Journal of Financial Economics 102 (2011) 643–670

Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

The influence of governance on investment: Evidence from a hazard model ☆

Matthew T. Billett [a], Jon A. Garfinkel [a,*], Yi Jiang [b]

[a] Tippie College of Business, University of Iowa, United States
[b] Mihaylo College of Business and Economics, California State University, Fullerton, United States

ARTICLE INFO

Article history:
Received 29 September 2009
Received in revised form
18 November 2010
Accepted 30 January 2011
Available online 20 July 2011

JEL classification:
G32
G34
J33

Keywords:
Corporate governance
Investment spike
Hazard model

ABSTRACT

Does corporate governance affect the timing of large investment projects? Hazard model estimates suggest strong shareholder governance may deter managers from pursuing large investments. Controlling for investment opportunities, firms with good governance experience longer spells between large investments. However, in the presence of financial constraints or strong CEO incentives (high delta (δ)), we find no such timing differences. Finally, these higher investment hazard firms exhibit significantly negative long-run operating and stock performance. Overall, our findings are consistent with the notion that poor governance associates with overinvestment.

1. Introduction

Does corporate governance affect the efficiency of firm investment? Empirical evidence is relatively clear when investment occurs in the form of an acquisition. For example, Lewellen, Loderer, and Rosenfeld (1985) show that bidder announcement returns are increasing in managerial ownership. More recently, Masulis, Wang, and Xie (2007) show that acquirers with worse governance experience more negative announcement returns to their bids. Both suggest that poor governance associates with less efficient investment decisions.

By contrast, the evidence is less clear when the investment is "built" via capital expenditures. Harford, Mansi, and Maxwell (2008) find evidence that poor governance associates with greater industry-adjusted investment, as does Richardson (2006). By contrast, Bertrand and Mullainathan (2003) and Giroud and Mueller (2010) suggest poor governance associates with underinvestment. It is difficult to draw sweeping conclusions regarding the relationship between governance and (directional) investment efficiency from such disparate results.

One problem with ascertaining the precise relation between governance and the efficiency of built investment is that firms need not announce internal investments, severely limiting the usefulness of event study approaches.[1] Instead, most studies use regressions of investment on proxies for investment opportunities. "Optimal" investment suggests investment opportunities should be the only significant determinant of investment. If investment is found

☆ We thank Paul Hribar, Mark Leary (the referee), Erik Lie, and Anand Vijh for many helpful comments and suggestions. All remaining errors are our own.
* Corresponding author.
E-mail addresses: matt-billett@uiowa.edu (M.T. Billett), jon-garfinkel@uiowa.edu (J.A. Garfinkel), yjiang@fullerton.edu (Y. Jiang).

0304-405X/$ - see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.jfineco.2011.07.004

[1] An exception is Chen (2006), who studies capital expenditure announcements by single-segment vs. diversified firms. There is no analysis of the influence of governance.

to depend on additional factors (such as cash flow, governance, leverage, etc.), then this may be interpreted as an inefficiency.

This approach, however, has been argued to suffer from a number of problems with regard to empirical implementation and interpretation of results. Numerous studies raise serious concerns about how to properly measure firm-specific investment opportunities, and how measurement error may bias the coefficients and inferences.[2] Second, there is significant evidence that the time-series of investment is lumpy rather than smooth.[3] This pattern of investment behavior violates a necessary assumption built into linear regressions of investment on *Q*: convex adjustment costs that are both differentiable and quadratic.

Whited (2006) proposes an empirical approach that alleviates the concerns of potential measurement error in proxies for investment opportunities and the lumpy nature of investment. She uses a hazard model to study the frequency of large investments (''spikes''), and the ''spells'' between spikes. Grouping firms by proxies for whether or not they are likely to be financially constrained, she compares the intertemporal pattern of investment spikes. Constrained firms have lower investment hazard rates (i.e., longer spells between investment spikes) than unconstrained firms, consistent with the importance of finance constraints.

We adapt Whited's (2006) approach to include governance. We use several proxies for the quality of a firm's corporate governance. However, our primary results are based on the ''*G*-Index'' of Gompers, Ishii, and Metrick (2003), which is designed to proxy for manager entrenchment by measuring firm use of anti-takeover provisions.[4] We group firms by whether they have a high or low *G*-Index, and estimate hazards on each group's investment behavior. High *G*-Index firms have more than the median number of ''insular'' (anti-takeover) provisions.

Two hypotheses predict the investment hazards of high *G*-Index firms will lie above those of low *G*-Index firms. Either entrenched managers (high *G*-Index) have a greater tendency to overinvest,[5] leading to a greater frequency of investment spikes, or strong shareholder protection (low *G*-Index) could suboptimally limit investment leading to less frequent large investment spikes (underinvestment). By contrast, it is possible that hazards will be *lower* for entrenched managers (high *G*-Index), if they prefer the ''quiet life.''[6]

We find that the investment hazards for high *G*-Index firms lie above those for low *G*-Index firms. A well-established form of weak shareholder protection (managerial entrenchment), associates with more frequent investment spikes. This leads to our first contribution: to use the hazard methodology to alleviate the influence of measurement error issues and the lumpy nature of investment, and shed light on the conflicting conclusions found in the literature. Our results are consistent with the conclusions in Harford, Mansi, and Maxwell (2008) and Richardson (2006), but without the serious concerns raised above with respect to a linear regression framework.

We then control for the effects of financial constraints. Since Whited (2006) shows that financial constraints reduce investment hazards, our results may be driven by less managerial entrenchment among financially constrained firms. We therefore stratify our sample based on both *G*-Index and whether the firm faces financial constraints. We find that unconstrained firms with more anti-takeover provisions spike most frequently, and the difference between this group and all others is significant (while there is no difference between these other groups' hazards).

These results suggest corporate governance and finance constraints interact to influence investment behavior. To date, little work has focused explicitly on this possibility.[7] Of particular interest is our finding that (one form of) good governance reduces the hazard (lengthens the time between spikes) among financially unconstrained firms. This suggests that precisely where managers may have greater opportunity to overinvest, governance plays a positive role. Also interesting is the result that the hazard rates of well-governed financially unconstrained firms are indistinguishable from well-governed financially constrained firms (as well as poorly governed constrained firms). It suggests that the impact of financial constraints appears to be most pronounced in the subgroup of firms with weak governance. Both governance and financial constraints appear to play important roles in explaining firms' investment patterns.

So what drives the difference in the hazards? How do we distinguish between the two possible interpretations that poor governance associates with ''overinvestment'' or strong governance associates with ''underinvestment''? We take two different approaches to gain insight on which interpretation carries more empirical weight. First, we focus on an alternative shareholder-manager alignment (i.e., governance) mechanism—a CEO incentives measured by delta (δ).[8] If unconstrained, high *G*-Index firms overinvest, then perhaps CEOs with higher deltas should be less inclined to overinvest given their stronger ties to shareholder outcomes.[9] In this case, among the unconstrained and high *G*-Index firms, we would expect

[2] See, for example, Erickson and Whited (2000), Bond and Cummins (2001), Cooper and Ejarque (2001) and Cummins, Hassett, and Oliner (2006).

[3] See, for example, Doms and Dunne (1998).

[4] This is in deference to its near ubiquitous use in the governance literature. Also, related work by Harford, Mansi, and Maxwell (2008) focuses on this metric. Our inferences are the same under alternate measures of executive insulation from the consequences of poor decision outcomes.

[5] In the spirit of Harford, Mansi, and Maxwell (2008) or Richardson (2006).

[6] For e.g., Bertrand and Mullainathan (2003) or Giroud and Mueller (2010).

[7] A notable exception is Bøhren, Cooper, and Priestley (2007). They orthogonalize governance with respect to financial constraints in recognition that the two may be correlated. However, they do not examine whether the two types of constraints (governance and financial) substitute in their influence on investment. Moreover, their inferences rely on a linear regression framework.

[8] This also recognizes that a firm's overall governance structure is a function of many factors, including corporate charter and compensation structures.

[9] There is an implicit assumption about CEO deltas and optimal investment incentives in this statement. We address it below.

to see lower investment hazards for the subgroup with *high CEO deltas (δ)*.

Partitioning the data into eight groups (based on unconstrained/constrained, high/low *G*-Index, and high/low CEO δ's), we find the following: unconstrained, high *G*-Index firms with low-delta CEOs have the highest investment hazards. These hazards differ significantly from all other groups' hazards. CEO pay incentives appear to curtail overinvesting tendencies when managers are not restricted by financial constraints or other forms of corporate governance. However, this interpretation assumes higher CEO incentives (δ) encourage optimal investment. It is also possible that high-delta CEOs are less diversified and prefer the "quiet life," suggesting underinvestment remains a possibility. Endogeneity and omitted variables could also drive the correlations between investment hazards, governance, and incentives. To better address these concerns, we conduct two additional sets of tests.[10]

In the first set of tests, we explore the relation between investment hazards and governance pre- and post- the implementation of Sarbanes-Oxley (SOX). This shock to governance allows us to see whether any association between governance and investment hazards was driven by an endogenous choice of governance. If the passage of SOX improves the governance of high *G*-Index firms relative to low *G*-Index firms, then we would expect to see the investment hazards for these two groups to be closer post-SOX. We find that post-SOX, there is no significant difference between the hazards of poor governance firms and well-governed firms. Moreover, we find that SOX lowered the investment hazards of poor governance firms significantly, while having no effect on the investment hazards of strong governance firms. Particularly where SOX should have an effect (reducing investment where it was likely overdone), it appears to. Overall, the SOX analysis suggests the full sample results are unlikely to be driven by omitted variables or endogeneity.

In our second set of tests we examine the long-run operating and stock return performance of firms following spike investments. Our tests based on future stock returns are particularly unlikely to suffer from endogeneity or omitted-variables concerns (see Section 5 for more detail). We segment our analysis by the same eight groups (based on governance, financial constraints, and CEO δ's) noted above. We find negative ex-post operating and stock performance among unconstrained, high *G*-Index, low CEO pay-incentive firms. If this group were pursuing optimal investment policies, we should not find such poor performance. Moreover, we do *not* find poor ex-post operating or stock performance among the other groups. Overall, our evidence suggests that poor governance, particularly among unconstrained firms with low CEO pay incentives, permits overinvestment.

In sum, there is contradictory evidence in the literature regarding the role of corporate governance in affecting investment via capital expenditures. We utilize a hazard model and study the relation between large investment frequency and managerial entrenchment, financial constraints, and CEO pay-based incentives. We find that strong governance lengthens the spell between investment spikes. We further find that the group of highest hazard firms (financially unconstrained firms with entrenched managers and low CEO pay-based incentives) underperform in both operating performance and stock returns following the large investment, while other firms do not.

Some of our conclusions confirm prior studies (and contradict others), which raises the question of the importance of our contribution. Again, we want to stress the problematic nature of making inferences from investment regressions. In the Appendix, we show that inferences from linear regressions of investment on governance (and other typical variables) are *not* robust to controls for measurement error. When we estimate linear regressions of investment on governance quality, we find that worse governance associates with greater investment. But when we control for measurement error using the techniques in Erickson and Whited (2000), this result disappears. Moreover, we know very little about how the non-normal/lumpy nature of investment biases inferences from regression results. Thus, prior conclusions about the influence of governance on investment may be tenuous. In this context, our conclusions regarding the general effect of governance on investment (without conditioning on financial constraints and/or CEO incentives) are different from a re-examination of views in the extant literature. Finally, by studying the influence of financial constraints, governance, and CEO incentives in a hazard framework, combined with analysis of post-investment outcomes, we are able to conclude that poor governance associates with overinvestment, rather than strong governance associating with underinvestment.

2. Background

Section 2.1 discusses the extant literature on investment efficiency and the potential influence of governance on it. Section 2.2 tightens the focus to more directly link with our tests. Specifically, we discuss Whited's (2006) model that underpins her empirical link between finance constraints and investment behavior. We do so with an eye toward understanding how governance may impact over- or underinvestment to alter the expected hazards. In Section 2.3, we discuss our approach to distinguishing between overinvestment and underinvestment explanations for governance's effect on large investment hazards.

2.1. *Investment efficiency and the effect of governance*

Numerous papers examine overinvestment from a mergers and acquisitions standpoint. Roll's (1986) hubris hypothesis and Jensen's (1986) free cash flow hypothesis offer two perspectives where firms overinvest in purchasing a target firm, either because they are overconfident about their ability to create value or because they would rather empire-build than pay out excess cash flow. Evidence in support of these forms of overinvestment is found in Lang, Stulz and Walkling (1991) and Hietala, Kaplan, and Robinson (2003). Good governance has been shown to mitigate

[10] Omitted variables are less of a concern given that we find the relation between investment hazards and governance is only within the unconstrained groups. Thus, any omitted-variable explanation would have to apply only to unconstrained firms.

value-destructive mergers and acquisitions (see Lewellen, Loderer, and Rosenfeld, 1985; Masulis, Wang, and Xie, 2007). What is unclear is whether governance can curb overinvestment that occurs internally (built investment), as in the case of mergers and acquisitions (bought investment).

The work on mergers and acquisitions is primarily based on event-studies. It is more difficult to conduct such studies for internal investment where there may not be announcements and the information content may be released over time. Instead, we follow the existing literature that looks at the level of investment and the timing of large investment. We have discussed the merits and drawbacks of these approaches above. However, there are additional caveats to using both investment regressions as well as investment hazards that we need to recognize.

First, by focusing on over- and underinvestment as quantity/frequency-based phenomena, rather than an asset substitution phenomena (Galai and Masulis, 1976; Childs and Mauer, 2008) we cannot address whether governance affects all characterizations of overinvestment. For example, our approach would not detect whether a firm substitutes a high risk negative NPV project in place of a low risk positive NPV one.[11] Rather, our approach focuses on whether governance influences the frequency of undertaking large projects, and it is designed to detect situations where managers speed up or delay undertaking large investments. This means we must quantify large investments, introducing additional caveats.

Several empirical papers study large internal investments. Mayer and Sussman (2005), Whited (2006), and Elsas, Flannery, and Garfinkel (2008) all define large investments as investment spikes: cases where capital expenditures are large relative to the firm's own history of investments. We also take a similar time-series perspective to identify investment spikes. For robustness, we examine investment spikes where investment is measured relative to the firm's industry. If a firm suffers from investment agency issues, they might consistently invest suboptimally. In this case, a time-series investment spike approach may not capture the over/under investment. The more appropriate efficient investment-level benchmark may be the industry median level. Thus, we also measure investment relative to the industry median and identify investment spikes on a year-by-year basis.[12]

Does good governance affect investment efficiency? Viewing the country's legal environment as a macro-indicator of governance, Giannetti (2003) finds that investment funds are more obtainable when investor rights are better protected. This suggests that governance and financial constraints interact. It also suggests that underinvestment is less likely to be a problem among strong-governance firms given Whited's (2006) evidence that reduced financial constraints encourage investment.

At the firm-level, Harford, Mansi, and Maxwell (2008) and Richardson (2006) interpret their results as good governance discouraging overinvestment. Gompers, Ishii, and Metrick (2003) show that capital expenditures are increasing in their *G*-Index, and reach a similar conclusion. Again, however, all of the above results are based on linear regressions. Our re-estimation of the relation between governance and investment behavior, using linear regression and the Erickson and Whited (2000) correction, yields no significant relation between the two.

By contrast, Bøhren, Cooper, and Priestley (2007) conclude that poorly governed firms underinvest—in pursuit of the "quiet life" while well-governed firms invest more. They control for financial constraints in their regressions using the KZ-indez (see Kaplan and Zingales, 1997). The nature of their test requires measuring investment levels relative to the optimal investment level. They recognize measurement error issues and try to address them by using a theoretically motivated sales-to-capital ratio. Given the ambiguous results shown across studies using tests based on investment levels [conflicting results in Bøhren, Cooper, and Priestley (2007) and the (noted above) non-robust results in Harford, Mansi, and Maxwell (2008) and Richardson (2006)], adding information based on the intertemporal pattern of investment is likely to be useful.

