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Executive Compensation, Macroeconomic Conditions, and Cash Flow Cyclicity

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Editor

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Executive Compensation, Macroeconomic Conditions, and Cash Flow Cyclicity*

Abstract

I model the joint effects of debt, macroeconomic conditions, and cash flow cyclicity on risk-shifting behavior and managerial pay-for-performance sensitivity. I show that risk-shifting incentives rise during recessions and that the shareholders can eliminate such adverse incentives by reducing the equity-based compensation in managerial contracts. I also show that this reduction should be larger in highly procyclical firms. Using a sample of U.S. public firms, I provide evidence supportive of the model's predictions. First, I find that equity-based incentives are reduced during recessions. Second, I show that the magnitude of this effect is increasing in a firm's cash flow cyclicity.

Keywords: risk-shifting, executive compensation, business cycle

JEL Classification: G32, J33, M52

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1 Introduction

Agency problems due to conflicts between equity and debt holders may lead to suboptimal investment decisions when debt is risky. In this respect, debt overhang (Myers, 1977) and risk-shifting (Jensen and Meckling, 1976) are the two most studied debt-related agency conflicts. A large literature suggests that these conflicts are countercyclical, as debt of procyclical firms becomes riskier in recessions (e.g., Bernanke and Gertler, 1989; Rampini, 2004). At the same time, a growing body of literature shows empirically and theoretically that the business cycle affects corporate policies, such as capital structure and investment choices (e.g., Korajczyk and Levy, 2003; Erel, Julio, Kim, and Weisbach, 2011; Guo, Miao, and Morellec, 2005). Moreover, recent papers highlight the importance of a firm's exposure to aggregate risk (what I call "cash flow cyclicity") for liquidity management and asset sales (Acharya, Almeida, and Campello, 2013; Arnold, Hackbarth, and Puhan, 2014). The firm-level relation between macroeconomic conditions, cash flow cyclicity, and executive compensation arrangements, however, remains largely unexplored.

In this paper, I try to fill this gap by arguing that a possible link between macroeconomic conditions and executive compensation at the firm-level is provided by the countercyclicity of agency costs of debt. The key intuition is that debt-related agency conflicts are more important in recessions because of an increase in debt riskiness, and especially so in highly procyclical firms. Given that these agency costs are eventually borne by shareholders, it is ex ante optimal for them to reduce the manager's compensation sensitivity to equity performance, to align more his interests with those of debt holders during recessions.

I focus on the risk-shifting problem as the economic mechanism underlying the relation between macroeconomic conditions and executive compensation. Whereas several studies analyze how debt overhang is affected by macroeconomic risk (Lamont, 1995; Philippon, 2010), the relation between risk-shifting and the business cycle has received little attention outside of the banking literature (e.g., Allen and Gale, 2000; Acharya, Mehran, and Thakor, 2011). Therefore, in this paper, I attempt to answer two questions. First, do shareholders react to the dynamics of risk-shifting throughout the business cycle by adjusting executive compensation? Second, if they do, is this relation substantially affected by the firm's degree of cash flow cyclicity?

Building on the theoretical framework of John and John (1993), I develop a stylized model to study the relation between managerial pay-for-performance sensitivity and cash flow cyclicity along the business cycle. First, I study how macroeconomic conditions and

the firm's cash flow cyclicalities affect the risk-shifting problem. I show that the higher the firm's cash flow cyclicalities (i.e., its correlation with macroeconomic conditions), the larger is the incentive to risk shift during recessions for an equity-aligned manager. Indeed, in my model, the face value of debt is fixed across macroeconomic states, so, in recessions, the debt recovery rate in default is lower and decreasing in cash flow cyclicalities. In other words, in recessions, a positive shock to cash flow cyclicalities engenders an increase in the value transfer from debt to equity that shareholders can appropriate by investing in riskier projects. Thus, an equity-aligned manager will have incentives to increase the risk of the firm's assets.

Second, I derive testable hypotheses relating the manager's pay-for-performance sensitivity (the sensitivity to stock performance of his annual compensation) to macroeconomic conditions and cash flow cyclicalities. Debt is priced at zero net present value (NPV) in the model. As a result, the agency costs related to risk-shifting are eventually borne by equity holders. Nevertheless, it is *ex post* (i.e., after debt is issued) optimal for an equity-aligned manager to risk shift, as the increased cost of debt is akin to a sunk cost. This is where executive compensation comes into play, serving as a commitment device to induce the manager to implement the *ex ante* optimal investment policy. In other words, executive compensation is meant to curb the agency conflicts between equity and debt holders. The model predicts that executive equity incentives are reduced during recessions in firms characterized by procyclical cash flows, and that the magnitude of such reduction is increasing in cash flow cyclicalities.

I test these predictions on a sample of Standard and Poor's (S&P) 1500 firms over the period 1992-2012. I use three different measures of managerial pay-for-performance sensitivity, each of which displays a different correlation with firm size, to reduce concerns that my findings are driven by size effects. I proxy for cash flow cyclicalities by means of the cash flow beta, i.e., a cash flow-based measure, to capture how the firm's profitability correlates with that of other firms in the economy.¹ As the estimation of cash flow cyclicalities is subject to measurement problems that may give rise to endogeneity, I measure cash flow betas at the industry-level, and also employ an instrumental variable approach.

In line with the model's predictions, I show that shareholders limit CEO pay-for-performance sensitivity during recessions. Furthermore, the magnitude of this reduction in incentives appears to be directly related to cash flow cyclicalities. These effects are found

¹By contrast, stock market-based measures of cyclicalities are prone to exhibit a mechanical relation with managerial equity incentives. In robustness tests, however, I also resort to the unlevered equity beta.

to be economically substantial, and robust to using several different sample definitions, measures of macroeconomic conditions and cash flow cyclicalities, and econometric techniques. I obtain similar results also for the pay-for-performance sensitivity of the entire top management team.

I carry out two further tests aimed at better identifying the economic mechanism underlying my results. First, I show that my predictions do not hold for low levered firms, for which risk-shifting incentives are arguably very small. Second, I verify the validity of an alternative explanation based on managerial power that might give rise to pay-for-performance sensitivity dynamics consistent with my main findings. Indeed, in recessions, powerful CEOs of highly procyclical companies, foreseeing poor performance, might decide themselves to reduce their equity incentives. However, restricting the analysis to a subsample of firm-years characterized by high managerial entrenchment, I find no support for this alternative hypothesis.

The reduction in CEO pay-for-performance sensitivity mainly stems from option incentives. Nevertheless, I provide evidence that my results are not simply driven by options going underwater to a larger extent in highly procyclical firms during recessions, mechanically reducing pay-for-performance sensitivity.² First, I illustrate that the same effects are present both measuring pay-for-performance sensitivity at grant date rather than at fiscal year-end, and looking at the number of awarded restricted shares and options (i.e., without weighting each option grant by its delta). Second, CEO wealth-for-performance sensitivity (the sensitivity to stock performance of CEO firm-specific wealth), despite being more sensitive to underwater options than pay-for-performance sensitivity, drops in recession periods, but such effect does not appear to be meaningfully related to cash flow cyclicalities.

Finally, based on the last result, I restrict the analysis to initial CEO incentives, namely in the year after a CEO change. The intuition is that initial compensation arrangements are closer to optimum, given that it becomes more difficult for shareholders to modify the entire CEO portfolio of equity incentives in later years of tenure (Gormley, Matsa, and Milbourn, 2013). I illustrate that initial CEO wealth-for-performance sensitivity indeed relates to macroeconomic conditions and cash flow cyclicalities as predicted by the model. This finding is robust to using a subsample of exogenous CEO dismissals.³

²It is also worth noting that recessions are usually characterized by higher volatility, which, in turn, increases the deltas of underwater options, thus reducing concerns that the observed reduction in pay-for-performance sensitivity is a mechanical consequence of poor stock performance.

³Most of the new CEOs in my sample are hired internally and have accumulated equity incentives in the years before their appointment as CEOs. This reduces concerns that their initial wealth-for-

This paper adds to the large empirical literature on executive incentive compensation.⁴ Recent studies by [Ortiz-Molina \(2007\)](#) and [John, Mehran, and Qian \(2010\)](#) assess the role of debt-equity conflicts, examining the relation between pay-for-performance sensitivity and capital structure. Both papers provide evidence supportive of the prediction of [John and John \(1993\)](#) that incentive compensation is decreasing in leverage. In the same spirit, [Chesney, Stromberg, and Wagner \(2012\)](#) analyze managerial incentives to take asset risk in financial institutions. However, the relation between CEO compensation and macroeconomic conditions has been generally overlooked. Few papers devote attention to this issue. [Eisfeldt and Rampini \(2008\)](#) provide aggregate evidence that managerial compensation and CEO turnover are procyclical. [Murphy \(2013\)](#) illustrates that firms use less stock options during recessions. [Cao and Wang \(2013\)](#) propose an agency model with CEO labor market frictions and find a negative relation between pay-for-performance sensitivity and systematic risk. [Schoar and Zuo \(2012\)](#) document that a CEO's managerial style is influenced by his macroeconomic experiences, in line with [Malmendier and Nagel \(2011\)](#). I contribute to this literature by examining the impact of macroeconomic conditions and cash flow cyclicity on executive compensation at the firm-level. To the best of my knowledge, this is the first paper to provide evidence consistent with the hypothesis that pay-for-performance sensitivity is optimally set to respond to the interactions between debt-equity conflicts and macroeconomic conditions.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical framework and develops testable predictions. Section 3 presents the empirical analysis. Section 4 concludes.

2 Model

In this section, I extend the framework of [John and John \(1993\)](#) to allow for uncertainty about future macroeconomic conditions and different degrees of cash flow cyclicity.

I consider a model with three dates ($t = 0, 1, 2$) and two periods. Agents are risk neutral, and the risk-free rate is assumed to be zero. The economy can be in two different macroeconomic states, G (expansion) and B (recession). At $t = 0$, the economy starts into one of these two states. A macroeconomic shock takes place between $t = 0$ and $t = 1$, while at $t = 2$ the economy stays in the same state reached at $t = 1$. The passage from the $t = 0$ macroeconomic state to the $t = 1$ one is governed by a set of transition

performance sensitivity is simply equal to pay-for-performance sensitivity.

⁴See, for instance, [Jensen and Murphy \(1990\)](#), [Gibbons and Murphy \(1992\)](#), [Hall and Liebman \(1998\)](#), and [Aggarwal and Samwick \(1999\)](#).

probabilities such that $\pi_{GG} > \pi_{GB}$ and $\pi_{BG} < \pi_{BB}$, where π_{sj} , $s, j = \{G, B\}$ is the probability that the economy goes from state s at $t = 0$ to state j at $t = 1$.

Equity holders delegate the firm's management to a manager, whose interests are perfectly aligned with those of shareholders. In other words, the manager's compensation is perfectly linked to shareholders' wealth.

At $t = 0$, I consider a fictitious distinction between $t = 0^-$ and $t = 0^+$ to make the model more intuitive. At $t = 0^-$, equity holders set the managerial compensation contract,⁵ while the manager chooses the investment policy at $t = 0^+$. At $t = 0^+$, the manager has access to two investment opportunities, one safe and one risky project, both paying off at $t = 2$. The safe asset bears macroeconomic risk, but no idiosyncratic risk. The safe project (at least safer) pays off θI and I/θ in state G and B , respectively. The risky project yields θH (H/θ) with probability q , and θL (L/θ) with probability $1 - q$, if at $t = 2$ the economy is in state G (B). Both projects outlay is θI if at $t = 1$ the economy is in state G , and I/θ if it is in state B .

