG. (2001). Behavioural responses of CEOs to stock ownership and stock option pay. Acad Manage J(44), 477–92.

Sanders, W.G. and Carpenter, M.A. (2003). Strategic satisficing? A behavioural-agency theory perspective on stock repurchase program announcements. Academy of Management Journal, 46(2), 160-178.

Sanders, W.G. and Hambrick, D.C. (2007). Swinging for the fences: The effects of CEO stock options on company risk taking and performance. Academy of Management Journal, 50(5), 1055-1078.

SIM 2017 IT Trend Study. (2017). Society for Information Management 2017.

Wu, J. and Tu, R. (2007). CEO stock option pay and R&D spending: a behavioural agency explanation. Journal of Business Research, 60(5), 482-492.