2.2. How might governance influence investment behavior?

Whited (2006) models optimal investment behavior in a setting with costly external finance. We discuss how one might incorporate shareholder-manager conflicts to affect testable implications on investment behavior. We begin with a summary of the existing model.

Whited (2006) assumes a profit-maximizing firm with concave revenue. Shocks to either demand or productivity (revenue) arrive following a first-order Markov process. A profit-maximizing firm without external finance requirements optimally invests in a lumpy fashion due to the fixed costs of adjusting the capital stock. In other words, the firm finds it optimal to invest only when its capital stock is sufficiently far from the desired level. The firm waits during the interval between spikes to economize on these lump-sum costs. Given non-trivial fixed costs, "enough" opportunity to invest must arrive (and this can take time, leading to lumpy investment) to clear this hurdle.[13]

Whited (2006) incorporates costly external finance by forcing the firm to pay a premium (increasing in the amount of external capital raised) above the cost of internal finance. Given costly external finance, the firm adjusts its capital stock less frequently than if it had sufficient internal funds to take all profitable investments. Given the added hurdle, greater investment opportunities must arrive or accumulate (over time) to exceed the combined higher cost. Thus, financially constrained firms

[11] We do, however, present very preliminary evidence on risk changes around large investments for two subsamples of firms. These results are presented to address alternative interpretations of our main hazard-based inferences.

[12] Empirical work that measures the efficiency of a firm's investment relative to the industry median includes Rajan, Servaes, and Zingales (2000) and numerous other studies. They are measuring the efficiency of investment levels whereas we are using it to measure the frequency of exceeding the benchmark. This is discussed in more detail below.

[13] Adjustment costs need not be solely fixed. Cooper and Haltiwanger (2006) contemplate both fixed and convex costs and also generate upward-sloping hazards.

(those with higher fixed costs of adjustment) will have longer spells between large (new) investments.

We think of agency costs in the following fashion. Investment opportunities arrive as in Whited's (2006) model. However, managerial opportunities to over- or underinvest also arrive over time. In fact, the arrival of investment opportunities and opportunities to over- or underinvest may be correlated. We discuss overinvestment opportunities first.

Suppose investment opportunities are perfectly correlated with overinvestment opportunities. In this case, a firm might correctly recognize when it is time to expand (say, due to an industry shock), but it over-expands each time to take advantage of the opportunity to build a larger empire. Thus, each time the firm invests, its expenditure is larger. Given that our analysis identifies large (spike) investments based on a quantity rule (the investment must exceed a benchmark), more investment spikes are likely to result.[14]

It is also possible that investment opportunities could be negatively correlated (or uncorrelated) with overinvestment opportunities. In this case, firms would spike more frequently because some spikes are driven by the arrival of large investment opportunities, while others are driven by overinvestment tendencies. Again, we would expect more frequent investment spikes if agency-based overinvestment is a concern.

On the other hand, underinvestment is possible every time an investment opportunity arrives. The manager can simply choose to delay or forego the opportunity. If underinvestment is prevalent in our data, we expect to find lower hazards (less frequent spikes) in such cases.

In sum, regardless of the various potential correlations between arrivals of investment opportunities and overinvestment opportunities, they can increase the observation of large (spike) investments relative to a model without empire-building agency concerns. Also, underinvestment should present as fewer or less frequent spikes in our data.

So what is the effect of strong governance on investment tendencies? We take a view similar to Whited's (2006) characterization of finance constraints. If strong governance imposes some extra cost on suboptimal investment decisions, then we expect the following. When the predominant agency concern is overinvestment, the manager of a well-governed firm is less likely to overinvest, lowering the hazard.[15] The case of underinvestment is more subtle. It may actually be caused by strong-governance structures, if such structures entail additional costs to undertaking any large investment. For example, managers might need additional time to convince all constituencies regarding the merits of a large investment in a more democratic environment. This would similarly lower the large investment hazard. The upshot is that lower hazards for large investments among strong-governance firms may be interpreted as evidence of either mitigation of overinvestment tendencies or realization of underinvestment outcomes.

2.3. *Distinguishing between overinvestment and underinvestment*

The above discussion implies that strong governance may result in lower hazards either because it reduces overinvestment tendencies, or it exacerbates delays in project approval (underinvestment). Distinguishing between the two is critical for the choice of optimal governance structure among firms that typically face different investment problems. For example, if a firm is financially unconstrained, there is a potential benefit to strong governance *if such strong governance discourages overinvestment*.

We approach this problem in two ways. First, we investigate the influence of an alternative incentive alignment mechanism to distinguish whether strong governance is limiting overinvestment or causing underinvestment. We study CEO deltas (δ). Higher deltas should encourage managers to undertake value-enhancing projects and avoid value-destructive ones.[16] In other words, they force the CEO to bear greater personal costs of overinvestment and should thus curb such activity. If the highest hazards (most frequent investment spikes) prevail among the sample of financially unconstrained firms with poor governance and low CEO incentives (δ), this suggests that weak governance associates with overinvestment.

Second, we study post-large investment outcomes. An implication of inefficient investment is poor performance ex post. We analyze both operating performance and stock returns over the several years following large investments, categorized by membership in one of the eight groups discussed above. If unconstrained firms with entrenched managers who have low deltas show evidence of significantly negative long-run operating and/or stock return performance, this is consistent with the overinvestment hypothesis. If there is no evidence of underperformance, this suggests efficient investment. An advantage of this latter approach is that it allows us to assess the empirical validity of the assumption that higher deltas encourage acceptance of positive NPV projects and discourage acceptance of negative ones. Performance (returns in particular) should reflect the efficiency of investment policy.

3. Data and descriptive statistics

Our primary measure of corporate governance strength uses the corporate governance index of Gompers, Ishii, and Metrick (2003) for the period 1990–2007 from RiskMetrics (formerly IRRC).[17] The governance index (*G*-Index) measures the number of anti-takeover provisions in a firm's charter, with values ranging from

[14] In this case, industry-based benchmarks (such as industry median investment rate) may be more likely to capture the large investment spikes.

[15] For example, ex post, poor investment decisions may carry significant pecuniary penalties in well-governed firms.

[16] Again this is an assumption. As noted earlier, we present confirmatory evidence below.

[17] Again, our robustness checks entertain alternative governance strength proxies: CEO pay slice and whether the CEO is also chairman.

zero to 24. Gompers, Ishii, and Metrick (2003) establish that a larger G-Index is an indication of poor corporate governance.

We use Standard & Poor's ExecuComp to construct the variables characterizing CEO incentives. Our primary measure of CEO incentive is delta (δ), which measures the sensitivity of stock value to a 1% change in stock price. We use the method of Core and Guay (2002) to estimate delta.

Our sample is comprised of firms with G-Index and CEO incentive (δ) data that also meet the following Compustat data requirements [largely adopted from Whited (2006)]. We delete any observations for which total assets (#6), the gross capital stock (#7), or sales (#12) are either zero or negative. To minimize the influence of outliers, we winsorize the following measures at the full sample's 1% and 99% tails of the distribution: Rate of investment (#30 minus #107, divided by #6), sales growth (#12 minus lag #12, all divided by lag #12), cash flow (#18 plus #14, all divided by #6), total assets (#6), Tobin's Q (#6 minus #60, plus #25 times #199, all divided by #6), and leverage (#9 plus #34, all divided by #6). We exclude utility firms (SIC=4900–4999) and financial firms (SIC=6000–6999). We require the investment rate to be higher than the rate of depreciation.

The resulting sample consists of between 710 and 1,497 firms per year. However, Whited (2006) shows that the aggregation of asynchronous actions across business units can smooth firm-level investment and reduce estimated hazard rates.[18] This aggregation bias likely rises with firm size. To ameliorate this issue, following Whited (2006) we focus on a subsample of small firms because they have less aggregation bias. We define small firms as those with real assets below the 33rd percentile of the real assets of firms in the first year that the test firm appears in the sample.

There is a trade-off involved in our decision to focus on small firms.[19] The advantage is that we ameliorate aggregation issues which would inhibit our ability to detect investment spikes (in general, not just the relation between spikes and governance). However, our approach also implies that the composition of the samples does not change. This implies that some firms which enter our sample as "small" may grow quickly and become not-small, but remain in our sample. A third consideration (one that encourages our approach) is that it avoids sample selection issues that may arise because we would select only slow-growth firms. On net, we believe the advantages far outweigh the disadvantages of focusing on small firms. After imposing the small-firm sampling criteria, we have between 278 and 569 firms per year over 1990–2007.

We create a dummy variable indicating whether a sample firm faces financial constraints. We define a firm-year observation as constrained if it pays no dividend that year. We also classify firms according to their governance characteristics. A firm is defined as a high (low) G-Index firm if its governance index is above (below) the median G-Index of all firms in the first year that the test firm appears in the sample.

We must measure whether a firm experiences an investment spike in each year of the sample period. Again following Whited (2006), we define a spike to be any occurrence where the firm's ratio of capital expenditures-to-assets exceeds a threshold of two times the firm's own median investment rate over the entire sample period. Our results are robust to examining investment spikes defined by any occurrence where capital expenditures-to-assets exceeds a threshold of two times the industry median ratio in a given year.

Our hazard estimation requires both an investment spike and its spell, where spell is defined as the length of time since the firm's prior spike. Given the finite period of our sample, not all firm-year observations and not all investment spikes are included in the estimation. First, we do not have information on the spell length for the firm's first observed spike in our sample, since the prior spike took place outside our sample period. This causes us to eliminate a firm's first observed spike occurrence, known as "left-censoring" the sample. The data suffer from "right" censoring as well. For example, if a firm's last observed spike occurs in 1999 and the data end in 2005, then the length of that firm's final spell is censored at six years. Our methodology follows Meyer's (1990) technique (see below) and this controls for such censoring. We also exclude, for econometric reasons, firms with one censored spell and one uncensored spell, if the censored spell is shorter than the uncensored spell.[20] This reduces our sample to between 254 and 529 firms per year over 1990–2007.[21] This is our final sample used in hazard estimations.

Table 1 presents summary statistics for the sample firms over 1990–2007. All dollar values are in 2007 constant dollars. We stratify the sample by whether the firm has an above- or below- median value of G-Index. For each group, we report the mean, median, and standard deviation of firm characteristics, spell characteristics, and corporate governance statistics. We also test for significant differences in means and medians across groups. Although not reported in the table, roughly 17% of our sample firm-years contain investment spikes.

Panel A of Table 1 shows that well-governed firms (low G-Index) have better investment opportunities as reflected by Tobin's Q and sales growth. They also carry higher leverage. Dividend yield is approximately the same (in the mean) across the two groups. Interestingly, more high G-Index firms are financially unconstrained than low G-Index firms (39.6% versus 33.9%).

The average investment-to-assets ratio is significantly higher for high G-Index firms (0.069 versus 0.066) even though their investment opportunities appear to be lower. This suggests that either high G-Index firms

[18] For example, investments are smoother for conglomerates, large firms, and their segments.

[19] See Whited (2006) for details. We summarize her arguments below.

[20] See Allison (1995, p. 245). In estimating job durations, he excludes these events for the purpose of efficient estimates. The estimates produced by this method are robust with respect to all unobserved individual heterogeneity that is persistent over time.

[21] Our results are robust to including these observations, rather than excluding them as we do in our reported results.

Table 1
Descriptive statistics

The table reports descriptive statistics for sample firms classified by finance constraints and corporate governance. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have zero dividend distribution in the year prior to the investment year. Unconstrained firms refer to the complement sample. The *G*-Index is a proxy for the firm's corporate governance quality developed by Gompers, Ishii, and Metrick (2003). A firm is defined as a high (low) *G*-Index firm if its governance index is above (below) the median of *G*-Index of firms in the first year that the firm appears in the sample. Investment /Asset is the difference between Compustat items 30 and 107 divided by item 6. Tobin's *Q* is the ratio of total market value to total asset value ((data6 − data60 + (data25 × data199))/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9 + data34)/data6). Dividend yield is the ratio of dividends in the previous fiscal year (data21) to market capitalization measured at calendar year-end. Avg. spell length is the number of years a firm has not exceeded the investment threshold. The thresholds are expressed in terms of 2 times the firm median investment rate. Fraction censored refers to the percentage of right-censored spells in the sample. Length censored (uncensored) refers to the number of censored (uncensored) years that a firm remains inactive. Asterisks indicate significant difference across subsamples. The difference in means *t*-test assumes unequal variances across groups when a test of equal variances is rejected at the 10% level. The significance level of the difference in medians is based on a Wilcoxon sum-rank test. All dollar values are in 2007 constant dollars. ***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Descriptive statistics for high G-Index and low G-Index firms

Variables		High *G*-Index firms				Low *G*-Index firms		
	N	Mean	Median	Std.	*N*	Mean	Median	Std.
A. Firm characteristics								
Investment/Asset	4047	0.069	0.050	0.064	3308	0.066**	0.043***	0.069
Tobin's *Q*	3944	2.184	1.548	1.824	3259	2.458***	1.756***	2.018
Cash flow	4047	0.070	0.100	0.143	3308	0.066	0.099	0.149
Sales growth	4047	0.197	0.110	0.259	3308	0.216***	0.111**	0.286
Total assets ($mil)	4047	184.4	152.3	135.0	3308	160.8***	126.6***	126.8
Leverage	4047	0.196	0.151	0.209	3308	0.210**	0.138	0.253
Dividend yield	4944	0.010	0.000	0.045	3259	0.067	0.000***	3.265
G-Index	4047	9.768	9.000	1.677	3308	5.638***	6.000***	1.204
% Unconstrained		39.6				33.9***		
B. Spell characteristics								
Avg. spell length	675	4.003	3.000	2.821	648	4.312*	3.000	3.080
Fraction censored	675	0.286	0.000	0.452	648	0.289	0.000	0.453
Length censored	193	5.176	5.000	3.144	187	5.583	5.000	3.098
Length uncensored	482	3.533	3.000	2.535	461	3.796	3.000	2.922
Number of spells			675				648	

Panel B: Descriptive statistics for firms based on constraints and governance

Variables	Unconstrained firms						Constrained firms					
	(1) High *G*-Index			(2) Low *G*-Index			(3) High *G*-Index			(4) Low *G*-Index		
	Mean	Median	Std.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
A. Firm characteristics												
Investment/Asset	0.074	0.058	0.059	0.068	0.049	0.062	0.065	0.044	0.067	0.065	0.040	0.073
Tobin's *Q*	1.840	1.441	1.253	1.959	1.519	1.348	2.411	1.654	2.088	2.716	1.924	2.245
Cash flow	0.123	0.122	0.073	0.121	0.121	0.074	0.036	0.079	0.166	0.039	0.084	0.169
Sales growth	0.109	0.072	0.125	0.121	0.078	0.140	0.254	0.148	0.304	0.265	0.147	0.327
Total assets ($mil)	236.4	222.7	129.0	211.6	202.5	122.4	150.3	112.7	127.7	134.8	94.1	121.1
Leverage	0.182	0.161	0.162	0.196	0.138	0.238	0.205	0.137	0.235	0.217	0.138	0.260
Div. per share	1.593	0.309	34.837	3.512	0.326	98.110	0.000	0.000	0.000	0.000	0.000	0.000
G-Index	10.16	10.00	1.84	5.67	6.00	1.15	9.51	9.00	1.51	5.62	6.00	1.23
No. of obs.	1601			1122			2446			2186		
B. Spell characteristics												
Avg. spell length	3.616	3.000	2.525	4.606	4.000	3.113	4.189	3.000	2.937	4.199	3.000	3.063
Fraction censored	0.174	0.000	0.380	0.250	0.000	0.434	0.340	0.000	0.474	0.303	0.000	0.460
Length censored	4.526	3.500	2.748	6.222	6.000	3.254	5.335	5.000	3.222	5.380	5.000	3.031
Length uncensored	3.425	3.000	2.441	4.067	4.000	2.881	3.598	3.000	2.593	3.684	2.000	2.936
Number of spells	219			180			456			468		

C. Testing for difference of means/medians

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Investment/Assets	***, ***	***, ***	***, ***	–, ***	–, ***	–, ***
Tobin's *Q*	**, **	***, ***	***, ***	***, ***	***, ***	***, ***
Cash flow	–,–	***, ***	***, ***	***, ***	***, ***	–, *
Sales growth	**, **	***, ***	***, ***	***, ***	***, ***	–, –
Total assets ($mil)	***, ***	***, ***	***, ******	***, ***	***, ***	***, ***
Leverage	*, –	***, –	***, –	–, –	**, –	–, –

Table 1 (*continued*)

Panel B: Descriptive statistics for firms based on constraints and governance

Variables	Unconstrained firms						Constrained firms					
	(1) High *G*-Index			(2) Low *G*-Index			(3) High *G*-Index			(4) Low *G*-Index		
	Mean	Median	Std.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
Div. per share		–, –	**, ***			**, ***		*, ***	*, ***			–, –
G-Index		***, ***	***, ***			***, ***		***, ***	–, –			***, ***
Avg. spell length		***, ***	**, **			***, *		–, –	–, –			–, –
Fraction censored		*, *	***, ***			***, ***		**, **	–, –			–, –
Length censored		**, **	–, –			–, –		–, –	–, –			–, –
Length uncensored		**, *	–, –			–, –		–, –	–, –			–, –

invest more than optimal given their lower investment opportunities, or low *G*-Index firms invest less than optimal given their greater opportunities. Looking at the characteristics of investment spells, the mean spell length is significantly shorter in high *G*-Index firms (4.003 versus 4.312), suggesting they undertake large investments more frequently. Given their lower sales growth and Tobin's *Q*, one would expect weakly governed firms to invest less often. Perhaps a weak governance structure fails to discipline managers from over investing in large projects, or a strong-governance structure unduly delays management from undertaking large investment projects.