The cyclical nature of investment projects is tied to the parameter θ : If $\theta > 1$, the firm is characterized by procyclical investment opportunities (larger investment and cash flows in state G); If $\theta < 1$, the firm is characterized by countercyclical investment opportunities (larger investment and cash flows in state B).

The expected rate of return of both investment projects does not depend on macroeconomic conditions. What makes the investment opportunities cyclical is their scale. Focusing on the procyclical case, the manager can undertake more growth options when the economy is expanding. Indeed, once the investment policy is set at $t = 0^+$, the funds are invested only at $t = 1$, making the size of the project random. The funds committed, which are the same regardless of the project picked, are either θI in G or I/θ in B . This is why the "safe asset strategy" is not truly riskless. Still, it is less risky, as it is not exposed to idiosyncratic risk, giving zero NPV in every state of nature.

An investment strategy is defined by the minimum probability of success, \hat{Q} , above which the risky project is undertaken, i.e., a probability threshold. As in [John and John \(1993\)](#), the probability of success, q , is observed at $t = 0^+$ only by the manager. Hence the chosen investment strategy is a private action and cannot be contracted upon. However, at $t = 0^-$ it is common knowledge that q is uniformly distributed over $[0, 1]$. As a consequence, at $t = 0^-$ the equity holders know that the probability of investing in the risky project and being successful is $\int_{\hat{Q}}^1 q dq$, the probability of investing in the risky project and failing is $\int_{\hat{Q}}^1 (1 - q) dq$, and the probability of investing in the safe asset is

⁵The features of the contract are described in Section [2.2.2](#).

$\int_0^{\hat{Q}} dq$. The equity holders observe the state of the economy. At $t = 1$ funds are invested according to the investment policy decided at $t = 0^+$. At $t = 2$, the firm's assets pay off and all the claims are settled.

After the managerial incentives are set at $t = 0^-$, debt with face value F due at $t = 2$ is issued. F is exogenous, but the market value of debt at $t = 0^-$, denoted as $V_0(F)$, is endogenous.⁶ The capital market is competitive, ensuring that the debt is always priced at zero NPV.⁷

Equity holders have deep pockets, i.e., they can always finance the difference between the investment outlay ($I\theta$ in state G and I/θ in state B) and the funds raised with debt (with face value F) with new equity. The timing of the model is summarized in Figure 1.

To have default only in case of failure of the risky project and obtain clear-cut comparative statics, I assume that the following assumptions on parameters hold throughout the paper:

- (i) $\frac{I}{\theta} > F$ and $\theta I > F$;
- (ii) $\frac{L}{\theta} < F$ and $\theta L < F$;
- (iii) $\sqrt{\frac{1-\pi_{GG}}{\pi_{GG}}} < \theta < \sqrt{\frac{1-\pi_{BG}}{\pi_{BG}}}$.

Assumptions (i) and (ii) are needed in order to have default only in case of failure of the risky project. The other cases yielding tractable results, namely riskless debt and default even on the safe project, lead to trivial implications. In the former case, riskless debt, the same optimal investment policy as in the all-equity firm is reached, while in case of default also on the safe project, the equity-aligned manager is forced to pick always the risky project as the benefits would go only to debt holders otherwise, i.e., the probability threshold would be zero. Assumption (iii) is key to the empirical predictions of the paper. However, it is not particularly restrictive as it accommodates for a large heterogeneity in the degree of firms' cash flow cyclicalities. This can be easily seen numerically: For instance, given that the π_{GG} and π_{BG} estimates from the business cycle dates presented in Table I of [Chauvet and Hamilton \(2005\)](#) are 0.95 and 0.78, respectively, assumption (iii) implies that θ can range between 0.23 and 1.88, an interval of values that allows

⁶ $V_0(F)$ denotes the funds raised by the firm issuing this debt.

⁷Managerial incentives are common knowledge, so bond holders' rational expectation about investment policy fully incorporate them. In this rational expectations equilibrium, agency costs of debt are thus eventually borne by shareholders.

a large dispersion across firms in terms of cyclicity of investment opportunities. In the remainder of the paper, I restrict the analysis to the procyclical case, i.e., $\theta > 1$, as it is more relevant from an empirical point of view. It is also worth noting that [Gourio \(2007\)](#) provides empirical support to the existence of substantial heterogeneity in cash flow cyclicity across firms.

In the following sections, I examine the distortions caused by risky debt on the investment policy chosen by the manager. After deriving the firm-value-maximizing investment policy, I show how defaultable debt induces the equity aligned manager to risk shift and deviate from the first-best investment policy, and how this behavior is related to cash flow cyclicity. Intuitively, what makes the manager choose a suboptimal investment strategy is the nature of residual claimants of equity holders, i.e., the convexity of their payoff stemming from limited liability. Indeed, when debt is risky, the downside risk of projects is not fully internalized by shareholders. By investing in negative NPV risky projects, shareholders give rise to a positive value transfer from debt to equity, even though firm value decreases. Finally, I show that in this framework a linear compensation contract induces firm-value-maximizing behavior.

2.1 *First-best benchmark*

Consider an all-equity firm in which the manager's incentives are perfectly aligned with equity holders' interests through compensation. This amounts to having the manager maximizing firm value, following the customary NPV rule:

$$\pi_{sG}(q\theta H + (1 - q)\theta L) + (1 - \pi_{sG})(qH/\theta + (1 - q)L/\theta) \geq \pi_{sG}\theta I + (1 - \pi_{sG})I/\theta,$$

where the left-hand (right-hand) side is the NPV of the risky (safe) project. This inequality yields the optimal investment policy (FB , first best), which consists in investing in the risky project whenever its realized probability of success, q , is larger than:

$$Q_{FB} := \frac{I - L}{H - L}. \tag{1}$$

In this simple framework, the optimal investment policy in the all-equity firm is not affected by macroeconomic conditions. The probability threshold Q_{FB} guarantees the implementation of the NPV rule in its basic form, which amounts to maximizing the value of the firm, that here is equal to the value of equity.

2.2 Levered firm

I now introduce risky debt. The manager's objective is to maximize equity value for a given debt level F :

$$\pi_{sG}q(\theta H - F) + (1 - \pi_{sG})q(H/\theta - F) \geq \pi_{sG}(\theta I - F) + (1 - \pi_{sG})(I/\theta - F), \quad (2)$$

where the left-hand (right-hand) side is the NPV of the risky (safe) project. Inequality (2) boils down to the following minimum threshold:

$$Q_{Lev} := \frac{(\pi_{sG}\theta + (1 - \pi_{sG})/\theta)I - F}{(\pi_{sG}\theta + (1 - \pi_{sG})/\theta)H - F}. \quad (3)$$

The cutoff level (3) is always between zero and one, thanks to the restriction $H > I$, consistent with being a probability threshold, and is always smaller than Q_{FB} , meaning that the manager, in presence of risky debt, undertakes an investment policy riskier than the optimal one regardless of the assumptions about cash flow cyclicity, as stated in the following proposition.

Proposition 1. *When the manager is perfectly aligned to equity holders, the presence of defaultable debt always yields suboptimal and riskier investment policies with respect to the all-equity firm.*

Whereas in the first-best benchmark the investment policy, as defined by Q_{FB} , does not depend on macroeconomic conditions, in the levered case it depends both on the current and future macroeconomic regime as in [Guo, Miao, and Morellec \(2005\)](#).

2.2.1 Comparative statics on risk-shifting

It is possible to derive a set of results about how macroeconomic conditions and cash flow cyclicity influence investment policy. First, I assess the effect of current macroeconomic conditions on the manager's risk-shifting incentives.

Proposition 2. *Given the realized state of the economy at $t = 0$, the degree of risk-shifting is higher in state B than in state G.*

It is also of interest to study the relation between risk-shifting incentives and θ , the parameter capturing the cyclicity of investment opportunities.

Proposition 3. *Risk-shifting incentives are increasing (decreasing) in cyclicity θ , if the economy is in state B (G) at $t = 0$.*

It is interesting to examine the economic forces behind Proposition 3. Risk-shifting arises whenever the loss borne by shareholder implied by a negative NPV project is more than offset by the value transfer from debt holders to equity holders.

The firm's incremental benefit from investing in the risky project with respect to the safe one is:

$$\Delta NPV = NPV_{\text{Risky}} - NPV_{\text{Safe}} = \left(\pi_{sG}\theta + \frac{(1 - \pi_{sG})}{\theta} \right) (qH + (1 - q)L - I).$$

On the other hand, the incremental market value of debt at $t = 0^+$ from investing in the risky project with respect to the safe one, that is the value transfer from equity holders to debt holders, is:

$$\Delta V_0(F) = V_0(F)_{\text{Risky}} - V_0(F)_{\text{Safe}} = (1 - q) \left[L \left(\pi_{sG}\theta + \frac{(1 - \pi_{sG})}{\theta} \right) - F \right] < 0.$$

This transfer is always negative, i.e., debt holders subsidize equity when the risky project is picked. Therefore, in light of these measures, the NPV rule (2) can be written as:

$$\underbrace{\left[\pi_{sG}\theta + \frac{(1 - \pi_{sG})}{\theta} \right] (qH + (1 - q)L - I)}_{\Delta NPV} \geq \underbrace{(1 - q) \left[L \left(\pi_{sG}\theta + \frac{(1 - \pi_{sG})}{\theta} \right) - F \right]}_{\Delta V_0(F)|_0}, \quad (4)$$

where the left-hand side is the firm's incremental benefit from investing in the risky project, ΔNPV , and the right-hand side is the (always negative) value transfer from equity holders to debt holders if the risky project is picked, $\Delta V_0(F)$. In presence of debt, the manager will invest in the risky project only if its incremental NPV is larger than the value transfer to debt holders. Furthermore, as established in Section 2.1, $\Delta NPV > 0$ only if $q > Q_{FB}$, whereas $\Delta V_0(F)$ is always negative.

As already shown, it is always optimal to undertake the risky project when $q \geq Q_{FB}$, therefore I will focus on the interval $q < Q_{FB}$, when $\Delta NPV < 0$. Below I show how, in bad times, the inequality (4) is more easily satisfied as the degree of cyclicity increases, consistent with Proposition 3.

I start with the left hand side of inequality (4), the benefit from risk-shifting in terms of expected NPV to equity holders. The derivative of this expected benefit with respect

to θ is given by:

$$\frac{\partial \Delta NPV}{\partial \theta} = ((1 + \theta^2)\pi_{sG} - 1) \underbrace{\frac{qH + (1 - q)L - I}{\theta^2}}_{<0}, \quad q \leq Q_{FB}. \quad (5)$$

By assumption (iii), the derivative in (5) is positive in state B and negative in state G , meaning that the expected loss from investing in the risky project, $\Delta NPV < 0$, becomes smaller during recessions as the cyclicality of investment opportunities increases. Therefore, when $q < Q_{FB}$ and the economy is in recession, ceteris paribus the NPV condition (4) is more easily satisfied as investment opportunities become more procyclical. When the economy is in recession at $t = 0^+$, an increase in θ makes the risky project more appealing to the equity-aligned manager, because it implies a smaller equity value loss at $t = 0^+$. Indeed, if at $t = 0^+$ the economy is in recession, it is more likely to stay in recession even at $t = 1$, yielding a smaller decrease in equity value at $t = 0$ as θ increases.⁸

An increase in θ affects also the value transfer from debt holders to equity holders, which is magnified in recessions. Indeed, in my model, the face value of debt is fixed across macroeconomic states, so, in recessions, the debt recovery rate in default is lower and decreasing in cash flow cyclicality. This effect emerges taking the partial derivative of the right-hand side of inequality (4) with respect to θ :

$$\frac{\partial \Delta V_0(F)}{\partial \theta} = ((1 + \theta^2)\pi_{sG} - 1) \frac{(1 - q)L}{\theta^2}. \quad (6)$$

The derivative (6) is positive in good times and negative in bad times, hence the value transfer to debt holders (always negative in this setup) increases in magnitude in bad times, yielding higher incentives to risk shift. The reasons are similar to those presented for the left-hand side of inequality (4). So, in general, if the degree of cyclicality increases, inequality (4) will be more easily satisfied when the economy is in recession at $t = 0$.

Behind this whole phenomenon, the residual claim nature of equity looms, linking the left and right hand side of (4). Indeed, equity can be viewed as a call option on the firm's assets with exercise price equal to the face value of outstanding debt, F . So, for $q < Q_{FB}$, if the equity-aligned manager invests in the risky project, the total value of assets at $t = 0^+$ is smaller than F , and the call option is out-of-the-money. An increased

⁸When $q < Q_{FB}$, the expected loss from investing in the risky project, contingent on being in G at $t = 1$, is $(qH + (1 - q)L - I)\theta$, while if at $t = 1$ the economy is in B the expected loss is $(qH + (1 - q)L - I)/\theta$. Clearly the latter becomes smaller as θ increases, while the opposite is true for the former.

risk of the underlying, i.e., the firm's assets, makes the option worthier. And that is exactly what happens when a positive shock to θ is introduced. Specifically, this shock increases the exposition of the risky asset to the business cycle, thus augmenting its risk. This, in turn, makes it more desirable to the equity-aligned manager during recessions. Moreover, this effect is magnified by the fact that not only the terminal cash flows depend on θ , but also the initial outlay.

Finally, notice that in this model the probability of default conditional on picking the risky project is $1 - q$ in both macroeconomic states. Hence, in this model a firm's cyclicity does not lie in the probability of default, but in the payoffs earned (and in the debt recovery rate in default), as the default depends only on the idiosyncratic risk of the risky project.

2.2.2 Comparative statics on optimal compensation

As debt is priced at zero NPV, equity holders bear the cost of investment distortions. Consequently, ex ante they set an optimal compensation aimed at reducing the manager's adverse investment incentives and committing him to firm value maximization. I show that the first-best investment policy, Q_{FB} , can be attained through a reduction of the equity-aligned manager's sensitivity to shareholders' wealth. Equity holders, who rationally anticipate manager's incentives to risk shift, make this decision at $t = 0^-$. I adopt the approach of [John and John \(1993\)](#), hence the managerial compensation contract $\{P, \psi, \alpha\}$, which is linear, consists of a fixed salary P , a penalty ψ in case of default, and a component tied to the equity performance of the firm, as defined by α . The fixed part of the contract, P , is undetermined in the model and assumed to be such that the whole compensation package is in line with the salary clearing the competitive managerial labor market. The penalty, ψ , is assumed to be a parameter describing the costs transferred to the manager in default states (for instance, the cost of searching for a new job).

To maximize his payoff under the compensation contract above, the manager invests in the risky project if:

$$\begin{aligned} & \pi_{sG}\{q(\alpha(\theta H - F)) + (1 - q)\psi\} + \\ & (1 - \pi_{sG})\{q(P + \alpha(H/\theta - F)) + (1 - q)\psi\} \geq \pi_{sG}\alpha(\theta I - F) + (1 - \pi_{sG})\alpha(I/\theta - F), \end{aligned}$$

where the left-hand (right-hand) side is the managers' expected payoff if he picks the

risky (safe) project. Thus the following threshold can be easily derived:

$$Q_{Mgr}(\alpha) := \frac{\psi + \alpha (\pi_{sG}(\theta I - F) + (1 - \pi_{sG})(I/\theta - F))}{\psi + \alpha (\pi_{sG}(\theta H - F) + (1 - \pi_{sG})(H/\theta - F))}. \quad (7)$$

The optimal incentive parameter $\hat{\alpha}$, i.e., the one solving $Q_{Mgr}(\alpha) - Q_{FB} = 0$, is:

$$\hat{\alpha} := \frac{\psi}{F - L(\pi_{sG}\theta + (1 - \pi_{sG})/\theta)} \quad (8)$$

The following implication examines the effect of macroeconomic conditions on the optimal incentive compensation.

Proposition 4. *Given the realized state of the economy at $t = 0$, the optimal incentive compensation, as defined by $\hat{\alpha}$, is lower (higher) in state B than in state G .*

It is also possible to study the effect of the degree of cyclicity on the optimal incentive compensation.

Proposition 5. *The optimal incentive compensation, as defined by $\hat{\alpha}$, is decreasing (increasing) in cyclicity, θ , if the economy is in state B (G) at $t = 0$.*

More intuitively, risk-shifting incentives are higher during recessions in procyclical firms. Moreover, during recessions, the more procyclical is a firm, the more severe risk-shifting problem it faces. As a consequence, the equity holders of a procyclical firm will find it ex ante optimal to lower the pay-for-performance sensitivity in bad times, thus committing the manager to firm value maximization. In fact, in such periods debt would become less worthy for the effect of larger ex post risk-shifting incentives otherwise, eventually destroying firm value.

2.3 Empirical predictions

The empirical predictions of the model concern the interactions among the optimal incentive compensation, cash flow cyclicity, and macroeconomic conditions.⁹ The model is static, thus the manager's pay-for-performance sensitivity (the sensitivity to stock performance of his annual compensation) coincides with his wealth-for-performance sensitivity (the sensitivity to stock performance of his firm-specific wealth). However, whereas

⁹Although the model also yields results about risk-shifting behavior throughout the business cycle, providing direct evidence of such phenomenon is beyond the scope of this paper. In other words, risk-shifting serves as the economic channel shaping managerial incentives. For empirical evidence of risk-shifting, see, e.g., [Eisdorfer \(2008\)](#), [Hovakimian and Kane \(2000\)](#), and [Landier, Sraer, and Thesmar \(2011\)](#).

shareholders can directly set annual compensation policy, they have limited control of outstanding incentives (because of executives exercising options or stock price dynamics), which account for a large part of the manager’s firm-specific wealth. Shareholders try to attain the optimal wealth-for-performance sensitivity through new grants (see, e.g., [Core and Guay, 1999](#)). Hence, new grants better reflect shareholders’ current preferences. For this reason, the empirical predictions of the model, which I summarize below, are stated in terms of pay-for-performance sensitivity, in line also with [Cao and Wang \(2013\)](#). Moreover, I restrict the attention to firms with procyclical cash flows, given that very few S&P 1500 firms are countercyclical. Finally, I focus on recession periods, as it can be argued that a firm’s exposure to macroeconomic risk is substantially more important for conflicts of interests between equity and debt holders during such periods (see, e.g., [Chen and Manso, 2010](#)).

Propositions 4 and 5 deliver two novel predictions.

PREDICTION 1: *Pay-for-performance sensitivity is lower in recessions.*

PREDICTION 2: *Pay-for-performance sensitivity is decreasing in cash flow cyclicalities during recessions.*

3 Empirical analysis

3.1 Data

I consider a sample of U.S. public firms. I merge executive compensation data from Standard and Poor’s Execucomp with stock market data from the Center for Research in Security Prices (CRSP), and accounting data from Compustat for the period 1992 to 2012. I exclude financial institutions, utilities, and firm-years with negative or missing assets or sales. I require each firm to have traded ordinary shares (CRSP share code 10 or 11). Finally, I obtain macroeconomic data from FRED, St. Louis Federal Reserve Bank. The final sample contains 2,441 unique firms, 5,296 CEOs, and 27,299 firm-year observations.¹⁰ For additional tests, I use corporate governance data from IRRC for the period 1992 to 2006 and Riskmetrics for the period 2007 to 2012, and I hand-collect data about stock option repricings for the period 2005 to 2010.

Using these data sources, I compute the following variables.

¹⁰In line with [Ortiz-Molina \(2007\)](#), I set equity incentives components reported as missing in Execucomp to zero.

Pay-for-performance sensitivity. The main dependent variable in my tests is CEO pay-for-performance sensitivity.¹¹ I perform the empirical analysis below using all the three measures of ex ante pay-for-performance sensitivity at fiscal year-end discussed by [Edmans, Gabaix, and Landier \(2009\)](#). The first one, denoted as b^I as in [Edmans, Gabaix, and Landier \(2009\)](#), is defined as:

$$b^I = \frac{(\Delta \times \text{Number of options granted} + \text{Number of shares granted}) \times \text{Stock price}}{\text{Flow compensation}},$$

where Δ is the option delta, and *Flow compensation* is the total annual compensation from salary, bonus, and new grants of stock and options.¹² This measure was first introduced by [Gibbons and Murphy \(1992\)](#) in ex post terms. It is computed as the fraction of annual equity incentives over total annual compensation, and can be interpreted as the elasticity of annual pay to firm value.

The second measure, denoted as $PPS_{\$}$, proxies for the executive’s dollars at stake, i.e., the dollar change (in thousands) in the executive’s annual compensation for a 1% change in firm value, and is computed as:

$$PPS_{\$} = (\Delta \times \text{Number of options granted} + \text{Number of shares granted}) \times \frac{\text{Stock price}}{100},$$

where Δ is the option delta. This measure was proposed in ex post terms by [Hall and Liebman \(1998\)](#), among others.

The third measure, denoted as $PPS_{\%}$, can be interpreted as the executive’s effective ownership from compensation, namely the dollar change in the executive’s annual compensation for a \$1 change in firm value. It is defined as:

$$PPS_{\%} = \frac{\Delta \times \text{Number of options granted} + \text{Number of shares granted}}{\text{Number of shares outstanding}},$$

where Δ is the option delta. [Jensen and Murphy \(1990\)](#) advocate the use of $PPS_{\%}$.

[Edmans, Gabaix, and Landier \(2009\)](#) argue that b^I , among the three measures, is the least affected by firm size. $PPS_{\$}$ is appropriate for actions that scale with size. Conversely, $PPS_{\%}$ represents the best measure “for activities whose dollar impact is the

¹¹I identify CEOs using Execucomp variables `becameceo` and `leftofc`, because `ceoann`, as pointed out by [Himmelberg and Hubbard \(2000\)](#), is often missing in the first year the CEO enters the sample. For the remaining firm-years without a CEO, I assume that the executive officer with highest total compensation, `tdc1`, is the CEO. Throughout this paper, original variable names in Execucomp, Compustat, and CRSP are typed in verbatim font.

¹²Further details about the computation of option deltas are provided in [Appendix B.1](#).

same regardless of the size of the firm” (Frydman and Saks, 2010). In other words, the last two measures have opposite correlations with firm size. Therefore, I consider all of these proxies to lessen concerns about the possibility that my results are driven by size effects.