Panel B of Table 1 presents summary statistics for firms classified by whether they are financially constrained in addition to their governance. Within the unconstrained sample, low *G*-Index firms have significantly better investment opportunities as measured by Tobin's *Q* and sales growth. There is no difference across these groups in cash flow. The investment/asset ratio is significantly higher in weak-governance firms (0.074 versus 0.068). Weak-governance firms also have large investment expenditures more frequently than their strong-governance counterparts (mean spell length 3.616 versus 4.606).

Within the constrained group, we find no difference in mean investment rate (0.065 versus 0.065) and spell lengths (4.189 versus 4.199) between weak- and strong-governance firms. Together the results imply that when financial constraints are present, there is little incremental effect of governance. Of the four groups classified by constraints and governance, we find unconstrained poorly governed firms spike the most and invest the most, and the difference between this group and all others is statistically significant. The curbing effect of governance on investment appears pronounced in unconstrained firms.

4. Investment behavior results

4.1. Regression analysis summary

We begin our discussion of results, by summarizing our replication of prior studies using investment regressions, both with and without correcting for measurement error. While details of the procedure and results are in the Appendix, we find the following general results. Regression estimates indicate that poor governance (high *G*-Index) associates with greater investment. However, this result disappears once we control for measurement error as in Erickson and Whited (2000). Given the lack of robustness to measurement error combined with the concern that the lumpy nature of investment raises concerns about the appropriateness of levels regressions, we turn to the hazard model.

4.2. Hazard method

Following Whited (2006), we adopt the hazard model developed by Meyer (1990) to estimate the investment hazard. Meyer's (1990) technique non-parametrically estimates the hazard shape and is well- suited for our interval-censored data [again, see Whited (2006) for a detailed discussion]. Another advantage of Meyer's approach is that it incorporates time-varying covariates and unobserved heterogeneity. It allows the hazard rates to shift upward and downward in response to each covariate. It also accommodates cross-sectional heterogeneity that arises from left and right data censoring.

Our hazard model analysis focuses on the length of time that passes until a firm experiences an investment spike. A hazard function consists of two parts. The first part is a function of time-varying explanatory variables, which affect the level and/or shape of hazard functions. The second part is a function of time duration. It is called the baseline hazard. As intimated above, the hazard is obtained by shifting the baseline hazard as the explanatory variables change. By examining "hazard rates" rather than investment levels, hazard models may avoid investment opportunity measurement and interpretation problems. Hazard models are also more appropriate in investigating the intermittent and lumpy nature of investment.

4.3. Hazard model results

4.3.1. Unconditional sampling on governance

We present our first results from estimating the hazard on firms' investment behaviors in Table 2. The table presents results using the firm's own time-series median investment rate (twice it) as the threshold for identifying investment spikes.[22] We group the firms based on proxies for quality of governance, and then

[22] In our robustness checks (below) we discuss (but do not table) the results using the firm's industry's median contemporaneous investment rate (twice it) as the threshold. Our inferences are unchanged.

Table 2
Corporate governance effects.

The table reports semiparametric hazard parameter estimates and baseline hazard rates based on different measures of corporate governance. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. The dependent variable is the number of years a firm has not exceeded the investment threshold. We use *G*-Index, CEO pay slice (CPS), and whether CEO is also the chairman of the board to measure corporate governance. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. The significance level of the difference in hazard functions across groups (high *G*-Index versus low *G*-Index; high CPS versus low CPS; CEO chmn. versus CEO non-chmn.) is based on a log-rank test.

Coefficient	High *G*	Low *G*	High CPS	Low CPS	CEO chmn.	Non-chmn.
Leverage	−0.127	−0.321	−0.281	−0.140	−0.129	−0.177
	(0.257)	(0.200)	(0.221)	(0.164)	(0.195)	(0.174)
Cash flow	0.913*	0.272	0.192	0.138	0.111	0.720
	(0.476)	(0.484)	(0.493)	(0.538)	(0.498)	(0.556)
Sales growth	0.171	0.380**	0.275*	0.398**	0.337**	0.253
	(0.166)	(0.149)	(0.163)	(0.162)	(0.157)	(0.172)
Total assets	−0.001***	−0.002***	−0.001***	−0.002***	−0.001***	−0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 year hazard	0.099***	0.092***	0.142***	0.066***	0.102***	0.104***
	(0.008)	(0.008)	(0.010)	(0.006)	(0.008)	(0.010)
2 year hazard	0.256***	0.276***	0.326***	0.237***	0.286***	0.278***
	(0.016)	(0.016)	(0.017)	(0.014)	(0.014)	(0.018)
3 year hazard	0.416***	0.389***	0.462***	0.393***	0.441***	0.412***
	(0.021)	(0.020)	(0.020)	(0.019)	(0.018)	(0.022)
4 year hazard	0.530***	0.496***	0.570***	0.502***	0.565***	0.497***
	(0.023)	(0.023)	(0.022)	(0.022)	(0.020)	(0.025)
5 year hazard	0.645***	0.573***	0.662***	0.593***	0.679***	0.554***
	(0.024)	(0.025)	(0.022)	(0.023)	(0.020)	(0.026)
6 year hazard	0.729***	0.620***	0.725***	0.668***	0.746***	0.626***
	(0.023)	(0.025)	(0.022)	(0.023)	(0.019)	(0.027)
7 year hazard	0.794***	0.701***	0.812***	0.731***	0.818***	0.705***
	(0.022)	(0.025)	(0.020)	(0.023)	(0.018)	(0.026)
8 year hazard	0.859***	0.746***	0.877***	0.803***	0.876***	0.787***
	(0.019)	(0.025)	(0.017)	(0.021)	(0.015)	(0.024)
9 year hazard	0.912***	0.795***	0.913***	0.866***	0.921***	0.842***
	(0.016)	(0.024)	(0.015)	(0.019)	(0.013)	(0.023)
10 year hazard	0.985***	0.986***	0.981***	0.989***	0.992***	0.973***
	(0.004)	(0.003)	(0.005)	(0.003)	(0.002)	(0.007)
Log likelihood	−2711.826	−2586.548	−3033.490	−3052.157	−3881.331	−2224.479
Likelihood ratio test	482.990***	427.863***	415.211	485.607	552.834	340.447
Number of spells	675	648	683	706	843	544
Log-rank test	2.800*		8.690***		3.911**	

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

compare hazards across the two groups for a particular proxy. In the first two columns, we study the influence of *G*-Index on large investment hazards. The column samples are defined by whether their *G*-Index is above or below the median *G*-Index for our sample in that year. In the second pair of columns, we group firms by whether their CEO pay slice (CPS) is above or below the median CPS for our sample in that year.[23] In the third pair of columns, we group firms by whether their CEO is also chairman of the board or not. Our results indicate that strong-governance firms have lower investment hazards than weak-governance firms.

When governance quality is measured using *G*-Index, the hazard for low *G*-Index firms lies below the hazard for high *G*-Index firms. Fig. 1 (first graph) shows the pictorial evidence, when *G*-Index proxies governance quality.[24] For example, the probability that a firm will spike, given that the firm has not done so in the last five years, is 0.645 for high *G*-Index governance firms and 0.573 for low *G*-Index firms. It indicates weak-governance firms make large investments sooner after their prior large investment. We reject at the 10% level, the null hypothesis that the hazards are equal at all time horizons. Individually, five out of ten hazard coefficients differ significantly across

[23] CEO pay slice is defined as the ratio of the CEO's total compensation to the sum of the top five executives' total compensation. Bebchuk, Cremers, and Peyer (2007) argue that CPS captures the relative significance of the CEO in terms of abilities, contribution, or power. Hence, CPS may proxy for CEO power in the top management team. They also find that CPS has strong explanatory power for firm value as measured by Tobin's Q and by stock market reactions to acquisition announcements.

[24] Figures using alternative proxies for governance quality, and sampling on financial constraints and CEO incentives, are provided below.

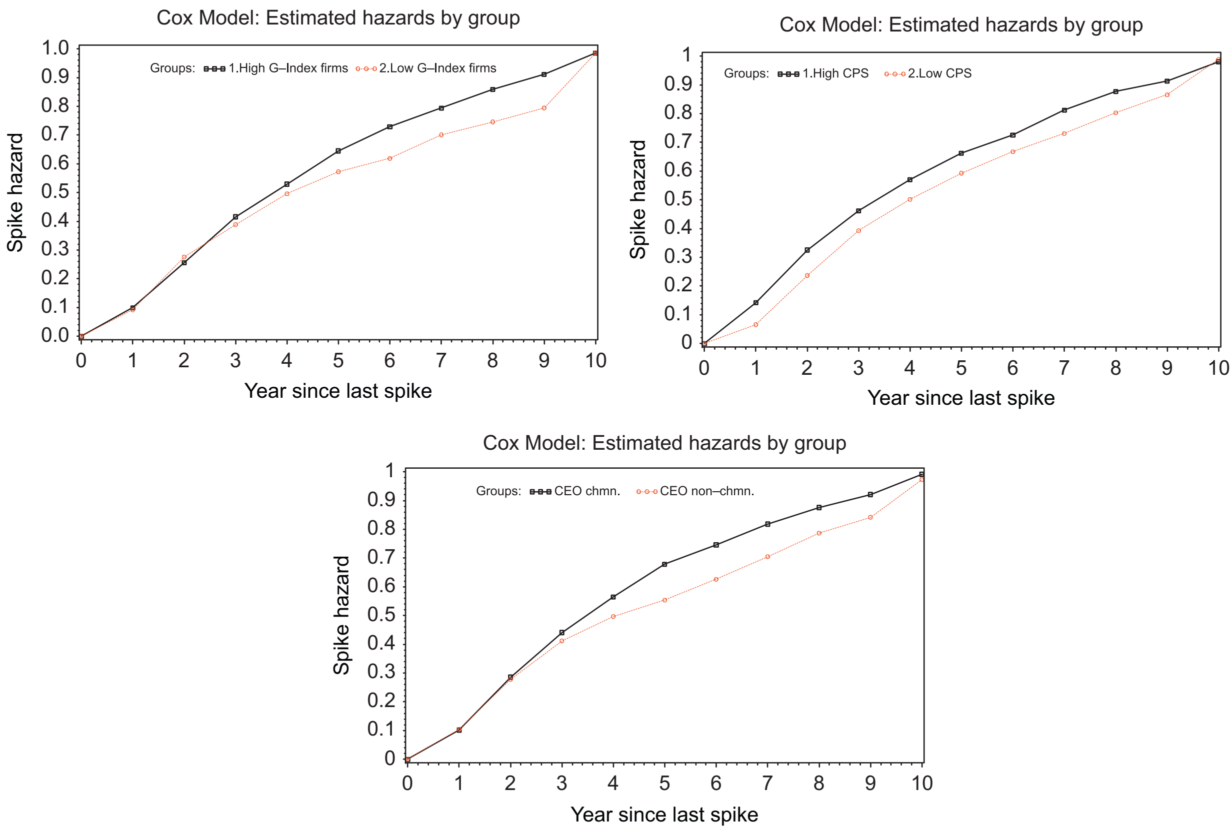

Fig. 1. Estimated hazards for high *G*-Index vs. low *G*-Index, high CPS vs. low CPS, and CEO chmn. vs. non-chmn. firms over 1990–2007. Estimates are from Table 2. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. A firm is defined as a high (low) *G*-Index firm if its governance index is above (below) the median of *G*-Index of firms in the first year that the firm appears in the sample. High (Low) CPS refers to the above- (below-) median CPS. CEO chmn. takes a value of one if the CEO is also the chairman of the board and zero otherwise. The horizontal axis measures the number of years since the last investment spike, and the vertical axis measures the probability of a spike, given that the firm has remained inactive up to that time.

the two groups. Good governance's association with lower-frequency large investment-taking, is similar to that found for financially constrained (relative to unconstrained) firms. As suggested in Section 2.2, strong governance might be perceived as adding an extra cost to large investments, and firms wait longer (presumably to acquire greater opportunities) to implement them.

Our results are similar when we measure governance quality with CEO pay slice or by differentiating among CEOs who are (vs. not) chairman of the board. Again, focusing on the five-year hazard, it is larger for high CPS firms than for low CPS firms. It is also larger for firms where the CEO is also chairman. In both cases, we reject at the 5% level or better, the null hypothesis that the hazards are equal at all time horizons. Our results are robust to varying proxies for the quality of a firm's governance.

We interpret these results as evidence that managerial entrenchment associates with more frequent investment spikes, but it does not necessarily imply causality. An alternative explanation for the results is that we do not observe a firm attribute (such as operating strategy) that simultaneously encourages more frequent investment and looser governance structure. However, as we show below, our results linking investment behavior with entrenchment are restricted to the subsample of firms that is less subject to financial constraints. It is less clear how an omitted variable (such as operating strategy) would cause a link between investment policy and governance only among unconstrained firms. By contrast, the discussion in Section 2.2 suggests viewing strong governance as an additional cost or constraint on investment, and this fits naturally with the results we discuss in Section 4.3.3.

4.3.2. *Unconditional sampling on constraints*

Table 3 presents results on the effects of financial constraints on large investment hazards. Again, there are six columns of results, based on three pairs of constraint indicators. In the first two columns, we group firms based on whether they paid a dividend in the prior fiscal year or not. We then compare the hazards across the two groups. In the second pair of columns, we expand our payout definition to include repurchases. In the third pair of columns, we use the KZ-Index from Kaplan and Zingales (1997).