For further analysis, I also compute CEO wealth-for-performance sensitivity (the sensitivity to stock performance of his entire portfolio of equity incentives), and the mean and median pay-for-performance sensitivity of the top five executives reported in Execucomp.¹³ The measures of wealth-for-performance sensitivity corresponding to b^I , $PPS_{\$}$, and $PPS_{\%}$ are computed following the “one-year approximation method” of Core and Guay (2002), and denoted as B^I , $WPS_{\$}$ and $WPS_{\%}$, respectively, as in Edmans, Gabaix, and Landier (2009). More details are provided in Appendix B.1.

Finally, it is worth noting that the accounting treatment of stock options underwent a major change in 2005 following the enforcement of FAS 123R. I follow Hayes, Lemmon, and Qiu (2012) and Coles, Daniel, and Naveen (2014) to reach coherent compensation measures around this regulation change. Further details about this procedure are provided in Appendix B.1.

Macroeconomic conditions. As usual in the literature, I rely on the business cycle dates provided by the NBER to capture macroeconomic conditions. In particular, I consider a firm-year as in recession if it belongs to a recession period according to the NBER. In robustness tests, I identify bad macroeconomic states looking at the three-month moving average of the Chicago Fed National Activity Index (CFNAI), and at the GDP growth rate.

Cash flow cyclicality. I measure a firm’s cash flow cyclicality by means of the cash flow beta, *Beta cash flow*, as defined by Acharya, Almeida, and Campello (2013). This measure is based directly on cash flows rather than on stock market data. Hence, it allows me to reduce concerns that my findings are driven by a mechanical relation between stock option deltas and stock prices, as it might be the case if I used equity betas. The estimation of cash flow cyclicality is a non-trivial task, and is particularly prone to measurement error. To deal with endogeneity from measurement error, I compute *Beta cash flow* at the three-digit SIC code industry level as in Acharya, Almeida, and Campello (2013).¹⁴ In particular, using quarterly data, I estimate *Beta cash flow* by regressing the aggregate

¹³Execucomp usually reports the top five executives, but for some firms up to nine executives are reported (see Edison Inc., for instance).

¹⁴Several authors argue and provide evidence that asset exposure to aggregate risk, i.e., cash flow cyclicality, is homogeneous within industries (see, e.g., Faff, Brooks, and Kee, 2002; Korteweg, 2010).

industry cash flow on the aggregate cash flow across the Compustat universe (excluding financial institutions and utilities) over the last ten years. An industry-year is classified as highly procyclical if it belongs to the top tercile of *Beta cash flow*, where the tercile threshold is obtained year-by-year over the Compustat universe rather than on the final sample, to better proxy for a firm’s cash flow cyclicalities relative to other firms in the economy. If this condition is satisfied, the indicator *Beta cash flow T3* is set equal to one. Despite the potential mechanical effects pointed out above, as a robustness test, I also use a market-based measure of cash flow cyclicalities, *Beta asset*, unlevering the equity beta estimated over the last 36 months at the firm-level.¹⁵ The use of this measure is motivated by [Gourio \(2007\)](#), who provides a theoretical and empirical link between betas and cash flow cyclicalities.

Leverage. I measure market leverage as the ratio of total debt to the market value of assets. In unreported tests, I also proxy for leverage by means of long-term market leverage, and of the measures used by [John, Mehran, and Qian \(2010\)](#).¹⁶ Consistent with [Hackbarth, Miao, and Morellec \(2006\)](#), [Halling, Yu, and Zechner \(2014\)](#) show that both observed and target leverage ratios exhibit countercyclical dynamics. Such behavior is broadly in line with the assumption of debt face value fixed across macroeconomic states in my model, which, in turn, leads to higher loss given default for debt holders in recessions.

Other variables. In the pay-for-performance sensitivity regressions, I include a set of control variables in line with the literature (see e.g., [Hall and Knox, 2002](#); [Himmelberg, Hubbard, and Palia, 1999](#)). Though my analysis is mostly concerned with pay-for-performance sensitivity, which is affected to a lesser extent by options going underwater than wealth-for-performance sensitivity, I control for stock market valuation by means of the market-to-book ratio.¹⁷ I also control for firm size (total assets), squared size, discretionary expenses (such as research and development, and advertising), capital expenditures, cash holdings, the return on assets, sales growth, and CEO characteristics (age and tenure).¹⁸

¹⁵To unlever it and obtain the asset beta, *Beta asset*, I follow [Kemsley and Nissim \(2002\)](#).

¹⁶[Barnea, Haugen, and Senbet \(1980\)](#) argue that long-term leverage is the most relevant for risk-shifting incentives.

¹⁷Indeed, as recessions tend to coincide with a general decrease in stock prices, it is more difficult to attribute a reduction in wealth-for-performance sensitivity in bad macroeconomic states to the economic channel underlying Prediction 1.

¹⁸*Ceteris paribus*, firms with more liquid assets generally tend to risk shift more ([Smith and Warner, 1979](#)).

Table 1 presents the summary statistics for data used in my tests. Panel A reports the descriptive statistics for the whole sample. The average b^I , $PPS_{\$}$, and $PPS_{\%}$ are 0.63, \$37.08 thousand, and 0.17%, respectively. It emerges that pay-for-performance sensitivity mainly stems from stock options. However, following the adoption of FAS 123R, restricted stock awards gained prominence. In line with the literature (see, e.g., [Edmans, Gabaix, and Landier, 2009](#)), the average B^I , $WPS_{\$}$, and $WPS_{\%}$ are 20.47, \$590.81 thousand, and 3.29%, respectively. The average *Beta cash flow* is 0.64, with a median of 0.60. As expected, the *Beta equity* exhibits higher mean (1.246) and median (1.126). The average market leverage is 13.3%, 10.5% of firm-years are classified as in NBER recession, and the average total assets are \$2564.44 million.

Panel B of Table 1 reports summary statistics of compensation variables across different macroeconomic states. Pay-for-performance sensitivity is substantially lower during recession periods, and this effect is sharper for the option component.

All the variables are winsorized at the 5st and 95th percentile. Detailed definitions of the variables are given in Table B.1. All dollar amounts are expressed in 2012 dollars.

3.2 Empirical approach

I test the model’s predictions by means of panel regressions of pay-for-performance sensitivity on macroeconomic conditions, cash flow cyclicality, and the control variables presented above. I use a logarithmic transformation of severely right-skewed variables, such as pay-for-performance sensitivity.¹⁹ To reduce concerns about omitted variables, I include industry fixed effects at the two-digit SIC code level, and year fixed effects. As a robustness check, I also estimate the baseline regression with firm fixed effects. In line with [Acharya, Almeida, and Campello \(2013\)](#), to deal with endogeneity from measurement error in the estimation of cash flow cyclicality, I use a twofold approach. First, I measure cash flow betas at the industry-level. Second, I adopt an instrumental variables approach. By contrast, reverse causality is not a major concern, as macroeconomic conditions are arguably exogenous, and cash flow cyclicality is measured at the industry-level and reflects structural features of a certain product market. The t -statistics are calculated with Huber-White robust standard errors clustered by firm as recommended by [Petersen \(2009\)](#).

¹⁹If a variable can be equal to zero, such as the pay-for-performance sensitivity measures, I use the transformation $\ln(1 + y)$, in order not to lose any observation (see, e.g., [Dai, Jin, and Zhang, 2012](#)). In untabulated tests, I find similar results using GLM and the Stata option `link(log)`.

3.3 Main results

Table 2 reports the estimated coefficients of panel regressions of the three measures of pay-for-performance sensitivity on the variables of interest. Panel A presents the baseline tests. Columns 1 through 3 focus on b^I , the percent-percent measure. Column 1 tests Prediction 1. In line with such prediction, the NBER recession indicator exhibits a negative and statistically significant at the 1% level effect on pay-for-performance sensitivity. To test also Prediction 2, in columns 2 and 3, I interact *NBER recession* with an indicator variable equal to one if a three-digit SIC code industry-year belongs to the top tercile of cash flow beta, *Beta cash flow T3*, thus capturing highly procyclical firms. Column 3 includes also year fixed effects. In both specifications, the interaction term exhibits a negative and significant coefficient at the 1% level, meaning that the impact of recessions on pay-for-performance sensitivity mainly stems from highly procyclical firms. Moreover, the overall effect of *Beta cash flow T3* in recession periods is negative consistent with Prediction 2. *Beta cash flow T3* has a positive albeit insignificant coefficient out of recessions, supporting the idea that in good times conflicts of interests between equity and debt holders are not important enough to substantially affect managerial incentives.

Similar results hold for $PPS_{\$}$ (dollars at stake measure) in columns 4 through 6, and for $PPS_{\%}$ (effective ownership) in columns 7 through 9. *Beta cash flow T3* has a negative coefficient also in good times for $PPS_{\%}$, but, again, it is statistically indistinguishable from zero. These findings complement the evidence of an unconditional negative relation between pay-for-performance sensitivity and a firm's aggregate risk provided by [Cao and Wang \(2013\)](#), pointing out that such a relation stems mainly from bad macroeconomic states. *Market leverage* exhibits a negative and significant coefficient both for b^I and $PPS_{\$}$ in line with [John, Mehran, and Qian \(2010\)](#).²⁰ Somewhat surprisingly, the relation is instead positive for $PPS_{\%}$.

It is also of interest to examine the economic significance of these results. Given the estimates in columns 1, 4, and 7 (i.e., unconditional on cash flow cyclicality), recession periods are associated with 14.34%, 3.64%, and 9.27% lower transformed b^I , $PPS_{\$}$, and $PPS_{\%}$, respectively (evaluated at the mean). Moreover, as it can be seen from columns 3, 6, and 9, during recessions, CEO pay-for-performance sensitivity in highly procyclical firms is lower by 8.19%, 4.86%, and 17.00% compared to other firms, if measured as transformed b^I , $PPS_{\$}$, and $PPS_{\%}$, respectively (evaluated at the mean). These effects are economically substantial, and especially so given that executive compensation

²⁰See also [Albert \(2014\)](#) and [Ortiz-Molina \(2007\)](#).

arrangements tend to be quite sticky.

In Panel B of Table 2, I conduct several tests aimed at better identifying the economic mechanism underlying my results. In columns 1 through 3, I consider b^I . First, in column 1, I focus on firm-years in the bottom quartile of *Market leverage*, which are arguably characterized by very small risk-shifting incentives.²¹ Consistent with the economic mechanism described in the model, pay-for-performance sensitivity, though lower in recessions, exhibits no clear relation with cash flow cyclicality. By contrast, in column 2, I exclude from the sample firm-years in the bottom quartile of *Market leverage*, finding evidence in line with my predictions. Interestingly, the interaction term displays an economically larger coefficient than in column 3 of Panel A. One can also argue that my findings are consistent with a managerial power explanation. In fact, in recessions, powerful CEOs of highly procyclical companies, foreseeing poor performance, might decide themselves to reduce their equity incentives. To account for such mechanism, in column 3, I analyze a subsample of firm-years displaying high managerial entrenchment. A firm-year is included in this subsample if it has an E-index (Bebchuk, Cohen, and Ferrell, 2009) above 3.²² Cash flow cyclicality does not seem to play an important role for pay-for-performance sensitivity over this subsample, reducing the concern that my results are driven by highly entrenched CEOs. Overall, this is evidence supportive of the economic mechanism underlying the model's predictions.