Table 3
Finance constraints effects

The table reports semiparametric hazard parameter estimates and baseline hazard rates based on different measures of finance constraints. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. The dependent variable is the number of years a firm has not exceeded the investment threshold. Constrained firms refer to a sample of firms that have zero dividend distribution/zero dividend distribution and share repurchase/above-median KZ-Index in the year prior to the investment year. Unconstrained firms refer to the complement sample. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. The significance level of the difference in hazard functions across groups (unconstrained versus constrained based on three different measures of finance constraints.) is based on a log-rank test.

Coefficient	Dividend		Dividend+Repurchase		KZ-Index	
	Uncons.	Cons.	Uncons.	Cons.	Uncons.	Cons.
Leverage	−0.008	−0.373**	−0.021	−0.382	0.094	−0.300
	(0.249)	(0.185)	(0.232)	(0.193)	(0.262)	(0.201)
Cash flow	1.603*	0.332	0.746	0.588	0.903	−0.189
	(0.875)	(0.365)	(0.597)	(0.418)	(0.532)	(0.537)
Sales growth	0.403	0.161	0.346*	0.137	0.441***	0.256
	(0.446)	(0.118)	(0.213)	(0.132)	(0.167)	(0.165)
Total assets	−0.000	−0.002***	0.000	−0.002***	−0.002***	−0.002***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1 year hazard	0.080***	0.093***	0.103***	0.088***	0.122***	0.087***
	(0.009)	(0.007)	(0.009)	(0.007)	(0.009)	(0.008)
2 year hazard	0.263***	0.258***	0.271***	0.262***	0.312***	0.262***
	(0.021)	(0.013)	(0.019)	(0.014)	(0.017)	(0.015)
3 year hazard	0.419***	0.391***	0.420***	0.398***	0.452***	0.418***
	(0.030)	(0.017)	(0.026)	(0.018)	(0.021)	(0.019)
4 year hazard	0.577***	0.489***	0.554***	0.502***	0.561***	0.522***
	(0.034)	(0.019)	(0.029)	(0.020)	(0.023)	(0.021)
5 year hazard	0.718***	0.572***	0.694***	0.580***	0.654***	0.608***
	(0.034)	(0.020)	(0.029)	(0.021)	(0.024)	(0.022)
6 year hazard	0.797***	0.632***	0.767***	0.643***	0.714***	0.679***
	(0.032)	(0.021)	(0.028)	(0.022)	(0.024)	(0.022)
7 year hazard	0.893***	0.693***	0.856***	0.708***	0.796***	0.745***
	(0.024)	(0.021)	(0.023)	(0.022)	(0.022)	(0.021)
8 year hazard	0.940***	0.747***	0.906***	0.764***	0.879***	0.799***
	(0.018)	(0.020)	(0.020)	(0.021)	(0.018)	(0.020)
9 year hazard	0.974***	0.797***	0.955***	0.809***	0.922***	0.852***
	(0.010)	(0.020)	(0.013)	(0.020)	(0.015)	(0.019)
10 year hazard	0.999***	0.973***	0.999***	0.973***	0.984***	0.991***
	(0.000)	(0.004)	(0.001)	(0.005)	(0.005)	(0.002)
Log likelihood	−1529.677	−3805.336	−2103.562	−3631.189	−3035.854	−2894.261
Likelihood ratio test	362.515***	585.789***	394.247	519.342	419.099	409.627
Number of spells	399	924	487	827	684	668
Log-Rank test	7.766***		6.225**		8.417***	

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

The results indicate that constrained firms have lower hazards than unconstrained firms, consistent with Whited (2006). The hazard for non-dividend paying firms lies below the hazards for dividend paying firms. Fig. 2 (the first graph) illustrates this. The log-rank test for hazard homogeneity indicates a significant difference between the two groups (Chi-square=7.766 and p-value=0.005 for the log-rank test). The individual hazards (one through ten) are significantly different across the two groups in seven out of ten cases. We confirm the conclusions in Whited (2006) that financial constraints reduce large investment (spike) frequencies.

The results are similar when we augment our payout proxy with repurchases. The hazard for firms with neither dividends nor repurchases lies below the hazard for firms with one or both. The log-rank test for hazard homogeneity has a test statistic of 6.225, significant at the 5% level. The results are also similar when we proxy financial constraints with the KZ-Index. The test statistic of 8.417 (significant at the 1% level) indicates that constrained firms have lower hazards than unconstrained firms.

Overall, our unconditional results indicate that financial constraints and strong governance have similar associations with large investment hazard rates. Given financially constrained firms already exhibit muted hazards, we next turn to the question of whether governance's association with large investment hazards persists after controlling for the influence of financial constraints.

4.3.3. *Conditional sampling on constraints and governance*

Table 4 presents our results on the joint relation between finance constraints and governance and investment behavior. We present four hazard model

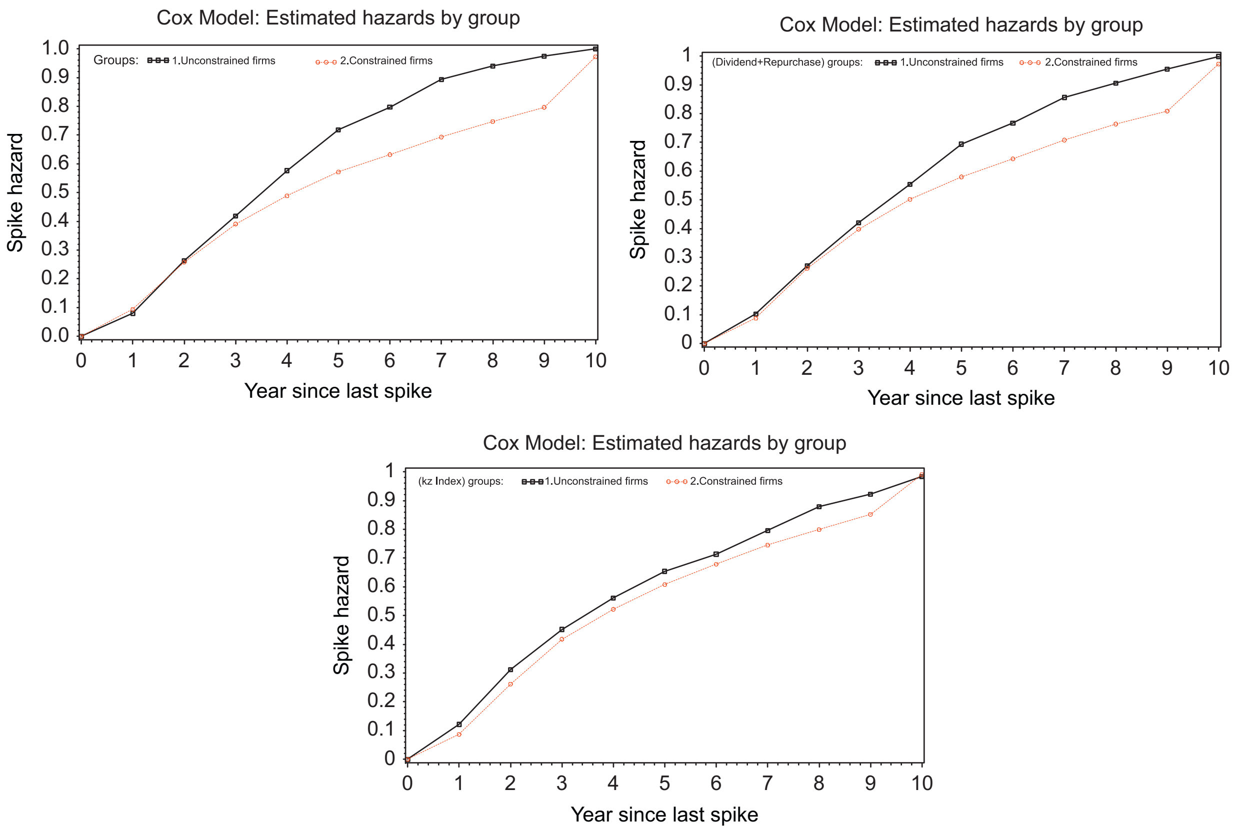

Fig. 2. Estimated hazards for unconstrained vs. constrained firms over 1990–2007. Estimates are from Table 3. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to (respectively) samples of firms that have zero dividend distribution, zero payout including share repurchase, and above-median KZ-Index in the year prior to the investment year. Unconstrained firms refer to the complement sample. The horizontal axis measures the number of years since the last investment spike, and the vertical axis measures the probability of a spike, given that the firm has remained inactive up to that time.

estimations in each panel, distinguished by the sample firms: unconstrained and poor governance, unconstrained and good governance, constrained and poor governance, constrained and good governance. In Panel A, governance quality is proxied with *G*-Index. In Panels B and C, it is proxied with (respectively) CEO pay slice (CPS) and whether the CEO is also chairman of the board or not. For Table 4, we proxy financial constraints with the absence of dividend payments.[25]

In Panel A, unconstrained poor governance (high *G*-Index) firms have the highest hazard. They make large (spike) investments with significantly greater frequency than all other groups. For instance, the probability that a firm will spike, given that the firm has not done so in the last five years, is 0.863 for unconstrained poor governance firms, and 0.540, 0.563, and 0.573 for the other three groups. Fig. 3 illustrates the difference. The log-rank tests of differences in the hazards between unconstrained high *G*-Index firms and the other three samples are always significant. Similarly, comparison of individual hazards from group one with the other three groups indicates significant differences in 25 out of 30 cases. Our evidence is consistent with inefficient investment by either firms facing neither financial constraints nor effective governance (overinvestment), or by firms with either financial constraints or strong shareholder protections (underinvestment).

Note too that these results shed light on potential causality direction. As intimated above, investment and governance may move together because of their correlation with an unobserved variable. This obscures the assignment of causality. However, the omitted variable must also be able to explain why investment is related to governance only among unconstrained firms. If strong governance imposes an additional cost on managers for inefficient investment behavior, this naturally fits our results. The lack of a relation between investment and governance among constrained firms suggests that governance and financial constraints are substitutes in mitigating overinvestment. The causality appears to run from governance to investment behavior.

In Panels B and C we study the influence of CEO pay slice (Bebchuk, Cremers, and Peyer, 2007) and of joint CEO

[25] In Tables 5 and 6, we proxy financial constraints using dividends and repurchases or KZ-Index, respectively.

Table 4

Corporate governance and finance constraints measured by dividend policy.

The table reports parameter estimates and baseline hazard rates for sample firms. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have zero dividend distribution in the year prior to the investment year. Unconstrained firms are the complement sample. In Panel A, High (Low) *G*-Index refers to the above- (below-) median *G*-Index. In Panel B, CPS is the ratio of CEO total compensation to the sum of all top five executives' total compensation. High (Low) CPS refers to the above- (below-) median CPS. In Panel C, CEO chmn. takes a value of one if the CEO is also the chairman of the board and zero otherwise. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. Test of the difference in hazard functions across groups is based on a log-rank test.

Panel A: Duration model estimates: G-Index as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High *G*-Index	(2) Low *G*-Index	(3) High *G*-Index	(4) Low *G*-Index
Leverage	0.713	−0.024	−0.313	−0.390
	(0.684)	(0.318)	(0.299)	(0.253)
Cash flow	2.289**	2.010	0.899*	0.070
	(1.374)	(1.526)	(0.522)	(0.532)
Sales growth	−0.351	1.022	0.057	0.323**
	(0.666)	(0.719)	(0.182)	(0.163)
Total assets	0.000	−0.000	−0.002***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.085***	0.065***	0.090***	0.090***
	(0.012)	(0.011)	(0.043)	(0.010)
2 year hazard	0.343***	0.176***	0.211***	0.294***
	(0.032)	(0.028)	(0.010)	(0.019)
3 year hazard	0.574***	0.258***	0.351***	0.418***
	(0.041)	(0.040)	(0.016)	(0.024)
4 year hazard	0.719***	0.418***	0.458***	0.508***
	(0.042)	(0.055)	(0.019)	(0.026)
5 year hazard	0.863***	0.540***	0.563***	0.573***
	(0.032)	(0.062)	(0.021)	(0.027)
6 year hazard	0.931***	0.610***	0.648***	0.614***
	(0.023)	(0.066)	(0.021)	(0.029)
7 year hazard	0.975***	0.760***	0.709***	0.679***
	(0.012)	(0.061)	(0.021)	(0.029)
8 year hazard	0.994***	0.824***	0.781***	0.720***
	(0.004)	(0.056)	(0.020)	(0.029)
9 year hazard	0.995***	0.887***	0.838***	0.768***
	(0.003)	(0.046)	(0.017)	(0.029)
10 year hazard	0.999***	0.996***	0.961***	0.988***
	(0.000)	(0.003)	(0.006)	(0.003)
Log likelihood	−755.709	−540.841	−1594.571	−1743.458
Likelihood ratio test	203.684***	175.417***	320.501***	281.377***
Number of spells	219	180	456	468

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	15.091***	18.120***	17.711***	0.009	0.115	0.228

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
Leverage	0.780	0.254	−0.508*	−0.176
	(0.686)	(0.571)	(0.261)	(0.181)
Cash flow	1.251	1.875	0.179	0.231
	(1.549)	(1.642)	(0.618)	(0.560)
Sales growth	0.115	0.952	0.174	0.220
	(0.671)	(0.830)	(0.192)	(0.169)
Total assets	0.000	−0.001	−0.002***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.112***	0.039***	0.116***	0.090***
	(0.015)	(0.007)	(0.011)	(0.010)
2 year hazard	0.267***	0.194***	0.297***	0.269***
	(0.031)	(0.025)	(0.019)	(0.018)
3 year hazard	0.415***	0.357***	0.423***	0.435***
	(0.040)	(0.039)	(0.024)	(0.023)
4 year hazard	0.588***	0.487***	0.519***	0.539***

Table 4 (*continued*)

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
	(0.046)	(0.046)	(0.026)	(0.025)
5 year hazard	0.709***	0.633***	0.606***	0.619***
	(0.046)	(0.049)	(0.028)	(0.026)
6 year hazard	0.802***	0.727***	0.669***	0.692***
	(0.042)	(0.048)	(0.028)	(0.026)
7 year hazard	0.895***	0.825***	0.762***	0.747***
	(0.032)	(0.042)	(0.027)	(0.026)
8 year hazard	0.957***	0.903***	0.824***	0.818***
	(0.019)	(0.032)	(0.025)	(0.023)
9 year hazard	0.984***	0.948***	0.868***	0.879***
	(0.010)	(0.022)	(0.023)	(0.021)
10 year hazard	0.999***	0.999***	0.963***	0.994***
	(0.000)	(0.000)	(0.010)	(0.002)
Log likelihood	−670.535	−711.826	−1750.229	−1798.786
Likelihood ratio test	160.613***	223.341***	300.909***	309.371***
Number of spells	204	222	479	484

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	4.289**	2.315	3.774*	0.394	0.210	0.092