In Panel C of Table 2, I carry out two complementary tests for each of the pay-for-performance sensitivity measures. In columns 1 and 2, I consider b^I . First, given that firms often set compensation in the first two fiscal quarters (Hall and Knox, 2004), and thus beginning of the year conditions might be particularly relevant, in column 1 all the regressors are lagged by one year. The estimated coefficients are consistent with the model's predictions. Second, column 2 interacts *NBER recession* with *Beta cash flow*. In the spirit of Acharya, Almeida, and Campello (2013), to deal with measurement error, I instrument *Beta cash flow* and *NBER recession* \times *Beta cash flow* with the first two lags of *Beta cash flow* and the interactions of such lags with the recession indicator. Both *NBER recession* and the interaction term exhibit a negative and significant coefficient, and the Hansen's test does not reject the joint null hypothesis that the instruments are valid. In columns 3 and 4 (5 and 6), I obtain similar results for $PPS_{\$}$ ($PPS_{\%}$). In column 6, *Beta cash flow* exhibits a negative and significant coefficient also in expansion periods.

²¹The median firm in this subsample is unlevered.

²²The E-index has a maximum value of six. A high value of this index represents high managerial power. I rely on the E-index rather than the G-index by Gompers, Ishii, and Metrick (2003), because the latter is not available for the period 2007 to 2012.

Nevertheless, this coefficient is rather small.

3.4 *Pay-for-performance sensitivity components and stock price dynamics*

Table 3 decomposes pay-for-performance sensitivity into its stock and option components, and isolates the changes in compensation that are not driven by stock price dynamics. From columns 1 and 2, in which I consider the percent-percent measure, b^I , it emerges that the results above mainly stem from option incentives. Columns 3 through 6 provide analogous evidence for $PPS_{\$}$ and $PPS_{\%}$. This finding is consistent with [Murphy \(2013\)](#), who documents a substitution effect between options and restricted stock during recessions. However, as pointed out by [Zhou \(2001\)](#), “changes in ownership or options alone do not reflect changes in total equity incentives”. Thus, the weak evidence about stock incentives is not a major concern, given that total incentives exhibit dynamics consistent with the model’s predictions. Quite importantly, then, restricted stock grants account only for a minor fraction of pay-for-performance sensitivity for most of the sample period.

As seen above, shareholders adapt CEO pay-for-performance sensitivity to business cycle conditions mainly through the stock option component. Even though I control for the stock market valuation by means of the market-to-book ratio, one may still be concerned that stock returns drive the results about total annual incentives in Table 2 through option deltas, as the stock price might substantially change between the grant date and the fiscal year-end. Because of this, in columns 7 through 9 of Table 3, I perform several tests on the effective ownership measure $PPS_{\%}$, the least sensitive to stock price dynamics. First, I examine both total and option incentives without weighting the number of new options granted by their delta (column 8 and 9). Second, I evaluate total incentives at grant date, i.e., before any stock price variation takes place (column 9). In each of these specifications, the results confirm previous findings.

3.5 *Wealth-for-performance sensitivity and non-CEO executives*

Table 4 investigates the dynamics of CEO wealth-for-performance sensitivity, i.e., the performance sensitivity of the whole CEO’s portfolio of equity incentives, and of top five executives’ pay-for-performance sensitivity. Panel A focuses on wealth-for-performance sensitivity. Columns 1 through 3 consider the size-invariant measure introduced by [Edmans, Gabaix, and Landier \(2009\)](#), B^I . Interestingly, column 1 shows that $NBER\ recession \times Beta\ cash\ flow\ T3$ has a positive and significant coefficient. On the one hand, this finding reinforces my previous results on pay-for-performance sensitivity. Indeed, it

helps to rule out that the negative effect of cyclicalities on pay-for-performance sensitivity is just a mechanical consequence of options going underwater to a larger extent in highly procyclical firms when the economy is contracting. In fact, if it were the case, such a mechanical effect should be all the more observed for outstanding incentives, which are generally more sensitive to options going underwater. On the other hand, it can be interpreted as evidence that shareholders are not able to timely control outstanding incentives, as found also by [Gormley, Matsa, and Milbourn \(2013\)](#). For this reason, in column 2, I restrict the analysis to initial compensation contracts (the year after CEO turnover), which are arguably closer to the optimum, given that potential adjustment costs may impede alignment to the optimal level in later years of tenure.²³ *NBER recession* \times *Beta cash flow T3* exhibits a large negative and significant coefficient, and the overall effect of *Beta cash flow T3* on wealth-for-performance sensitivity is negative during recessions. It is worth noting that 81.13% of new CEOs are internally hired, which reduces concerns that the initial wealth-for-performance sensitivity simply coincides with pay-for-performance sensitivity. Indeed, an internally hired CEO has generally accumulated equity incentives in the years before his appointment as CEO.

However, CEO turnover and compensation policy are endogenous, and CEO dismissals are more likely in recessions. Distressed firms, indeed, exhibit higher managerial turnover. These firms, then, tend to hire specialists in restructuring and turnaround strategies, whose compensation structure is usually significantly different, in particular in the case of outside replacements (see e.g. [Gilson, 1989](#); [Gilson and Vetsuypens, 1993](#); [Eckbo, Thornburn, and Wang, 2012](#)). To tackle these problems, I carry out the same analysis of initial wealth-for-performance sensitivity over a subsample of 385 exogenous CEO turnover events. To identify these cases, I follow [Pan, Wang, and Wang \(2013\)](#). A turnover is classified as exogenous if the resigning CEO is older than 65 years, or if Execucomp reports him as “deceased”.²⁴ Given the small number of observations, I do not include year and industry fixed effects. Again, Column 3 shows that the interaction term displays a large negative coefficient, statistically significant at the 10% level. Columns 4 through 6 (7 through 9) provide consistent evidence for $WPS_{\$}$ ($WPS_{\%}$). Only in column 6, in the exogenous turnover analysis for $WPS_{\$}$, the interaction term, albeit displaying an economically large coefficient, is insignificant at conventional levels. This may be due

²³See, e.g., [Allgood, Farrel, and Kamal \(2012\)](#) and [Cronqvist and Fahlenbrach \(2013\)](#) for studies of initial compensation.

²⁴Unlike [Pan, Wang, and Wang \(2013\)](#), I do not complement this sample of events with a news search of CEO departures due to death or health conditions.

to lack of power resulting from the small sample size.²⁵

Finally, it is not trivial to understand who has the control of a firm. Most empirical studies focus on the CEO alone. Nevertheless, a growing body of literature makes the case for the importance of the entire team of top managers (see, e.g., [Bebchuk, Cremers, and Peyer, 2011](#)). Because of this, in Panel B of Table 4, I consider also the mean and the median pay-for-performance sensitivity of top five executives, where the latter is meant to rule out that the result is merely due to CEO incentives. Also in this case, the data match the model's predictions.

3.6 Additional robustness tests

In this section, I present a battery of robustness tests contained in Table 5, relating to estimation techniques, sample definition, and measures of cash flow cyclicalities, and macroeconomic conditions.

Panel A of Table 5 focuses on alternative estimation methods and sample definitions. Columns 1 through 3 deal with the percent-percent pay-for-performance sensitivity measure, b^I . In column 1, I use firm fixed effects to take into account time-invariant unobservable firm-specific factors. In column 2, as suggested by [Petersen \(2009\)](#), I cluster standard errors by both firm and year, to account for potentially varying time effects.²⁶ In column 3, I perform the baseline regression, excluding the most financially constrained firms, i.e., firm-years in the top tercile of the SA index by [Hadlock and Pierce \(2010\)](#). In fact, one can argue that the observed drop in pay-for-performance sensitivity is larger for more procyclical firms just because these firms tend to run out of cash during recessions, impeding them to grant their CEOs the desired level of equity incentives, which, following the adoption FAS 123R, have to be expensed. In each of these cases, the results above hold. The same is observed for PPS_{\S} ($PPS_{\%}$) in columns 4 through 6 (7 through 9). Finally, in column 10, I map the effective ownership measure, $PPS_{\%}$, which is bounded between zero and one, on the real line using the logistic transformation as in [Himmelberg, Hubbard, and Palia \(1999\)](#). This transformation does not affect my main findings.

Panel B of Table 5 addresses robustness with respect to different measures of cash flow cyclicalities. Columns 1 through 3 use the percent-percent measure, b^I , as dependent

²⁵As an alternative line of inquiry, in Appendix C I examine firms' adjustments to outstanding equity incentives, i.e., option repricing events. I find that firms do not seem to manage wealth-for-performance sensitivity through option repricings. In fact, repricing events are very rare and seldom open to executive officers.

²⁶To compute two-way clustered standard errors, I use the Stata code `cgmreg.do` provided by Doug Miller on his webpage (<http://www.econ.ucdavis.edu/faculty/dlmiller/statafiles/>).

variable. In column 1, I define a firm as highly procyclical if it falls in the top quartile of the cash flow beta. In column 2, I rely on the top tercile of the cash flow beta as in the baseline case, but the beta is estimated with annual rather than quarterly Compustat data, increasing the number of firms per industry. In column 3, I use a market-based measure of cash flow cyclical, i.e., the unlevered equity beta, *Beta asset*. As it is measured at the firm-level, the measurement error problem is a major issue in this case, thus I pursue an instrumental variable approach. In particular, I instrument *Beta asset* and *NBER recession* \times *Beta asset* with the first two lags of *Beta asset*, the interactions of such lags with the recession indicator, and the interaction of the second lag with the logarithm of the firm's total assets, namely one of the included instruments. I obtain evidence supportive of my previous findings for each of these tests. In columns 4 through 6 (7 through 9), similar results are found measuring pay-for-performance sensitivity with $PPS_{\$}$ ($PPS_{\%}$), with the exception of column 5, where the interaction between the recession indicator and the top tercile of cash flow cyclical (based on annual cash flow betas) exhibits a positive but insignificant coefficient.

In Panel C of Table 5, I consider several different proxies of macroeconomic conditions. In columns 1 through 3, I study the b^I measure. As one might argue that my findings are attributable just to the 2007-2009 financial crisis, in column 1, I identify bad macroeconomic periods as those in which the CFNAI is negative (economy growth below trend). According to this indicator variable, 42.5% of firm-years are classified as in bad macroeconomic states versus 10.5% using the NBER indicator. Interestingly, in several instances, such as 2003 and 2006, periods that are classified as characterized by bad macroeconomic conditions according to the CFNAI coincide with strong stock market performance. Therefore, this is also a further check that my findings are not driven by options going underwater. In column 2 (3), I use a recession indicator equal to one if GDP growth is negative in a firm's last fiscal quarter (year). In columns 4 through 6 (7 through 9), I carry out the same tests for $PPS_{\$}$ ($PPS_{\%}$). Once again, the results confirm the previous findings.

Finally, unreported tests illustrate that my main results survive when firm-years characterized by negative cash flow beta are excluded,²⁷ when a firm is defined as highly procyclical if it belongs to the top half of the cash flow beta, when alternative measures of leverage are used, and when I do not control for industry fixed effects.

²⁷This test is meant to focus only on strictly procyclical firms for consistency with the parameter restrictions of the model.

4 Conclusion

The recent empirical literature suggests that macroeconomic conditions matter for corporate policies, such as investment and financing choices, and executive compensation. However, the firm-level exposure to macroeconomic risk is usually neglected in empirical studies of corporate governance. I fill this gap by taking into account heterogeneity in firms' cash flow cyclicality in the analysis of the link between macroeconomic conditions and compensation structure.

I motivate my empirical analysis extending the model of [John and John \(1993\)](#). I introduce uncertainty about future macroeconomic conditions and heterogeneity in firms' cash flow cyclicality. In my model, executive compensation is meant to curb conflicts of interests between equity holders and debt holders, which lead an equity aligned manager to suboptimally risk shift. Procyclical firms are more prone to risk-shifting in recessions, and this effect is increasing in cash flow cyclicality. As a consequence, it is ex ante optimal for the equity holders of a procyclical firm to set a lower managerial pay-for-performance sensitivity during recessions. Again, this effect is increasing in the degree of cash flow cyclicality.

I use a large sample of U.S. public firms to test the model's predictions. First, I provide evidence that shareholders lower pay-for-performance sensitivity during recessions to an extent increasing in cash flow cyclicality, mostly through stock options. This effect is economically large and robust to several alternative pay-for-performance sensitivity measures, specifications, subsamples, and cash flow cyclicality proxies. Second, I illustrate that wealth-for-performance sensitivity exhibits a behavior in line with the model's prediction only at the beginning of the CEO's term, and the same results holds restricting the sample to the first year after an exogenous CEO dismissal. I interpret this finding as evidence that shareholders, when they are able to do so, indeed adjust wealth-for-performance sensitivity to deal with debt-equity conflicts throughout the business cycle. On the other hand, in later years of tenure, shareholders do not have full control of outstanding equity incentives, and, as a consequence, wealth-for-performance sensitivity does not meaningfully react to macroeconomic conditions. Furthermore, firms do not seem to manage wealth-for-performance sensitivity through option repricings. In fact, repricing events are very rare and seldom open to executive officers.

Overall, I shed new light on the interaction between debt-equity conflicts and macroeconomic conditions, providing evidence that shareholders optimally account for this interaction in setting executives' incentive pay.

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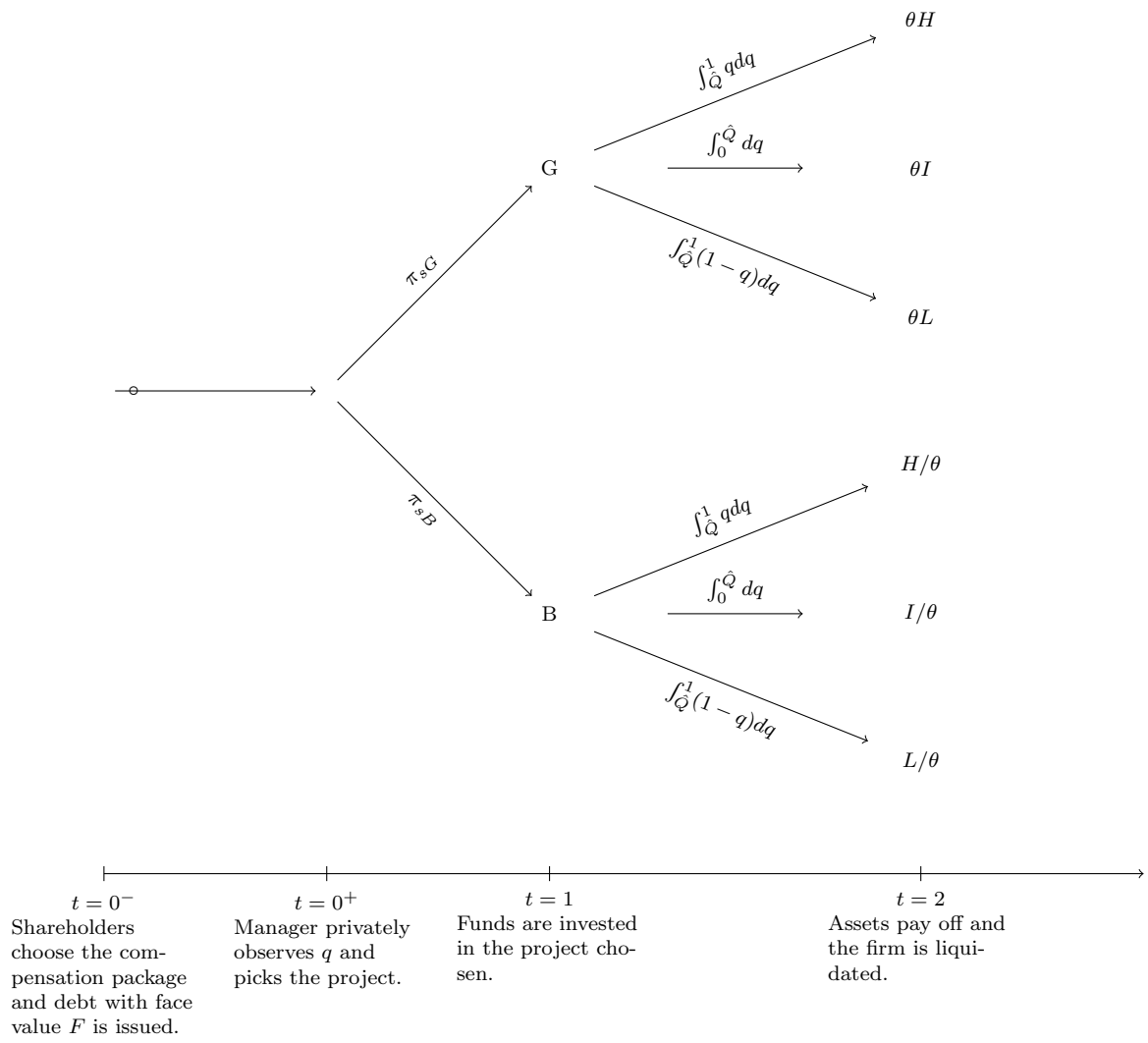


Figure 1: Timing and general setting of the model.

Table 1: Summary statistics

This table reports summary statistics of all variables employed in the paper. The sample includes 2,441 U.S. firms over the period 1992 to 2012, excluding financial institutions and utilities. I obtain accounting data from Compustat, stock market data from CRSP, executive compensation data from Execucomp, and macroeconomic data from FRED, St. Louis Federal Reserve Bank. Panel A presents the descriptive statistics of the variables over the entire sample. Panel B presents the descriptive statistics for executive compensation structure across different macroeconomic states, as measured by NBER recession dates. All dollar amounts are in millions of 2012 dollars. Refer to [Table B.1](#) for variable definitions.

Panel A: Main variables						
	Mean	Std. Dev.	Q1	Med.	Q3	Obs.
<i>Executive compensation</i>						
Total b^I	0.625	0.548	0.068	0.550	0.979	26921
Stock b^I	0.113	0.188	0.000	0.000	0.186	26921
Option b^I	0.503	0.547	0.000	0.355	0.858	26921
Total $PPS_{\$}$	37.080	52.137	0.510	14.953	48.016	27278
Stock $PPS_{\$}$	6.787	13.774	0.000	0.000	6.044	27278
Option $PPS_{\$}$	27.808	43.375	0.000	7.504	35.211	27278
Total $PPS_{\%}$ (pp)	0.166	0.206	0.004	0.091	0.231	27292
Stock $PPS_{\%}$ (pp)	0.030	0.061	0.000	0.000	0.027	27292
Option $PPS_{\%}$ (pp)	0.124	0.177	0.000	0.047	0.171	27292
Total $PPS_{\%}$ non-weighted (pp)	0.205	0.248	0.005	0.119	0.290	27292
Option $PPS_{\%}$ non-weighted (pp)	0.163	0.222	0.000	0.072	0.233	27292
Total $PPS_{\%}$ grant date (pp)	0.187	0.232	0.016	0.103	0.251	26980
Total B^I	20.057	34.141	3.196	6.854	16.502	26921
Total $PPS_{\$}$	583.614	848.404	83.775	230.247	645.276	27278
Total $WPS_{\%}$ (pp)	3.244	4.397	0.615	1.474	3.535	27292
Mean total b^I top five	0.554	0.420	0.229	0.489	0.811	27047
Mean total $PPS_{\$}$ top five	15.571	18.697	2.302	8.224	22.026	27278
Mean total $PPS_{\%}$ top five (pp)	0.072	0.072	0.017	0.051	0.105	27292
<i>Macroeconomic conditions</i>						
NBER recession	0.105	0.306	0.000	0.000	0.000	27299
CFNAI slowdown	0.425	0.494	0.000	0.000	1.000	27299
<i>Cash flow cyclicality</i>						
Beta cash flow	0.643	0.908	0.006	0.603	1.336	27232
Beta cash flow (annual)	0.722	1.295	-0.180	0.643	1.583	27253
Beta equity	1.246	0.768	0.707	1.126	1.677	27272
Beta asset	1.069	0.711	0.565	0.941	1.436	27102
<i>Leverage</i>						
Market leverage	0.143	0.138	0.017	0.110	0.222	27277
Long-term market leverage	0.122	0.125	0.006	0.090	0.194	27172
Total book leverage	0.208	0.174	0.041	0.193	0.326	27299

(Continued)

Table 1: – *Continued*

<i>Other variables</i>						
Total assets (\$ million)	2564.443	2834.348	464.190	1205.162	3691.862	27299
Market-to-book ratio	2.026	1.157	1.243	1.637	2.375	27277
ROA	0.135	0.098	0.093	0.141	0.194	27211
Sales growth	0.095	0.228	-0.023	0.060	0.173	26598
Cash holdings	0.155	0.174	0.025	0.085	0.229	27290
R&D exp.	0.035	0.059	0.000	0.005	0.048	27299
Advertising exp.	0.011	0.021	0.000	0.000	0.010	27299
Capital exp.	0.038	0.045	0.000	0.024	0.056	27299
CEO age	54.942	7.849	50.000	55.000	60.000	27299
CEO tenure	7.091	7.352	2.000	5.000	10.000	27299
CEO turnover	0.132	0.338	0.000	0.000	0.000	27299
Exogenous CEO turnover	0.014	0.119	0.000	0.000	0.000	27299

(Continued)

Table 1: – *Continued*

Panel B: Executive compensation across macroeconomic states								
	Expansion				NBER recession			
	Mean	Std. Dev.	Med.	Obs.	Mean	Std. Dev.	Med.	Obs.
Total b^I	0.642	0.556	0.576	24065	0.483	0.445	0.398	2856
Stock b^I	0.107	0.186	0.000	24065	0.162	0.196	0.069	2856
Option b^I	0.525	0.554	0.394	24065	0.313	0.435	0.096	2856
Total $PPS_{\$}$	37.652	52.718	15.287	24422	32.185	46.599	12.809	2856
Stock $PPS_{\$}$	6.405	13.518	0.000	24422	10.055	15.416	1.505	2856
Option $PPS_{\$}$	28.774	44.056	8.277	24422	19.544	36.010	2.545	2856
Total $PPS_{\%}$ (pp)	0.168	0.209	0.091	24435	0.150	0.181	0.091	2857
Stock $PPS_{\%}$ (pp)	0.028	0.059	0.000	24435	0.051	0.073	0.009	2857
Option $PPS_{\%}$ (pp)	0.129	0.181	0.051	24435	0.082	0.136	0.018	2857
Total $PPS_{\%}$ non-weighted (pp)	0.206	0.250	0.118	24435	0.198	0.225	0.127	2857
Option $PPS_{\%}$ non-weighted (pp)	0.167	0.226	0.075	24435	0.128	0.190	0.042	2857
Total $PPS_{\%}$ grant date (pp)	0.189	0.235	0.102	24155	0.173	0.205	0.106	2825
Total B^I	20.470	34.402	7.064	24065	16.584	31.651	5.083	2856
Total $WPS_{\$}$	590.809	851.767	235.792	24422	522.090	816.638	189.233	2856
Total $WPS_{\%}$ (pp)	3.286	4.423	1.500	24435	2.878	4.153	1.291	2857
Mean total b^I top five	0.570	0.425	0.510	24190	0.414	0.343	0.339	2857
Mean total $WPS_{\$}$ top five	15.891	18.940	8.433	24422	12.838	16.217	6.410	2856
Mean total $PPS_{\%}$ top five (pp)	0.073	0.073	0.051	24435	0.062	0.062	0.044	2857