Panel C: Duration model estimates: CEO chmn. as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) CEO chmn.	(2) CEO non-chmn.	(3) CEO chmn.	(4) CEO non-chmn.
Leverage	−0.182	1.071	−0.146	−0.226
	(0.555)	(0.958)	(0.223)	(0.190)
Cash flow	0.155	3.504*	0.315	0.484
	(1.556)	(1.830)	(0.553)	(0.634)
Sales growth	1.552**	−0.274	0.152	0.199
	(0.710)	(0.807)	(0.173)	(0.188)
Total assets	0.000	0.000	−0.002***	−0.003***
	(0.001)	(0.001)	(0.000)	(0.001)
1 year hazard	0.087***	0.057***	0.098***	0.114***
	(0.011)	(0.012)	(0.009)	(0.012)
2 year hazard	0.272***	0.189***	0.279***	0.297***
	(0.027)	(0.029)	(0.017)	(0.021)
3 year hazard	0.440***	0.343***	0.435***	0.426***
	(0.036)	(0.043)	(0.021)	(0.026)
4 year hazard	0.606***	0.479***	0.549***	0.502***
	(0.040)	(0.052)	(0.024)	(0.028)
5 year hazard	0.779***	0.522***	0.641***	0.568***
	(0.035)	(0.055)	(0.024)	(0.030)
6 year hazard	0.850***	0.650***	0.709***	0.631***
	(0.032)	(0.058)	(0.024)	(0.031)
7 year hazard	0.930***	0.751***	0.772***	0.710***
	(0.021)	(0.055)	(0.023)	(0.030)
8 year hazard	0.972***	0.871***	0.831***	0.784***
	(0.012)	(0.043)	(0.021)	(0.029)
9 year hazard	0.994***	0.904***	0.874***	0.849***
	(0.004)	(0.038)	(0.020)	(0.026)
10 year hazard	0.999***	0.993***	0.984***	0.976***
	(0.000)	(0.006)	(0.004)	(0.008)
Log likelihood	−997.446	−390.538	−2171.388	−1414.476
Likelihood ratio test	221.293***	135.518***	362.924***	231.872***
Number of spells	277	143	566	401

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	9.300***	4.643**	6.663***	1.817	1.024	0.169

***, **, * Denote significance at the 1%, 5%, 10% levels, respectively.

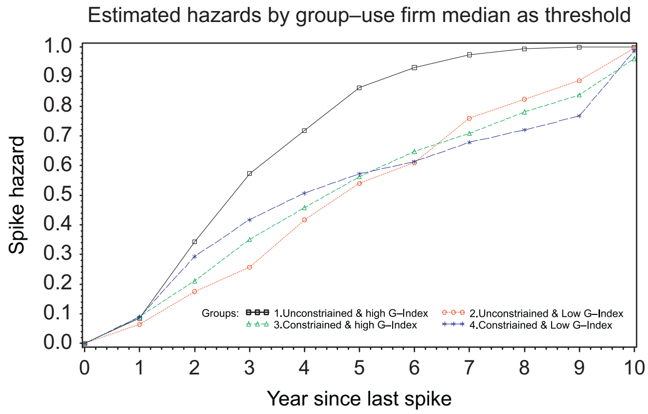

Fig. 3. Estimated hazards for sample firms based on constraints and corporate governance over 1990–2007. Estimates are from Panel A of Table 4. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to firms that have zero dividend distribution in the year prior to the investment year. Unconstrained firms are the complement sample. High (Low) *G*-Index refers to the above- (below-) median *G*-Index. The horizontal axis measures the number of years since the last investment spike, and the vertical axis measures the probability of a spike, given that the firm has remained inactive up to that time.

and chairmanship of the board on investment behavior. In Panel B, our main conclusions hold for the most part. Unconstrained firms with poor governance (above the sample median CEO pay slice) make large investments more frequently than other groups. The one exception is that unconstrained and constrained firms with high CEO pay slice appear to have investment behaviors that are insignificantly different from each other. The results presented in Panel C more closely resemble those in Panel A. Unconstrained firms where the CEO is also chairman of the board have higher hazards than all other groups. On the whole, our results highlight important links between governance and large investment frequency.

A benefit of our results' robustness across governance quality metrics is that it lends itself to sorting between the overinvestment and underinvestment interpretations of our findings. Recalling that either poor governance firms may be overinvesting or good governance firms may be underinvesting, the latter seems less likely when we use CEO pay slice, given low CEO pay slice is less likely to imply cumbersome project approval processes. If high CEO pay slice proxies power, and power implies greater control over investment approval, our inferences persist. Examining cases where the CEO is also the chairman of the board suggests these more powerful CEOs have greater flexibility to pursue investments they want. The fact that both high CEO pay slice firms and firms where the CEO also serves as chairman have higher investment hazards suggests over-, rather than underinvestment is the likely interpretation of the differing investment hazards between high and low *G*-Index firms.

There is an element of generalization in the above thinking. It ignores the potentially differential effect of CEO power on investment policy for firms at different stages of their life cycle. Specifically, more powerful CEOs may be more likely to invest in "empires" when the firm is older with fewer good investment opportunities. However, more powerful CEOs may be less likely to underinvest when the firm is younger (has more growth opportunities). We therefore examine large investment hazards for the following groups: firms without financial constraints and high *G*-Index that have been listed on CRSP more than five years; seven other groups defined by financial constraints (yes or no), *G*-Index (high or low), and "age" (more than five years listed on CRSP vs. five or fewer years).[26] The overinvestment hypothesis predicts that older firms with high *G*-Index and no financial constraints will have higher hazards than all seven other groups. This is what we find. We continue to infer that weak shareholder protection associates with overinvestment.

We next establish the robustness of our results across differing proxies for financial constraints. Table 5 mimics Table 4, but using dividends and repurchases to measure payout policy. Financially constrained firms are those with neither form of payout. The results indicate that financially unconstrained firms with poor governance have higher hazards than the other three groups. Poor governance is proxied by high *G*-Index in Panel A, by high CEO pay slice in Panel B, and by joint CEO and board chairmanship in Panel C. Regardless of our governance strength proxy, the combination of poor governance and lack of financial constraints associates with weak incentives to limit the frequency of large investments.

Finally, Table 6 mimics Table 4 but using the KZ-Index to proxy financial constraints. Constrained firms are those with higher than median index value in the year prior to the investment year. Again, regardless of the governance proxy, the results indicate that financially unconstrained firms with poor governance have higher hazards than the other three groups.

[26] Results are not tabled for brevity, but are available from the authors upon request.

Table 5

Corporate governance and finance constraints measured by payout policy.

The table reports parameter estimates and baseline hazard rates for sample firms. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have zero dividend distribution and share repurchase in the year prior to the investment year. Unconstrained firms are the complement sample. In Panel A, High (Low) *G*-Index refers to the above- (below-) median *G*-Index. In Panel B, CPS is the ratio of CEO's total compensation to the sum of all top five executives' total compensation. High (Low) CPS refers to the above- (below-) median CPS. In Panel C, CEO chmn. takes a value of one if the CEO is also the chairman of the board and zero otherwise. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. Test of the difference in hazard functions across groups is based on a log-rank test.

Panel A: Duration model estimates: G-Index as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High *G*-Index	(2) Low *G*-Index	(3) High *G*-Index	(4) Low *G*-Index
Leverage	0.509	0.071	−0.340	−0.320
	(0.572)	(0.296)	(0.312)	(0.270)
Cash flow	1.126	0.183	1.026*	0.308
	(0.841)	(0.893)	(0.597)	(0.611)
Sales growth	0.283	0.542*	0.036	0.273
	(0.385)	(0.291)	(0.199)	(0.182)
Total assets	0.000	−0.001*	−0.002***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.098***	0.095***	0.090***	0.081***
	(0.012)	(0.013)	(0.045)	(0.010)
2 year hazard	0.318***	0.219***	0.220***	0.295***
	(0.028)	(0.026)	(0.107)	(0.020)
3 year hazard	0.537***	0.304***	0.358***	0.425***
	(0.036)	(0.034)	(0.163)	(0.025)
4 year hazard	0.666***	0.442***	0.470***	0.522***
	(0.037)	(0.043)	(0.198)	(0.028)
5 year hazard	0.813***	0.574***	0.575***	0.577***
	(0.033)	(0.047)	(0.215)	(0.029)
6 year hazard	0.886***	0.640***	0.667***	0.617***
	(0.027)	(0.049)	(0.218)	(0.030)
7 year hazard	0.944***	0.763***	0.730***	0.688***
	(0.018)	(0.046)	(0.214)	(0.030)
8 year hazard	0.979***	0.817***	0.804***	0.733***
	(0.010)	(0.043)	(0.193)	(0.030)
9 year hazard	0.992***	0.871***	0.846***	0.784***
	(0.001)	(0.038)	(0.176)	(0.029)
10 year hazard	0.999***	0.993***	0.960***	0.987***
	(0.001)	(0.004)	(0.067)	(0.003)
Log likelihood	−1020.624	−814.637	−1562.736	−1654.358
Likelihood ratio test	214.535	201.471	287.288	241.72
Number of spells	258	229	412	415

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	12.124***	13.256***	14.772***	0.010	0.0208	0.083

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
Leverage	−0.038	−0.204	−0.495*	−0.037
	(0.217)	(0.487)	(0.272)	(0.261)
Cash flow	0.192	−0.267	0.316	0.372
	(0.814)	(1.264)	(0.644)	(0.670)
Sales growth	0.508*	0.481	0.209	0.166
	(0.302)	(0.486)	(0.203)	(0.195)
Total assets	−0.001*	−0.001*	−0.002***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.150***	0.076***	0.102***	0.070***
	(0.015)	(0.011)	(0.011)	(0.009)
2 year hazard	0.341***	0.235***	0.282***	0.235***
	(0.025)	(0.025)	(0.020)	(0.019)
3 year hazard	0.529***	0.401***	0.402***	0.378***
	(0.029)	(0.036)	(0.025)	(0.026)

Table 5 (*continued*)

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
4 year hazard	0.690***	0.515***	0.502***	0.466***
	(0.029)	(0.041)	(0.028)	(0.029)
5 year hazard	0.791***	0.631***	0.598***	0.539***
	(0.027)	(0.042)	(0.029)	(0.031)
6 year hazard	0.854***	0.742***	0.646***	0.619***
	(0.024)	(0.041)	(0.030)	(0.033)
7 year hazard	0.909***	0.842***	0.733***	0.681***
	(0.019)	(0.034)	(0.029)	(0.033)
8 year hazard	0.959***	0.904***	0.803***	0.757***
	(0.012)	(0.028)	(0.027)	(0.031)
9 year hazard	0.983***	0.946***	0.847***	0.826***
	(0.007)	(0.020)	(0.026)	(0.030)
10 year hazard	0.999***	0.999***	0.950***	0.981***
	(0.000)	(0.000)	(0.013)	(0.006)
Log likelihood	−1173.269	−910.072	−1541.610	−1260.361
Likelihood ratio test	187.830***	224.927***	279.776***	264.552***
Number of spells	297	258	443	391

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	6.377**	11.556***	20.271***	0.637	3.126*	1.244

Panel C: Duration model estimates: CEO chmn. as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) CEO chmn.	(2) CEO non-chmn.	(3) CEO chmn.	(4) CEO non-chmn.
Leverage	−0.116	0.559	−0.147**	−0.073
	(0.242)	(0.667)	(0.231)	(0.251)
Cash flow	0.300	1.237	0.567	0.317
	(1.114)	(1.375)	(0.577)	(0.686)
Sales growth	0.845**	0.465	0.142	0.256
	(0.429)	(0.469)	(0.184)	(0.207)
Total assets	−0.000	−0.001	−0.002***	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.103***	0.111***	0.083***	0.108***
	(0.012)	(0.016)	(0.009)	(0.012)
2 year hazard	0.292***	0.282***	0.255***	0.289***
	(0.026)	(0.031)	(0.017)	(0.022)
3 year hazard	0.459***	0.463***	0.401***	0.416***
	(0.033)	(0.040)	(0.022)	(0.027)
4 year hazard	0.621***	0.580***	0.517***	0.480***
	(0.035)	(0.045)	(0.025)	(0.030)
5 year hazard	0.765***	0.612***	0.615***	0.555***
	(0.032)	(0.046)	(0.025)	(0.032)
6 year hazard	0.831***	0.758***	0.669***	0.622***
	(0.030)	(0.043)	(0.026)	(0.033)
7 year hazard	0.923***	0.826***	0.738***	0.687***
	(0.020)	(0.040)	(0.026)	(0.033)
8 year hazard	0.963***	0.906***	0.804***	0.769***
	(0.013)	(0.030)	(0.024)	(0.031)
9 year hazard	0.991***	0.928***	0.853***	0.828***
	(0.005)	(0.027)	(0.023)	(0.030)
10 year hazard	0.999***	0.998***	0.975***	0.967***
	(0.000)	(0.002)	(0.006)	(0.010)
Log likelihood	−1196.295	−589.136	−1932.734	−1214.177
Likelihood ratio test	222.783***	154.054***	332.614***	220.985***
Number of spells	312	183	526	366

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	3.264*	11.019***	12.072***	1.038	1.320	0.067

***, **, * Denote significance at the 1%, 5%, 10% levels, respectively.

Table 6
Corporate governance and finance constraints measured by KZ-Index.

The table reports parameter estimates and baseline hazard rates for sample firms. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have above median KZ-Index in the year prior to the investment year. Unconstrained firms are the complement sample. In Panel A, High (Low) *G*-Index refers to the above- (below-) median *G*-Index. In Panel B, CPS is the ratio of CEO's total compensation to the sum of all top five executives' total compensation. High (Low) CPS refers to the above- (below-) median CPS. In Panel C, CEO chmn. takes a value of one if the CEO is also the chairman of the board and zero otherwise. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. Test of the difference in hazard functions across groups is based on a log-rank test.

Panel A: Duration model estimates: G-Index as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High *G*-Index	(2) Low *G*-Index	(3) High *G*-Index	(4) Low *G*-Index
Leverage	0.762	−0.439	−0.795	−0.672
	(0.565)	(0.563)	(0.532)	(0.468)
Cash flow	1.354	0.607	0.837	−0.219
	(1.147)	(1.145)	(1.402)	(1.271)
Sales growth	0.340	0.875**	0.537	0.389
	(0.311)	(0.340)	(0.453)	(0.310)
Total assets	−0.002**	−0.002**	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.129***	0.092***	0.059***	0.049***
	(0.015)	(0.013)	(0.010)	(0.010)
2 year hazard	0.334***	0.256***	0.206***	0.252***
	(0.027)	(0.026)	(0.024)	(0.027)
3 year hazard	0.516***	0.356***	0.396***	0.405***
	(0.034)	(0.034)	(0.034)	(0.038)
4 year hazard	0.627***	0.475***	0.545***	0.529***
	(0.036)	(0.040)	(0.039)	(0.044)
5 year hazard	0.731***	0.569***	0.666***	0.594***
	(0.035)	(0.043)	(0.039)	(0.047)
6 year hazard	0.788***	0.622***	0.751***	0.653***
	(0.034)	(0.045)	(0.038)	(0.048)
7 year hazard	0.852***	0.725***	0.812***	0.767***
	(0.030)	(0.044)	(0.035)	(0.044)
8 year hazard	0.917***	0.795***	0.865***	0.834***
	(0.022)	(0.041)	(0.031)	(0.040)
9 year hazard	0.956***	0.844***	0.916***	0.914***
	(0.016)	(0.039)	(0.025)	(0.030)
10 year hazard	0.997***	0.966***	0.991***	0.997***
	(0.002)	(0.014)	(0.005)	(0.002)
Log likelihood	−1063.095	−861.484	−796.761	−739.857
Likelihood ratio test	183.146	201.174	186.693	170.610
Number of spells	269	243	222	209

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	6.598**	8.180***	4.075**	0.031	0.257	0.643

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
Leverage	−0.315	0.450	−0.668	−0.382
	(0.409)	(0.353)	(0.420)	(0.253)
Cash flow	0.926	0.903	−0.649	0.277
	(0.789)	(0.832)	(0.938)	(0.736)
Sales growth	0.362	0.455**	0.553**	0.041
	(0.272)	(0.228)	(0.252)	(0.244)
Total assets	−0.002**	−0.002***	−0.001	−0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.149***	0.089***	0.104***	0.057***
	(0.015)	(0.011)	(0.012)	(0.009)
2 year hazard	0.342***	0.264***	0.276***	0.223***
	(0.025)	(0.023)	(0.022)	(0.020)
3 year hazard	0.494***	0.393***	0.393***	0.418***
	(0.029)	(0.031)	(0.028)	(0.026)
4 year hazard	0.614***	0.496***	0.507***	0.522***
	(0.031)	(0.036)	(0.032)	(0.029)