Table 2: CEO pay-for-performance sensitivity and cash flow cyclicality

This table reports panel regressions of CEO pay-for-performance sensitivity on measures of cash flow cyclicality, macroeconomic conditions, and various firm characteristics for the period 1992 to 2012. The transformed dependent variable $\ln(1 + y)$ is used each column. Panel A presents the baseline tests. Columns 1 through 3 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 regresses pay-for-performance sensitivity on the NBER recession indicator. Column 2 interacts the NBER recession indicator with an indicator equal to one if a three-digit SIC code industry-year cash flow beta is in the top tercile. Column 3 includes also year fixed effects. Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS\%$) measure. Panel B considers several different subsamples. The control variables are the same as in Column 2 of Panel A. Columns 1 through 3 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 focuses on the bottom quartile of the distribution of market leverage from the sample. Column 2 excludes the bottom quartile of the distribution of market leverage from the sample. Column 3 focuses on firm-years characterized by an E-index (Bebchuk, Cohen, and Ferrell, 2009) larger than 3. Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS\%$) measure. Panel C considers several alternative tests. The control variables are the same as in Column 2 of Panel A. Columns 1 and 2 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 regresses pay-for-performance sensitivity on lagged regressors. Column 2 interacts the NBER recession indicator with the cash flow beta. The cash flow beta and its interaction with the NBER recession indicator are instrumented with the first two lags of the cash flow beta, and the interaction of such lags with the NBER recession indicator. Columns 3 and 4 (5 and 6) repeat the same tests for the $PPS_{\$}$ ($PPS\%$) measure. The t -statistics (in parentheses) are calculated with robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively. Refer to Table B.1 for variable definitions.

Panel A: Baseline case									
	b^I			$PPS_{\$}$			$PPS\%$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NBER recession	-0.0624*** (-6.30)	-0.0554*** (-7.80)	-0.0448*** (-4.15)	-0.0914* (-1.84)	0.00549 (0.15)	-0.0288 (-0.52)	-0.0128** (-2.55)	-0.00778** (-2.03)	-0.00442 (-0.80)
Beta cash flow T3		0.00836 (1.23)	0.00871 (1.26)		-0.0184 (-0.54)	0.0165 (0.48)		-0.00424 (-1.33)	-0.00353 (-1.10)
NBER rec. × Beta cash flow T3		-0.0387*** (-3.61)	-0.0377*** (-3.53)		-0.132** (-2.27)	-0.135** (-2.35)		-0.0186*** (-3.27)	-0.0186*** (-3.30)
Market leverage	-0.139*** (-5.03)	-0.133*** (-4.89)	-0.141*** (-5.12)	-0.645*** (-4.23)	-0.686*** (-4.51)	-0.657*** (-4.29)	0.105*** (7.31)	0.112*** (7.89)	0.104*** (7.21)
Log of assets	0.0675*** (3.02)	0.0759*** (3.36)	0.0676*** (3.02)	0.103 (0.93)	0.156 (1.40)	0.103 (0.93)	0.0477*** (3.70)	0.0524*** (4.00)	0.0477*** (3.72)
Log of assets (squared)	0.000493 (0.30)	0.00000766 (0.00)	0.000488 (0.30)	0.0390*** (4.78)	0.0370*** (4.50)	0.0390*** (4.79)	-0.00528*** (-5.96)	-0.00552*** (-6.12)	-0.00527*** (-5.97)
Log of market-to-book	0.164*** (17.49)	0.169*** (18.41)	0.164*** (17.43)	0.625*** (13.15)	0.603*** (12.92)	0.621*** (13.05)	-0.0183*** (-4.11)	-0.0174*** (-3.99)	-0.0191*** (-4.28)
R&D exp.	0.291*** (3.91)	0.246*** (3.34)	0.288*** (3.89)	1.981*** (5.37)	1.574*** (4.31)	1.986*** (5.40)	0.175*** (4.49)	0.160*** (4.12)	0.179*** (4.60)
Missing R&D exp.	-0.0133 (-1.49)	-0.0160* (-1.79)	-0.0139 (-1.54)	-0.0990** (-2.11)	-0.122*** (-2.60)	-0.0989** (-2.11)	-0.00434 (-0.96)	-0.00615 (-1.35)	-0.00442 (-0.97)
Advertising exp.	-0.0276 (-0.12)	-0.113 (-0.48)	-0.0268 (-0.11)	0.468 (0.39)	-0.835 (-0.70)	0.444 (0.37)	0.179* (1.68)	0.130 (1.22)	0.173 (1.62)
Missing adv. exp.	0.0101 (1.13)	0.00772 (0.89)	0.00978 (1.09)	0.0154 (0.33)	-0.0587 (-1.29)	0.0116 (0.25)	0.00585 (1.39)	0.00491 (1.20)	0.00562 (1.33)
Capital exp.	-0.165** (-2.39)	-0.225*** (-3.29)	-0.164** (-2.39)	-0.630* (-1.76)	-1.318*** (-3.67)	-0.628* (-1.76)	-0.0842** (-2.57)	-0.119*** (-3.62)	-0.0845*** (-2.58)
Log of ROA	-0.0745* (-1.76)	-0.100*** (-2.71)	-0.0733* (-1.76)	0.0174 (0.15)	-0.124 (-0.31)	0.0220 (0.28)	-0.0715*** (-2.57)	-0.0839*** (-2.71)	-0.0710*** (-2.58)

(Continued)

Table 2: – *Continued*

	(-1.91)	(-2.58)	(-1.88)	(0.09)	(-0.66)	(0.12)	(-3.54)	(-4.19)	(-3.52)
Log of sales growth	0.114***	0.0799***	0.116***	0.633***	0.455***	0.638***	0.0896***	0.0741***	0.0904***
	(4.86)	(3.49)	(4.92)	(5.45)	(4.05)	(5.48)	(7.59)	(6.42)	(7.66)
Cash holdings	-0.0814***	-0.0625**	-0.0822***	-0.164	0.103	-0.164	0.0430***	0.0572***	0.0442***
	(-2.92)	(-2.27)	(-2.95)	(-1.10)	(0.69)	(-1.09)	(3.22)	(4.28)	(3.29)
CEO age	-0.00320***	-0.00317***	-0.00320***	-0.0125***	-0.0111***	-0.0125***	-0.00143***	-0.00137***	-0.00145***
	(-6.47)	(-6.35)	(-6.44)	(-4.76)	(-4.15)	(-4.77)	(-6.39)	(-6.04)	(-6.44)
CEO tenure	-0.00290***	-0.00282***	-0.00289***	-0.0162***	-0.0155***	-0.0161***	-0.000691***	-0.000641***	-0.000677***
	(-5.41)	(-5.24)	(-5.38)	(-5.54)	(-5.25)	(-5.50)	(-2.86)	(-2.64)	(-2.81)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Observations	26136	26079	26079	26484	26425	26425	26484	26425	26425
Adjusted R^2	0.19	0.18	0.19	0.30	0.28	0.30	0.13	0.11	0.13

(Continued)

Table 2: – *Continued*

Panel B: Alternative subsamples									
	b^I			PPS_{\S}			$PPS_{\%}$		
	(1) Low lev.	(2) High lev.	(3) High entrench.	(4) Low lev.	(5) High lev.	(6) High entrench.	(7) Low lev.	(8) High lev.	(9) High entrench.
NBER recession	-0.0561** (-2.51)	-0.0435*** (-3.47)	-0.0485** (-2.21)	-0.103 (-0.91)	-0.0393 (-0.60)	-0.00809 (-0.07)	-0.0210* (-1.86)	-0.00363 (-0.56)	-0.0194* (-1.87)
Beta cash flow T3	0.00480 (0.32)	0.0102 (1.38)	-0.00818 (-0.46)	0.0133 (0.18)	0.0218 (0.59)	-0.101 (-1.24)	-0.00359 (-0.52)	-0.00392 (-1.12)	-0.0167** (-2.14)
NBER rec. × Beta cash flow T3	-0.00521 (-0.23)	-0.0485*** (-4.07)	-0.0172 (-0.71)	0.0571 (0.49)	-0.192*** (-2.95)	-0.0899 (-0.72)	0.00502 (0.42)	-0.0242*** (-3.89)	-0.000598 (-0.05)
Market leverage	1.170 (0.95)	-0.193*** (-6.35)	-0.0914 (-1.16)	5.872 (0.96)	-0.935*** (-5.40)	-0.386 (-0.95)	0.690 (1.30)	0.0837*** (5.32)	0.135*** (3.75)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6424	19655	2391	6512	19913	2398	6512	19913	2398
Adjusted R^2	0.18	0.20	0.26	0.25	0.32	0.34	0.14	0.13	0.18

(Continued)

Table 2: – *Continued*

Panel C: Alternative specifications						
	b^I		$PPS_{\$}$		$PPS_{\%}$	
	(1) Lagged	(2) IV	(3) Lagged	(4) IV	(5) Lagged	(6) IV
NBER recession	0.0159 (1.41)	-0.0572*** (-5.25)	0.0445 (0.80)	-0.0670 (-1.19)	0.0173*** (2.88)	-0.00793 (-1.39)
Beta cash flow T3	0.00417 (0.56)		0.0169 (0.46)		-0.00256 (-0.76)	
NBER rec. × Beta cash flow T3	-0.0283** (-2.50)		-0.113** (-1.98)		-0.0203*** (-3.33)	
Beta cash flow		0.00143 (0.30)		-0.00109 (-0.05)		-0.00533** (-2.31)
NBER rec. × Beta cash flow		-0.0176*** (-2.78)		-0.0684** (-2.01)		-0.00838** (-2.41)
Market leverage	-0.0939*** (-3.10)	-0.156*** (-5.36)	-0.507*** (-3.07)	-0.756*** (-4.66)	0.111*** (7.40)	0.0983*** (6.55)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23761	21914	23864	22005	23869	22005
Adjusted R^2	0.15	0.16	0.28	0.27	0.14	0.08
Hansen J -stat p -value		0.65		0.52		0.23