Table 6 (*continued*)

Panel B: Duration model estimates: CPS as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) High CPS	(2) Low CPS	(3) High CPS	(4) Low CPS
5 year hazard	0.695***	0.608***	0.619***	0.599***
	(0.031)	(0.038)	(0.033)	(0.030)
6 year hazard	0.753***	0.674***	0.705***	0.670***
	(0.030)	(0.039)	(0.033)	(0.030)
7 year hazard	0.845***	0.752***	0.795***	0.731***
	(0.026)	(0.037)	(0.031)	(0.030)
8 year hazard	0.916***	0.851***	0.853***	0.789***
	(0.020)	(0.030)	(0.028)	(0.028)
9 year hazard	0.963***	0.889***	0.885***	0.866***
	(0.013)	(0.028)	(0.026)	(0.025)
10 year hazard	0.991***	0.984***	0.988***	0.998***
	(0.005)	(0.007)	(0.005)	(0.001)
Log likelihood	−1333.641	−1339.547	−1245.550	−1305.678
Likelihood ratio test	167.787	272.554	243.461	201.351
Number of spells	332	350	336	332

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	4.747**	7.221***	14.687***	0.317	2.101	0.629

Panel C: Duration model estimates: CEO chmn. as governance measure

Coefficient	Unconstrained firms		Constrained firms	
	(1) CEO chmn.	(2) CEO non-chmn.	(3) CEO chmn.	(4) CEO non-chmn.
Leverage	0.148	−0.140	−0.349	−0.387
	(0.308)	(0.607)	(0.329)	(0.253)
Cash flow	0.814	1.092	0.147	0.267
	(0.740)	(0.866)	(0.781)	(0.881)
Sales growth	0.771***	0.135	0.128	0.497*
	(0.261)	(0.255)	(0.232)	(0.268)
Total assets	−0.001***	−0.001**	−0.001**	−0.004***
	(0.001)	(0.001)	(0.000)	(0.001)
1 year hazard	0.129***	0.099***	0.076***	0.080***
	(0.012)	(0.013)	(0.041)	(0.013)
2 year hazard	0.330***	0.267***	0.249***	0.232***
	(0.022)	(0.028)	(0.134)	(0.025)
3 year hazard	0.480***	0.398***	0.413***	0.374***
	(0.026)	(0.037)	(0.202)	(0.032)
4 year hazard	0.631***	0.459***	0.519***	0.487***
	(0.028)	(0.041)	(0.238)	(0.036)
5 year hazard	0.751***	0.515***	0.633***	0.546***
	(0.026)	(0.044)	(0.250)	(0.037)
6 year hazard	0.808***	0.580***	0.716***	0.618***
	(0.025)	(0.047)	(0.247)	(0.039)
7 year hazard	0.872***	0.695***	0.798***	0.678***
	(0.021)	(0.047)	(0.226)	(0.039)
8 year hazard	0.928***	0.835***	0.858***	0.735***
	(0.016)	(0.037)	(0.195)	(0.038)
9 year hazard	0.971***	0.873***	0.898***	0.823***
	(0.010)	(0.035)	(0.165)	(0.035)
10 year hazard	0.998***	0.972***	0.996***	0.992***
	(0.001)	(0.014)	(0.012)	(0.003)
Log likelihood	−1669.952	−1015.108	−1734.863	−824.833
Likelihood ratio test	244.848	208.362	312.922	136.662
Number of spells	403	280	429	238

	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	5.434**	8.572***	14.699***	0.020	1.248	1.220

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

4.3.4. The effects of CEO pay incentives (δ)

As noted above, the fact that unconstrained poorly governed firms have higher large investment hazards than other groupings can be interpreted in two ways. Such firms may be overinvesting or the other groups of firms may be underinvesting. In this and the next section, we attempt to discriminate between these two interpretations. Here, we focus on the influence of CEO pay incentives—deltas (δ).[27] There are two benefits to studying pay-based incentives. First, sorting firms based on delta may avoid multiple interpretations of hazard results. High deltas should encourage managers to accept value-enhancing projects and reject value-destroying ones.[28] Second, CEO pay incentives seem unlikely to affect the hurdles associated with strong-governance structures. This lack of correlation can be exploited.

Table 7 presents results from estimating hazards for various groupings of firms that incorporate CEO deltas in the sorting. The first two columns group firms solely by delta. If the CEO's delta is above the median delta of all firms in that year, it is labeled a high-delta firm, otherwise it is a low-delta firm. The hazards for low-delta (weaker CEO pay-based incentive) firms lie above those for high-delta firms. The test of differences in hazards across the two groups is significant at the 5% level. CEOs that are less well-aligned with shareholders (through their pay) are quicker to undertake a large investment. Given that high incentive alignment should encourage good investments and discourage value destructive ones, the lower hazards among high incentive CEO firms suggests that they are not underinvesting, while low-delta firms are overinvesting.

The next four columns of Table 7 provide additional evidence on the influence of CEO incentives. However, it is conditioned on the existence or absence of financial constraints. Columns 1 and 2 contain hazard estimates for unconstrained firms, while columns 3 and 4 represent constrained firms. The key column is column 2. If overinvestment is a likely concern, then it will be most pronounced among unconstrained low-delta firms. In general, that is what we find. The hazards for unconstrained low-delta firms are significantly higher than those of high-delta firms, both constrained and unconstrained. The lone exception is that constrained low-delta firms do not exhibit significantly different hazards from unconstrained ones. As we show below, this may be happening because we have not controlled for managerial entrenchment differences in these tests.

4.3.5. *The joint influence of G-Index, constraints, and CEO pay incentives on investment*

Given the presumed disincentive to take value-destructive investments when CEO incentives are high, we re-examine the joint effects of financial constraints and *G*-Index on investment hazards, but with an added sort on delta. Recall that large investment hazards are higher for unconstrained high *G*-Index firms than for other firms. If this is due to overinvesting by unconstrained poor governance firms, then high CEO deltas should mitigate this result.

Table 8 sorts firms into eight groups based on financial constraints, governance, and CEO incentives, and runs large investment hazards on the eight groups. We return to our original definitions of constraints and governance quality: lack of dividends and high *G*-Index, respectively. As predicted above, the lack of any sort of constraint (financial, governance-related, or incentive-based) associates with higher large investment hazards. Tests of whether unconstrained, high *G*-Index, low-δ firms (which we label group-2 firms in the table) have significantly different hazards from other groups, they always reject the null at the 5% level or better. If high deltas discourage the acceptance of negative NPV projects, these results are most consistent with the interpretation that poor governance (in the absence of financial constraints) associates with overinvestment.[29] On the other hand, if high deltas discourage the acceptance of positive NPV projects (because of diversification concerns), this suggests underinvestment by group-1 firms and efficient investment by group-2 firms. Below, we present further analysis to distinguish between these two possibilities.

4.3.6. *The influence of Sarbanes-Oxley on investment hazards*

In Table 9 we study the influence of Sarbanes-Oxley (SOX) on investment hazards. SOX was designed to improve firm governance structures. Therefore, the passage of it may reduce investment hazards for overinvesting firms while raising investment hazards for underinvesting firms. It should have no significant effect on the hazards of firms investing efficiently.

The difficulty in tests of differences in hazards pre- vs. post-SOX is sample composition. There are fewer years over which to study spells between large investments, potentially increasing concerns with right-censoring. This is likely to be especially problematic when we construct subsamples based on governance, financial constraints, and CEO deltas. We therefore examine the influence of SOX on investment hazards for less-specific groupings of firms. For our full sample of firms, there are 931 spells pre-SOX and 392 spells post-SOX. The hazards are not significantly different across these two samples. However, if we condition our pre- vs. post-SOX analysis on governance (only), we find interesting differences in hazards. Among high *G*-Index firms, SOX significantly lowers large investment hazards, suggesting good governance mitigates overinvestment. Also, SOX has little effect on hazards among low *G*-Index firms, suggesting these firms were investing efficiently prior to SOX. Finally, post-SOX, there is no significant difference between the large investment hazards of high and low *G*-Index firms. Taken together with our other results, this suggests that SOX encouraged more efficient investment behavior among firms with higher probability of managerial entrenchment.

We then compare pre-SOX and post-SOX hazards for the two subsamples of firms we highlight in our Table 8 tests.[30] Group-2 firms (financially unconstrained, with entrenched managers and low CEO deltas) showed evidence consistent with overinvestment. We find that the large investment hazard for group-2 firms is significantly

[27] In Section 5 we study ex-post investment results for our various groups of firms.

[28] We empirically confirm this assumption below.

[29] This notion that CEO incentives and other governance mechanisms may act as substitutes is similar to Zhang (2009) who finds that leverage and CEO incentives are substitutes in controlling overinvestment of free cash flow.

[30] These results are not tabled for brevity. Again, they are available from the authors upon request.

Table 7
The influence of CEO pay incentives (δ).

The table reports parameter estimates and baseline hazard rates for sample firms. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is ''small''—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have zero dividend distribution in the year prior to the investment year. Unconstrained firms are the complement sample. H- (L-) delta refers to the above- (below-) median delta. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. Standard errors are in parentheses. The significance level of the difference in hazard functions across groups is based on a log-rank test.

Coefficient	CEO pay incentives (δ)		Unconstrained firms		Constrained firms	
	H-Delta	L-Delta	(1) H-Delta	(2) L-Delta	(3) H-Delta	(4) L-Delta
Leverage	−0.181	−0.071	0.030	0.533	−0.179	−0.168
	(0.196)	(0.182)	(0.756)	(0.639)	(0.215)	(0.217)
Cash flow	−0.101	0.410	1.357	1.569	−0.475	0.409
	(0.517)	(0.560)	(1.836)	(1.405)	(0.565)	(0.656)
Sales growth	0.305**	0.190	2.259***	0.312	0.299*	0.119
	(0.150)	(0.200)	(0.986)	(0.613)	(0.161)	(0.234)
Total assets	−0.002**	−0.001***	−0.001***	0.000	−0.003***	−0.001***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.106***	0.090***	0.060***	0.073***	0.101***	0.090***
	(0.010)	(0.008)	(0.011)	(0.011)	(0.011)	(0.010)Z
2 year hazard	0.277***	0.271***	0.201***	0.227***	0.280***	0.280***
	(0.016)	(0.017)	(0.031)	(0.027)	(0.018)	(0.021)
3 year hazard	0.403***	0.436***	0.330***	0.405***	0.412***	0.443***
	(0.019)	(0.022)	(0.045)	(0.039)	(0.022)	(0.026)
4 year hazard	0.502***	0.547***	0.450***	0.574***0.	517***	0.530***
	(0.021)	(0.024)	(0.057)	(0.045)	(0.024)	(0.029)
5 year hazard	0.574***	0.655***	0.596***	0.709***	0.581***	0.630***
	(0.022)	(0.024)	(0.062)	(0.045)	(0.025)	(0.030)
6 year hazard	0.619***	0.742***	0.651***	0.810***	0.630***	0.716***
	(0.023)	(0.024)	(0.064)	(0.040)	(0.026)	(0.030)
7 year hazard	0.703***	0.799***	0.814***	0.882***0.	710***	0.766***
	(0.022)	(0.023)	(0.054)	(0.033)	(0.025)	(0.029)
8 year hazard	0.745***	0.891***	0.873***	0.964***0.	753***	0.860***
	(0.022)	(0.017)	(0.048)	(0.016)	(0.025)	(0.024)
9 year hazard	0.783***	0.945***	0.926***	0.989***	0.791***	0.926***
	(0.021)	(0.012)	(0.037)	(0.007)	(0.024)	(0.019)
10 year hazard	0.940***	0.992***	0.995***	0.999***	0.949***	0.987***
	(0.009)	(0.003)	(0.004)	(0.001)	(0.009)	(0.006)
Log likelihood	−3025.250	−2756.846	−608.234	−886.874	−2122.587	−1547.478
Likelihood ratio test	350.087	427.833	177.865	193.727	258.989	263.565
Number of spells	689	637	176	235	513	402

	H–L Delta	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	4.5435**	3.577*	0.030	1.018	4.661**	1.188	1.431

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

lower in the post-SOX window than in the pre-SOX window. This suggests that stronger governance reduces overinvestment. By contrast, we find that there is no significant difference between the pre- and post-SOX hazards of group-1 firms, consistent with efficient investment among these firms.

While these latter results suggest SOX differentially influenced investment by group-2 and group-1 firms, we again hasten to point out our concerns with the nature of the data. For both group 2 and group 1, the number of spikes in the post-SOX window is small. It is 19 for group 2 and nine for group 1, suggesting that a large fraction of the data is subject to right-censoring. Moreover, we have a shorter window post-SOX, which does not allow us to view all spell-lengths.

Overall, our SOX-based tests suggest that financially unconstrained firms with high *G*-Index and low CEO deltas are overinvesting (at least prior to SOX). Our evidence does not suggest that other groups of firms underinvest. Rather, it appears that any form of constraint (financial, governance-related, or pay-related) encourages efficient investment.

5. Post-investment outcomes

There are (as noted above) several possible barriers to understanding the relationship between governance and investment efficiency. One is endogeneity. In general, many forms of governance (anti-takeover amendments, managerial compensation, board structure) likely depend on a firm's investment opportunity set (Smith and Watts, 1992), as does a firm's actual investment behavior. While the hazard methodology used by Whited (2006) [and us] is less susceptible to such concerns, the concerns are not

Table 8
Corporate governance, finance constraints, and CEO incentives.

The table reports parameter estimates and baseline hazard rates for sample firms. Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. Constrained firms refer to a sample of firms that have zero dividend distribution in the year prior to the investment year. Unconstrained firms are the complement sample. High (Low) *G*-Index refers to the above- (below-) median *G*-Index. H- (L-) delta refers to the above- (below-) median delta. Based on corporate governance, finance constraints, and delta, we group sample firms into: (1) unconstrained, high-*G*, and high-delta, (2) unconstrained, high-*G*, and low-delta, (3) unconstrained, low-*G*, and high-delta, (4) unconstrained, low-*G*, and low-delta, (5) constrained, high-*G*, and high-delta, (6) constrained, high-*G*, and low-delta, (7) constrained, low-*G*, and high-delta, (8) constrained, low-*G*, and low-delta. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9+data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. Test of the difference in hazard functions across groups is based on a log-rank test.

Coefficient	Unconstrained firms				Constrained firms			
	High *G*-Index		Low *G*-Index		High *G*-Index		Low *G*-Index	
	H-delta (1)	L-delta (2)	H-delta (3)	L-delta (4)	H-delta (5)	L-delta (6)	H-delta (7)	L-delta (8)
Leverage	1.521	0.340	0.038	−0.484	−0.240	−0.587	0.000	−1.352*
	(2.307)	(0.962)	(1.176)	(1.591)	(0.637)	(0.584)	(0.365)	(0.818)
Cash flow	3.800	1.957	−5.315	5.907	−0.593	3.456***	−0.168	−1.290
	(3.996)	(2.408)	(3.879)	(3.915)	(2.009)	(1.166)	(1.238)	(1.335)
Sales growth	0.632	−0.280	0.861	0.469	−0.180	0.558	0.261	0.013
	(2.781)	(0.947)	(1.827)	(1.761)	(0.541)	(0.357)	(0.311)	(0.417)
Total assets	0.000	−0.001	−0.004**	−0.001	−0.007**	−0.003**	−0.004**	−0.003**
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.094***	0.074***	0.040***	0.051***	0.079***	0.135***	0.096***	0.050***
	(0.025)	(0.015)	(0.011)	(0.014)	(0.018)	(0.018)	(0.016)	(0.012)
2 year hazard	0.199***	0.363***	0.153***	0.140***	0.248***	0.291***	0.341***	0.258***
	(0.049)	(0.044)	(0.037)	(0.032)	(0.034)	(0.030)	(0.028)	(0.036)
3 year hazard	0.326***	0.639***	0.300***	0.228***	0.389***	0.482***	0.495***	0.397***
	(0.071)	(0.052)	(0.059)	(0.048)	(0.043)	(0.037)	(0.034)	(0.048)
4 year hazard	0.626***	0.788***	0.498***	0.477***	0.556***	0.578***	0.573***	0.498***
	(0.083)	(0.047)	(0.075)	(0.065)	(0.046)	(0.039)	(0.036)	(0.055)
5 year hazard	0.684***	0.912***	0.619***	0.613***	0.635***	0.667***	0.643***	0.540***
	(0.088)	(0.031)	(0.079)	(0.071)	(0.046)	(0.038)	(0.037)	(0.058)
6 year hazard	0.794***	0.956***	0.725***	0.670***	0.689***	0.750***	0.687***	0.571***
	(0.081)	(0.022)	(0.082)	(0.072)	(0.046)	(0.037)	(0.037)	(0.059)
7 year hazard	0.852***	0.984***	0.896***	0.731***	0.768***	0.786***	0.765***	0.636***
	(0.077)	(0.011)	(0.052)	(0.071)	(0.043)	(0.035)	(0.036)	(0.061)
8 year hazard	0.953***	0.998***	0.962***	0.792***	0.818***	0.846***	0.794***	0.704***
	(0.041)	(0.002)	(0.031)	(0.068)	(0.040)	(0.032)	(0.035)	(0.060)
9 year hazard	0.968***	0.999***	0.990***	0.873***	0.857***	0.878***	0.825***	0.762***
	(0.008)	(0.000)	(0.012	(0.056)	(0.037)	(0.030)	(0.034)	(0.059)
10 year hazard	0.995***	0.999***	1.000***	0.991***	0.998***	1.000***	0.989***	0.995***
	(0.002)	(0.000)	(0.000)	(0.007)	(0.001)	(0.000)	(0.004)	(0.002)
Log likelihood	−151.656	−399.448	−198.957	−214.840	−417.807	−711.905	−729.480	−408.944
Likelihood ratio test	58.879	104.764	73.730	77.080	69.853	118.972	115.360	95.475
Number of spells	53	119	77	79	126	192	206	128
	(2)–(1)	(2)–(3)		(2)–(4)	(2)–(5)		(2)–(6)	(2)–(7)
Log-rank test	10.229****	5.6676**		13.1585***	8.7254***		4.1689**	6.0313**
	(2)–(8)	(3)–(4)						
	8.6627***	2.1644						

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

completely alleviated.[31] Another issue with interpreting differences in hazards as evidence of either over- or underinvestment by a particular group of firms, is that the interpretations rely on assumptions about managerial incentives. If high deltas encourage efficient investment behavior, our results suggest overinvestment by group-2 firms (with no financial constraints, entrenched managers, and low pay-related incentives). On the other hand, high deltas may discourage the acceptance of certain types of (i.e., risky) positive NPV projects because of CEO diversification concerns. This leads to the interpretation that group-2 firms are investing efficiently, while other groups of firms underinvest. And while our analysis of the effects of Sarbanes-Oxley on investment behavior is also suggestive (of the conclusion that good governance mitigates overinvestment), sample constraints give us pause.

[31] Our Table 9 results on the influence of SOX on hazards also alleviates endogeneity concerns somewhat.

Table 9
The effects of SOX on investment hazards.

The table reports parameter estimates and baseline hazard rates for sample firms over a pre-SOX period (1990–2001) and a post-SOX period (2002–2007). Sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. The dependent variable is the number of years a firm has not exceeded the investment threshold. Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9 + data34)/data6). Cash flow is the sum of data18 and data14, divided by data6. Sales growth is the growth rate of sales, deflated by the producer price index. Total assets is Compustat data6. All other variables are defined as in Table 1, including two-digit industry and year effects. Standard errors are in parentheses. The significance level of the difference in hazard functions across groups is based on a log-rank test.

Coefficient	Full sample		Low *G*-Index		High *G*-Index	
	Pre-SOX	Post-SOX	(1) Pre-SOX	(2) Post-SOX	(3) Pre-SOX	(4) Post-SOX
Leverage	−0.042	−0.231	0.076	−0.001	−0.234	−0.397
	(0.255)	(0.252)	(0.372)	(0.396)	(0.367)	(0.361)
Cash flow	3.185***	1.596**	2.932**	1.354	3.442***	1.588
	(0.853)	(0.778)	(1.234)	(1.181)	(1.254)	(1.078)
Sales growth	1.134***	0.711**	0.767***	1.091***	1.294***	0.482
	(0.335)	(0.277)	(0.496)	(0.401)	(0.491)	(0.402)
Total assets	−0.001***	−0.001***	−0.001**	−0.001**	−0.002**	−0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
1 year hazard	0.175***	0.185***	0.161***	0.181***	0.187***	0.235***
	(0.011)	(0.013)	(0.015)	(0.019)	(0.095)	(0.019)
2 year hazard	0.377***	0.342***	0.336***	0.341***	0.441***	0.391***
	(0.016)	(0.017)	(0.022)	(0.023)	(0.261)	(0.023)
3 year hazard	0.496***	0.473***	0.459***	0.507***	0.567***	0.491***
	(0.018)	(0.018)	(0.025)	(0.025)	(0.334)	(0.025)
4 year hazard	0.586***	0.544***	0.556***	0.589***	0.658***	0.553***
	(0.019)	(0.018)	(0.026)	(0.025)	(0.367)	(0.026)
5 year hazard	0.676***	0.608***	0.644***	0.654***	0.761***	0.617***
	(0.019)	(0.018)	(0.026)	(0.024)	(0.372)	(0.026)
6 year hazard	0.725***	0.652***	0.711***	0.694***	0.791***	0.665***
	(0.019)	(0.017)	(0.025)	(0.024)	(0.371)	(0.025)
7 year hazard	0.764***	0.689***	0.741***	0.731***	0.844***	0.704***
	(0.018)	(0.017)	(0.025)	(0.023)	(0.355)	(0.025)
8 year hazard	0.795***	0.714***	0.769***	0.743***	0.882***	0.743***
	(0.018)	(0.017)	(0.025)	(0.023)	(0.335)	(0.025)
9 year hazard	0.806***	0.748***	0.962***	0.774***	0.907***	0.783***
	(0.018)	(0.016)	(0.007)	(0.022)	(0.318)	(0.024)
10 year hazard	0.985***	0.993***	0.986***	0.996***	0.998***	0.998***
	(0.005)	(0.001)	(0.008)	(0.001)	(0.066)	(0.001)
Log likelihood	−2927.074	−3634.998	−1437.100	−1617.589	−1112.952	−1571.061
Likelihood ratio test	350.377	156.844	179.314	135.839	206.389	140.507
Number of spells	931	392	458	190	473	202

	Pre-Post	(1)–(2)	(1)–(3)	(1)–(4)	(2)–(3)	(2)–(4)	(3)–(4)
Log-rank test	2.5208	0.403	3.0522*	0.0583	2.8146*	0.2096	2.8768*

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

In this section we examine how firms perform in both operating and stock return terms following large investment spikes. We do so to address both types of concerns listed above. Stock returns in particular are useful for addressing endogeneity concerns, as post-investment abnormal stock returns should not be influenced by these endogenous relations. Put simply, the value consequences of over- and underinvestment should present in *future* stock returns. Even if investment behavior and governance are correlated with an omitted variable, the omitted variable would have to change at the same time as the investment spike, to influence post-event abnormal returns. On the other hand, the underperformance subsequent to large investments fits naturally with our interpretation that poor governance associates with overinvestment.

Finally, we also examine how firm risk evolves over the years following these investments. Section 5.1 details results on operating performance. Section 5.2 presents long-run stock return results. Section 5.3 tests whether firm risk is lower when delta is high. Our tests focus on financially unconstrained, high *G*-Index firms that differ by their CEO pay-deltas. Those with low deltas (and according to Table 8, the highest investment hazards) are called group-2 firms (see above). Those with high deltas are called group-1 firms.

5.1. Operating performance changes following large investments

We measure long-run operating performance using the methodology of Loughran and Ritter (1997). Operating performance (for brevity) actually refers to peer-adjusted operating performance. Peers are chosen following Barber and Lyon (1996) and others. We choose the

Table 10

Operating performance measures.

Starting sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. We then create subsamples based on *G*-Index, financial constraints and delta. The table reports the median operating performance ratios for Group 2 (unconstrained, high *G*, and low delta) and Group 1 (unconstrained, high *G*, and high delta) firms; Group 2 (unconstrained, high *G*, and low delta) and Group 4 (unconstrained, low *G*, and low delta) firms. Operating performance refers to peer-adjusted operating performance. The matching procedure follows Barber and Lyon (1996) and Loughran and Ritter (1997). Matching firms with the same two-digit SIC code and closest size (within 10% difference) in year 0 and operating performance within 90% to 110% of the operating performance of sample firms in year −1 are selected. The adjusted operating income is the paired difference between the operating income of the sample firms and the operating income of their respective matching firms. The statistical tests are based on the Wilcoxon signed-rank test or the Wilcoxon rank-sum test.

Panel A: Median earnings before interest and taxes to assets (%)

Year	Group 2		Group 1		Difference in adjusted
	N	Adjusted	N	Adjusted	
+1	213	−1.83**	188	−0.41	1.42**
+2	201	−0.93	182	0.57	−1.50*
+3	189	−1.23	168	−0.05	−1.18
−1 to +1		−1.79***		0.04	−1.83**
−1 to +2		−1.21		0.42	−1.63*
−1 to +3		−1.30**		−0.02	−1.28**

Panel B: Median earnings before interest and taxes to assets (%)

Year	Group 2		Group 4		Difference in adjusted
	N	Adjusted	N	Adjusted	
+1	213	−1.83***	186	0.56	−2.39**
+2	201	−0.93	174	0.17	−1.10*
+3	189	−1.23	162	0.16	−1.39*
−1 to +1		−1.79***		0.58	−2.37**
−1 to +2		−1.21		0.23	−1.44*
−1 to +3		−1.30**		0.19	−1.49*

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

peer to match on two-digit SIC code and closest size and operating performance (each within 10% difference) in the year prior to the large investment year. Changes in operating performance equal the difference between (EBIT/Assets)[32] over the fiscal year preceding the event (large investment) and either one, two, or three years after the large investment year.

Table 10 presents the results. Financially unconstrained, high *G*-Index firms with low CEO deltas experience significant decreases in peer-adjusted operating performance.[33] This suggests that financially unconstrained and entrenched CEOs, with lower exposure to shareholder outcomes, are investing less efficiently than their peers when they make large investments. Combined with the fact that these firms exhibit the highest investment hazards, we infer that they are likely to be overinvesting. This interpretation is also consistent with the notion that firms typically face concave production functions.

By contrast, financially unconstrained, high *G*-Index firms with high CEO deltas (group 1) experience similar operating performance to their peers.[34] This suggests they are investing efficiently. Put differently, if they were underinvesting, we would expect operating profitability to be higher. Under-investing firms forego positive NPV projects. However, these untaken projects should be of lower profitability than the ones they do accept. The net effect of this will be to raise the average profitability of investments (made), even though the value implications of it are negative. Overall, our results do not support the underinvestment hypothesis (i.e., that CEOs with high deltas are discouraged from taking positive NPV projects perhaps because the projects are perceived as too risky given the CEO's lack of diversification). In other words, the long-run operating performance evidence suggests that higher deltas encourage CEOs to take value-enhancing projects and avoid value-destroying ones.

As a final check on our interpretation that weak governance associates with investment-based underperformance, we compare long-run operating performance for unconstrained, low-delta firms that differ by *G*-Index. This is a comparison of groups 2 and 4 from Table 8.

[32] Our results are robust to using OIBD/TA as a measure of operating performance.

[33] Underperformance is significant from the end of the fiscal year prior to the large investment through one (and also through three) year(s) after the large investment year. The negative change in peer-adjusted operating performance through year +2 is insignificant.

[34] When the peer-adjusted performance of group-1 firms carries a negative sign, it is always insignificant, it is an order of magnitude smaller in absolute value (compared to group-2 firms' peer-adjusted operating performance), and it is significantly better than group-2 firms' performance.

Table 11
Long-run stock returns.
Starting sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. We then create subsamples based on *G*-Index, financial constraints and delta. The table presents long-run stock returns for Group 2 (unconstrained, high *G*, and low delta) and Group 1 (unconstrained, high *G*, and high delta) firms; Group 2 (Unconstrained, high *G*, and low delta) and Group 4 (unconstrained, low *G*, and low delta) firms. In Panel A, we report buy-and-hold abnormal returns (BHAR) calculated as the peer-adjusted returns from the investment spike year to 1/2/3 years following the spike year. Following Barber and Lyon (1996) and others, BHAR peers are chosen by matching on industry (two-digit SIC), size, and book-to-market equity. BHAR1 is the one-year buy-and-hold abnormal return. BHAR2 is the two-year buy-and-hold abnormal return. BHAR3 is the three-year buy-and-hold abnormal return. In Panel B, we estimate Fama-French (1993) alphas, but including the momentum factor of Carhart (1997). The monthly data for the market, size, book-to-market factor, and momentum factor are obtained from Professor French's website.

Panel A: Buy-and-hold abnormal returns % (BHAR)

	Group 2		Group 1			
	Mean	Median	Mean	Median	Difference in mean	Difference in median
BHAR1	−13.77***	−14.86***	1.06	−5.02	*	***
BHAR2	−25.09*	−11.38*	−6.67	−3.81		
BHAR3	−31.44*	−15.44*	−17.04*	−1.32		
	Group 2		**Group 4**			
	Mean	Median	Mean	Median	Difference in mean	Difference in median
BHAR1	−13.77***	−14.86***	−3.13	1.02	***	
BHAR2	−25.09*	−11.38*	5.28	0.81	*	**
BHAR3	−31.44*	−15.44*	7.92	1.12	*	**

Panel B: Fama-French alphas

	Equal-weighted			Value-weighted		
	Group 2	Group 1	Diff=Group2−Group1	Group 2	Group 1	Diff= Group2-Group1
Intercept	−0.219	0.071	−0.291	−0.453*	0.167	−0.620**
	Equal-weighted			**Value-weighted**		
	Group 2	Group 4	Diff=Group2−Group4	Group 2	Group 4	Diff= Group2-Group4
Intercept	−0.219	0.226	−0.446*	−0.453*	0.038	−0.491*

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

We find that group-4 firms exhibit no significant abnormal performance following their spike investment year. This is statistically different from what we observe among group-2 firms. We confirm that poor governance associates with underperformance following large investments, suggesting overinvestment by this group.

5.2. Long-run stock returns post-investment

We offer additional evidence on the investment efficiency by group-1 and group-2 firms by studying shareholders' long-run experience in them. Long-run performance is measured using two opposing methodologies (event-time and calendar-time) because the literature on such measures continues to be contentious. We estimate BHARs (peer-adjusted long-term returns—see Barber and Lyon (1996)) and we also estimate Fama-French (1993) alphas, but including the momentum factor of Carhart (1997). Following convention, BHAR peers are chosen by matching on industry (two-digit SIC), size, and book-to-market equity. If the (mean or median) BHAR for a group is significantly negative, it suggests underperformance. Similarly, if the intercepts from Fama-French time-series regressions are significantly negative, this too suggests underperformance.

Table 11 presents our results. Panel A reports BHARs for group-2, group-1, and group-4 firms. Over either one year, two years, or three years, group-2 firms (those with the highest investment hazards) exhibit significantly negative mean and median BHARs. This underperformance suggests inefficient investment, and combined with the fact that these firms spike-invest most frequently, again suggests the problem is overinvestment. By contrast, group-1 firms' and group-4 firms' mean and median BHARs are insignificantly different from zero over both one and two years following the large investment year.[35] This suggests efficient investment behavior among group-1 firms.

Panel B, which reports Fama-French intercepts for group-2, group-1, and group-4 firms, also casts doubt on the notion that group-1 and group-4 firms' shareholders underperform over three years. Fama-French intercepts are insignificant (though they carry *positive* signs) for group-1 and group-4 portfolios, whether the firms are weighted equally or by market value in the portfolio. Again, this

[35] Over three years, group-1 firms exhibit significantly negative *mean* BHARs but the median is insignificant. Group-4 firms exhibit insignificant mean and median BHARs.

Table 12
Firm risk measures.
Starting sample is 7355 firm/years over 1990–2007, comprised as follows. For each observation we have data on *G*-Index (from RiskMetrics, formerly IRRC), we can calculate δ from ExecuComp data, and there is non-missing data on total assets, gross capital stock, and sales on Compustat. The firm is "small"—real assets are below the 33rd percentile of real assets of firms in the first year the test firm appears in the sample. We then create subsamples based on *G*-Index, financial constraints and delta. The table reports annualized equity volatility for Group 2 (unconstrained, high *G*, and low delta) and Group 1 (unconstrained, high *G*, and high delta) firms. Risk is the standard deviation of (monthly) stock returns measured in the event fiscal year. Risk-1 is the volatility in the prior fiscal year. Risk1 is the volatility in the fiscal year following the large investment year. Risk2 is the volatility in the second following fiscal year. Risk3 is the volatility in the third following fiscal year.

	Group 2		Group 1		Diff in mean	Diff in median
	Mean	Median	Mean	Median		
Risk-1	0.360***	0.333***	0.343***	0.312***		
Risk0	0.381***	0.353***	0.409***	0.388***	**	***
Risk1	0.364***	0.322***	0.381***	0.346***		
Risk2	0.364***	0.329***	0.371***	0.336***		
Risk3	0.346***	0.308***	0.381***	0.343***	**	*
Risk0–Risk-1	0.021**	0.021**	0.066***	0.076***		
Risk1–Risk-1	0.003	−0.010	0.038***	0.035***		
Risk2–Risk-1	0.003	−0.003	0.028**	0.024**		
Risk3–Risk-1	−0.014	−0.024**	0.038***	0.031**		

***, **, * Denote significance at the 1%, 5%, and 10% levels, respectively.

suggests group-1 and group-4 firms are investing efficiently. By contrast, the Fama-French intercepts are negative for group-2 firms, significantly so when the portfolio returns are weighted by the firms' market values. This too suggests (just like the BHARs and the operating performance results) that group-2 firms are investing inefficiently. Combined with our results from Section 4.3.5 (that group-2 firms have the highest investment hazards), we conclude that overinvestment is a problem among financially unconstrained, high *G*-Index firms with low CEO deltas. Our inference that good governance may mitigate overinvestment problems persists.

5.3. Firm risk following large investments

Table 12 presents estimates of spike firms' post-investment risk. We seek evidence on whether or not higher deltas discourage risk taking by CEOs who have diversification concerns, consistent with underinvestment due to the pursuit of the "quiet life." We measure risk as the standard deviation of stock returns over a fiscal year. The table reports (cross-firm) mean and median return annualized standard deviations for the large investment fiscal year (labeled *Risk*), the prior fiscal year (*Risk-1*), and the three fiscal years following the large investment year (respectively, *Risk1, Risk2, and Risk3*).[36] We compare these annual risk measures between groups 1 and 2. If higher CEO deltas discourage the taking of positive NPV projects because they are too risky (the CEOs have concerns with their lack of diversification), we expect to document lower risk measures for group-1 firms than for group-2 firms. We do not.

First, we find that risk is similar for the two groups in the year prior to the large investment (*Risk-1*). This suggests similar risk-taking incentives prior to the large investment event for the two types of firms delineated on delta. Second, over the fiscal year of the large investment, stock return volatility is significantly *higher* for group-1 firms than for group-2 firms. We also observe this in the third fiscal year following the large investment. In the first and second fiscal years following the large investment year, risk is not significantly different between the two groups. Combined, these results are inconsistent with high deltas discouraging risk taking when compared to low deltas (for firms with similar *G*-Index and lack of financial constraints).

However, our above interpretation ignores potentially complex relations between incentives and risk because the two are endogenously related (see Coles, Naveen, and Naveen, 2006). It is possible that high-delta firms deliberately set CEO compensation this way because their investments tend to be more risky, and shareholders want managers to exhibit caution. Given that their investments tend to be more risky (though this is not what we see in year −1), perhaps the higher risk in the investment year *would have been even higher*, but was mitigated by the diversification concerns of high-delta CEOs. Nevertheless, the preponderance of our evidence points toward the conclusion that good governance inhibits overinvestment rather than exacerbating underinvestment.

6. Conclusion

Prior studies of agency costs and investment behavior have often focused on acquisition announcements. We study the corollary of firm capital expenditures which often go unannounced. Ascertaining the relation between agency concerns and the efficiency of these events is complicated because of the need to control for the value of investment opportunities. Numerous papers investigating investment behavior utilize Tobin's *Q* as a proxy for investment opportunities, arguing that investment *unrelated* to such opportunities is inefficient, but measurement error concerns abound (Erickson and Whited, 2000). We take the alternative approach advocated by Whited (2006), estimating a hazard model to study large (spike) investment

[36] Calculated using monthly returns.

frequencies, somewhat side-stepping measurement error issues and other concerns that arise in investment-level regressions.

We study three factors that may influence the timing of large capital expenditures. We find that financial constraints, lack of managerial entrenchment, and high CEO deltas serve to reduce the frequency of these events. When firms are unconstrained and their managers are entrenched with low pay-based incentives, their hazards lie above those of other firms. Either lack of any constraints (financial, governance-related, or incentive pay-related) encourages overinvestment, or any one of these three (inefficiently) discourages large investments.

We distinguish between the over- and underinvestment interpretations by studying firm performance after the large investment. We find that the highest hazard firms significantly underperform benchmarks in both operating and stock return terms over the next three years. Moreover, the lack of consistent evidence of underperformance of benchmarks by other firms suggests efficient investment when one of the three types of constraints is in place. These results are most consistent with the view of overinvestment by financially unconstrained poor-governance firms posited above. We conclude that good governance and financial constraints mitigate overinvestment problems.

Interesting extensions remain. Hackbarth and Mauer (2010) show that capital structure and debt maturity structure influence firm investment behavior. Extending our empirical framework to test their model may prove fruitful.

Appendix: Investment level regressions

We test whether corporate governance affects investment levels using a linear regression framework for comparison with prior studies. We estimate these regressions both with and without correction for measurement error.

In a frictionless world, Tobin's marginal *Q* is the only determinant of investment (Tobin, 1969). However, empirical evidence suggests market imperfections such as information asymmetry (Myers and Majluf, 1984) and agency conflicts (Jensen, 1986) can influence investment decisions. We examine these imperfections by asking how corporate governance, finance constraints, and their interaction can affect investment level. We regress investment/assets on the following variables:

Tobin's Q is the ratio of asset market value to book asset value ((data6 − data60 + (data25 × data199))/data6).

Cash flow is the sum of Compustat data18 and data14, all divided by data6.

Unconstrained is a dummy variable that takes on the value of one if the firm is financially unconstrained (it paid a dividend in the prior fiscal year).

High G-Index is a dummy that takes on the value of one if the test firm's *G*-Index is above the median *G*-Index of firms in the first year that the test firm appears in the sample.

Log of assets is the natural log of total assets (data6) measured in 2007 dollars.

Leverage is the sum of long-term debt and debt in current liabilities, all divided by total assets ((data9 + data34)/data6).

All regressions include two-digit industry and year effects and statistical inferences are made using heteroskedasticity-consistent and autocorrelation-robust Newey-West asymptotic standard errors. Our key question is whether governance influences investment.

In the regressions that do not correct for measurement error, we find the coefficient on *High G*-Index is 0.006, positive and significant at the 1% level, suggesting firms with weak governance invest more than firms with strong governance. This is consistent with the conclusions of Richardson (2006) and Harford, Mansi, and Maxwell (2008).

It is also likely that investment and industry factors are strongly correlated, and that there is persistence in investment behavior. Therefore, we follow Harford, Mansi, and Maxwell (2008) and estimate the *change* in *industry-adjusted* capital expenditures, as a function of *prior G*-Index. We first calculate the industry median investment of all Compustat firms on a yearly basis ($i_{t,industry}$). The change in industry-adjusted capital expenditure is then $(i_t - i_{t,industry}) - (i_{t-1} - i_{t-1,industry})$. Regressions indicate that worse governance (high *G*-Index) associates with larger changes in industry-adjusted investment. This is again consistent with the extant literature suggesting overinvestment is a concern among poor-governance firms.

Next we repeat the levels regression, while controlling for measurement error as in Erickson and Whited (2000). We estimate three second-order moment equations and two third-order moment equations using variables not subject to measurement error (cash flow and leverage, in this case). This results in an exactly identified system of five equations and five unknowns, providing measurement error-consistent estimates that Erickson and Whited (2000) refer to as GMM3.[37]

Our results indicate that the regression relationship between investment and governance disappears after controlling for measurement error. The coefficient on the high *G*-Index dummy (indicating poor governance) drops to 0.001 with a corresponding *t*-statistic of 0.44. We also repeat the regression of change in industry-adjusted investment on governance, controlling for measurement error. The coefficient on the high *G*-Index dummy is now 0.001, insignificant at conventional levels (p-value = 0.28). The inferences of prior work using regression analysis of investment levels do not appear to be robust to measurement-error concerns.

References

Allison, P., 1995. Survival Analysis Using the SAS System: A Practical Guide. SAS Institute Inc., North Carolina.

[37] Adding fourth- and fifth-order product-moment equations along with third-order non-product-moment equations provides an overidentified system of equations, resulting in fourth- and fifth-order GMM estimates, referred to by Erickson and Whited (2000) as GMM4 and GMM5, respectively.

Barber, B., Lyon, J., 1996. Detecting long-run abnormal stock returns: the empirical power and specification of test statistics. Journal of Financial Economics 43, 341–372.

Bebchuk, L., Cremers, M., Peyer, U., 2007. Pay Distribution in the Top Executive Team. Unpublished Working Paper. Harvard University, Yale University, and INSEAD.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. Journal of Political Economy 111, 1043–1075.

Bøhren, O., Cooper, I., Priestley, R., 2007. Corporate Governance and Real Investment Decisions. Unpublished Working Paper. Norwegian School of Management.

Bond, S., Cummins, J.G., 2001. Noisy Share Prices and the Q Model of Investment. Unpublished Working Paper. Institute for Fiscal Studies, London, England.

Carhart, M., 1997. On persistence in mutual fund performance. The Journal of Finance 52, 57–82.

Chen, S., 2006. The economic impact of corporate capital expenditures: focused firms versus diversified firms. Journal of Financial and Quantitative Analysis 41, 341–355.

Childs, P.D., Mauer, D.C., 2008. Managerial discretion, agency costs, and capital structure. Unpublished Working Paper. University of Kentucky and Southern Methodist University.

Coles, J.L., Naveen, D.D., Naveen, L., 2006. Managerial incentives and risk taking. Journal of Financial Economics 79, 431–468.

Cooper, R., Ejarque, J., 2001. Exhuming Q: Market Power vs. Capital Market Imperfections. NBER Working Paper No. 8182.

Cooper, R., Haltiwanger, J.C., 2006. On the nature of capital adjustment costs. Review of Economic Studies 73, 611–634.

Core, J., Guay, W., 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. Journal of Accounting Research 40, 613–630.

Cummins, J.G., Hassett, K.A., Oliner, S.D., 2006. Investment behavior, observable expectations, internal funds. American Economic Review 96, 796–810.

Doms, M., Dunne, T., 1998. Capital adjustment patterns in manufacturing plants. Review of Economic Dynamics 1, 409–429.

Elsas, R., Flannery, M.J., Garfinkel, J.A., 2008. Major Investments, Firm Financing Decisions, and Long-run Performance. Unpublished Working Paper. Ludwig Maximilians University of Munich, University of Florida, and University of Iowa.

Erickson, T., Whited, T.M., 2000. Measurement error and the relationship between investment and *q*. Journal of Political Economy 108, 1027–1057.

Galai, D., Masulis, R., 1976. The option pricing model and the risk factor of stock. Journal of Financial Economics 3, 53–81.

Giannetti, M., 2003. On the Causes of Overlending: Are Guarantees on Deposits the Culprit? Unpublished Working Paper. Stockholm School of Economics.

Giroud, X., Mueller, H., 2010. Does corporate governance matter in competitive industries? Journal of Financial Economics 95, 312–331.

Gompers, P., Ishii, J., Metrick, A., 2003. Corporate governance and equity prices. Quarterly Journal of Economics 118, 107–155.

Hackbarth, D., Mauer, D.C., 2010. Optimal Priority Structure, Capital Structure, and Investment. Unpublished Working Paper. University of Illinois and Southern Methodist University.

Harford, J., Mansi, S., Maxwell, W.F., 2008. Corporate governance and a firm's cash holdings. Journal of Financial Economics 87, 535–555.

Hietala, P., Kaplan, S.N., Robinson, D.T., 2003. What is the price of hubris? Using takeover battles to infer overpayments and synergies. Financial Management 32, 5–31.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. American Economic Review 76, 323–329.

Kaplan, S., Zingales, L., 1997. Do financing constraints explain why investment is correlated with cash flow? Quarterly Journal of Economics 112, 169–216.

Lang, L., Stulz, R., Walkling, R., 1991. A test of the free cash flow hypothesis: the case of bidder returns. Journal of Financial Economics 29, 315–335.

Lewellen, W., Loderer, C., Rosenfeld, A., 1985. Merger decisions and executive stock ownership in acquiring firms. Journal of Accounting and Economics 7, 209–231.

Loughran, T., Ritter, J., 1997. The operating performance of firms conducting seasoned equity offerings. Journal of Finance 52, 1823–1850.

Masulis, R.W., Wang, C., Xie, F., 2007. Corporate governance and acquirer returns. Journal of Finance 62, 1851–1889.

Mayer, C., Sussman, O., 2005. A New Test of Capital Structure. Unpublished Working Paper. University of Oxford.

Meyer, B.D., 1990. Unemployment insurance and unemployment spells. Econometrica 58, 757–782.

Myers, S., Majluf, N., 1984. Corporate financing and investment decisions when firms have information that investors do not have. Journal of Financial Economics 13, 187–221.

Rajan, R., Servaes, H., Zingales, L., 2000. The cost of diversity: the diversification discount and inefficient investment. Journal of Finance 55, 35–79.

Richardson, S., 2006. Over-investment of free cash flow. Review of Accounting Studies 11, 159–189.

Roll, R., 1986. The hubris hypothesis of corporate takeovers. Journal of Business 59, 197–216.

Smith, C., Watts, R., 1992. The investment opportunity set and corporate financing, dividend, and financing policies. Journal of Financial Economics 32, 263–292.

Tobin, J., 1969. General equilibrium approach to monetary theory. Journal of Money, Credit and Banking 1, 15–27.

Whited, T.M., 2006. External finance constraints and the intertemporal pattern of intermittent investment. Journal of Financial Economics 81, 467–502.

Zhang, Y., 2009. Are debt and incentive compensation substitutes in controlling the free cash flow agency problem? Financial Management 38, 507–541.