Table 3: CEO pay-for-performance sensitivity and stock price dynamics

This table reports panel regressions of CEO pay-for-performance sensitivity (decomposed in its stock and option parts) on measures of cash flow cyclicality, macroeconomic conditions, and various firm characteristics for the period 1992 to 2012, aimed at filtering out stock price dynamics. The transformed dependent variable $\ln(1 + y)$ is used each column. Columns 1 and 2 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 considers the stock component of pay-performance sensitivity. Column 2 considers the option component of pay-performance sensitivity. Columns 3 and 4 (5 and 6) repeat the same tests for the PPS_s (PPS_o) measure. Column 7 (8) uses the total (option) PPS_o measure with options non-weighted by their deltas as dependent variable. Columns uses the PPS_o pay-for-performance sensitivity measured at grant-date as dependent variable. All the regressions include the same control variables as in Table 2. The t -statistics (in parentheses) are calculated with robust standard errors clustered by firm. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively. Refer to Table B.1 for variable definitions.

	b^I		PPS_s		PPS_o		PPS_o non-weighted		PPS_o grant date
	(1) Stock	(2) Option	(3) Stock	(4) Option	(5) Stock	(6) Option	(7) Total	(8) Option	(9) Total
NBER recession	-0.0109** (-2.02)	-0.0387*** (-3.66)	-0.00828 (-0.17)	-0.0374 (-0.65)	0.00266 (1.18)	-0.0112** (-2.37)	0.00500 (0.78)	-0.00175 (-0.30)	0.000787 (0.13)
Beta cash flow T3	0.00243 (0.79)	0.00553 (0.76)	-0.00343 (-0.13)	-0.000720 (-0.02)	0.000507 (0.45)	-0.00405 (-1.38)	-0.00469 (-1.22)	-0.00523 (-1.44)	-0.00321 (-0.93)
NBER rec. \times Beta cash flow T3	0.00304 (0.51)	-0.0426*** (-4.01)	-0.0240 (-0.45)	-0.223*** (-3.57)	-0.00367 (-1.44)	-0.0114** (-2.53)	-0.0237*** (-3.58)	-0.0175*** (-2.95)	-0.0217*** (-3.59)
Market leverage	-0.00736 (-0.57)	-0.145*** (-5.14)	-0.0151 (-0.13)	-0.818*** (-5.05)	0.0254*** (4.65)	0.0632*** (5.17)	0.120*** (7.09)	0.0790*** (5.13)	0.145*** (9.33)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26079	26079	26425	26425	26425	26425	26425	26425	26405
Adjusted R^2	0.29	0.20	0.32	0.24	0.21	0.15	0.12	0.13	0.16

Table 4: CEO wealth-for-performance sensitivity and top five executives' pay-for-performance sensitivity

This table reports panel regressions of executives' incentive compensation on measures of cash flow cyclicality, macroeconomic conditions, and various firm characteristics for the period 1992 to 2012. The transformed dependent variable $\ln(1 + y)$ is used each column. Panel A focuses on CEO wealth-for-performance sensitivity. Columns 1 through 3 use the B^I measure of wealth-for-performance sensitivity as dependent variable. The regression in column 1 is carried out over the entire sample. Column 2 restricts the analysis to the first year after a CEO change. Column 3 restricts the analysis to the first year after an exogenous CEO change. A turnover is classified as exogenous if the resigning CEO is older than 65 years, or if Execucomp reports him as "deceased". Columns 4 through 6 (7 through 9) repeat the same tests for the $WPS_{\$}$ ($WPS_{\%}$) measure. Panel B investigates the behavior of top five executives' pay-for-performance sensitivity. Columns 1 and 2 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 relies on the mean pay-for-performance sensitivity of top five executives as dependent variable. Column 2 relies on the median pay-for-performance sensitivity of top five executives as dependent variable. Columns 3 and 4 (5 and 6) repeat the same tests for the $PPS_{\$}$ ($PPS_{\%}$) measure. All the regressions include the same control variables as in Table 2, with the exception of those over the CEO turnover subsample, which do not control for CEO tenure. The t -statistics (in parentheses) are calculated with robust standard errors clustered by firm, with the exception of regressions over the CEO turnover subsample, for which robust standard errors are used. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively. Refer to Table B.1 for variable definitions.

Panel A: CEO wealth-for-performance sensitivity									
	B^I			$WPS_{\$}$			$WPS_{\%}$		
	(1) Whole	(2) Turnover	(3) Ex. turnover	(4) Whole	(5) Turnover	(6) Ex. turnover	(7) Whole	(8) Turnover	(9) Ex. turnover
NBER recession	-0.134*** (-3.85)	-0.0747 (-0.77)	0.0461 (0.18)	-0.113*** (-2.80)	-0.0509 (-0.39)	-0.0269 (-0.08)	-0.0101 (-0.48)	-0.0386 (-0.69)	0.0507 (0.33)
Beta cash flow T3	-0.00730 (-0.27)	0.0254 (0.61)	0.138 (1.25)	-0.0420 (-1.23)	0.0272 (0.44)	0.0627 (0.47)	-0.0341* (-1.80)	0.00890 (0.36)	0.0331 (0.51)
NBER rec. \times Beta cash flow T3	0.0887** (2.15)	-0.231** (-2.24)	-0.518* (-1.67)	0.0694 (1.47)	-0.416*** (-3.15)	-0.297 (-0.78)	0.00875 (0.34)	-0.174*** (-3.19)	-0.279* (-1.69)
Market leverage	-0.833*** (-6.82)	-0.718*** (-4.46)	-0.357 (-0.93)	-1.256*** (-8.34)	-1.133*** (-4.77)	-0.591 (-1.20)	0.259*** (2.91)	0.292*** (2.89)	0.647** (2.55)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Year effects	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Observations	26079	3215	385	26425	3326	389	26425	3326	389
Adjusted R^2	0.32	0.17	0.19	0.49	0.40	0.45	0.38	0.23	0.17

(Continued)

Table 4: – *Continued*

Panel B: Top five executives' pay-for-performance sensitivity						
	b^I		$PPS_{\$}$		$PPS_{\%}$	
	(1) Mean	(2) Median	(3) Mean	(4) Median	(5) Mean	(6) Median
NBER recession	-0.0362*** (-4.43)	-0.0337*** (-3.68)	-0.0404 (-1.15)	-0.0396 (-1.07)	-0.00149 (-0.71)	-0.000382 (-0.18)
Beta cash flow T3	0.00570 (1.08)	0.00773 (1.34)	0.00404 (0.17)	0.0108 (0.46)	-0.000982 (-0.76)	-0.000720 (-0.56)
NBER rec. × Beta cash flow T3	-0.0330*** (-4.11)	-0.0410*** (-4.57)	-0.0959*** (-2.64)	-0.0917** (-2.37)	-0.00750*** (-3.51)	-0.00750*** (-3.43)
Market leverage	-0.144*** (-6.62)	-0.149*** (-6.31)	-0.660*** (-6.15)	-0.715*** (-6.67)	0.0430*** (7.39)	0.0369*** (6.36)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26197	26197	26425	26425	26425	26425
Adjusted R^2	0.28	0.25	0.44	0.40	0.20	0.17

Table 5: Robustness tests

This table reports panel regressions of CEO pay-for-performance sensitivity on measures of cash flow cyclicality, macroeconomic conditions, and various firm characteristics for the period 1992 to 2012. The transformed dependent variable $\ln(1 + y)$ is used each column, with the exception of column 10 in Panel A. Panel A presents robustness with respect to alternative specifications and samples. Columns 1 through 3 use the b^I measure of pay-for-performance sensitivity as dependent variable. Column 1 controls for firm fixed effects. Column 2 presents t -statistics calculated with standard errors clustered on two dimensions (firm and year). Column 3 excludes the most distressed firm-years from the regression sample, as measured by the top decile of the SA index by [Hadlock and Pierce \(2010\)](#). Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS_{\%}$) measure. Column 10 uses the transformation $\ln(1 + y/(1 - y))$ of $PPS_{\%}$. Panel B presents robustness with respect to alternative measures of cash flow cyclicality. Columns 1 through 3 use the b^I measure of pay-for-performance sensitivity as dependent variable. In column 1, a three-digit SIC code industry-year is classified as highly procyclical if it belongs to the top quartile of the cash flow beta. In column 2, a three-digit SIC code industry-year is classified as highly procyclical if it belongs to the top tercile of the cash flow beta measured with annual Compustat data. Column 3 measures cash flow cyclicality by means of the market-based asset beta, i.e. the unlevered equity beta, estimated at firm-level. The market-based asset beta and its interaction with the NBER recession indicator are instrumented with the first two lags of the asset beta, the interaction of such lags with the NBER recession indicator, and the interaction of the second lag with the logarithm of the firm's total assets. Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS_{\%}$) measure. Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS_{\%}$) measure. Panel C presents robustness with respect to alternative measures of macroeconomic conditions. Columns 1 through 3 use the b^I measure of pay-for-performance sensitivity as dependent variable. In column 1, a firm-year is classified as characterized by bad macroeconomic conditions if the CFNAI is below zero in the last fiscal quarter. In column 2, a firm-year is classified as in recession if the GDP growth rate is negative in the last fiscal quarter. In column 3, a firm-year is classified as in recession if the GDP growth rate is negative in the last fiscal year. Columns 4 through 6 (7 through 9) repeat the same tests for the $PPS_{\$}$ ($PPS_{\%}$) measure. All the regressions include the same control variables as in [Table 2](#). The t -statistics (in parentheses) are calculated with robust standard errors clustered by firm, except in columns 2, 5, and 8 of Panel A. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively. Refer to [Table B.1](#) for variable definitions.

	b^I			$PPS_{\$}$			$PPS_{\%}$			
	(1)	(2) Two way s.e.	(3) Unconstr.	(4)	(5) Two way s.e.	(6) Unconstr.	(7)	(8) Two way s.e.	(9) Unconstr.	(10) Logistic
NBER recession	-0.0398*** (-3.72)	-0.0448 (-1.32)	-0.0451*** (-4.08)	0.00897 (0.17)	-0.0288 (-0.23)	-0.0212 (-0.37)	0.000864 (0.16)	-0.00442 (-0.44)	-0.00261 (-0.47)	-0.00988 (-0.80)
Beta cash flow T3	0.00275 (0.37)	0.00871 (1.03)	0.00942 (1.31)	0.00138 (0.04)	0.0165 (0.42)	0.0255 (0.71)	-0.00308 (-0.96)	-0.00353 (-0.98)	-0.00226 (-0.69)	-0.00989 (-1.45)
NBER rec. × Beta cash flow T3	-0.0325*** (-3.07)	-0.0377*** (-2.75)	-0.0373*** (-3.38)	-0.124** (-2.28)	-0.135*** (-3.19)	-0.140** (-2.34)	-0.0161*** (-2.99)	-0.0186*** (-3.61)	-0.0180*** (-3.22)	-0.0384*** (-3.17)
Market leverage	-0.219*** (-6.58)	-0.141*** (-5.56)	-0.143*** (-4.92)	-1.302*** (-7.85)	-0.657*** (-4.56)	-0.641*** (-3.92)	0.0542*** (3.12)	0.104*** (8.09)	0.101*** (6.98)	0.230*** (7.47)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	Yes	No	No	Yes	No	No	Yes	No	No	No
Industry effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26079	26079	23861	26425	26425	24158	26425	26425	24158	26425
Adjusted R^2	0.10	0.19	0.19	0.13	0.31	0.30	0.04	0.13	0.13	0.12

(Continued)

Table 5: – Continued

Panel B: Alternative cash flow cyclical measures									
	b^I			$PPS_{\$}$			$PPS_{\%}$		
	(1)	(2)	(3) IV	(4)	(5)	(6) IV	(7)	(8)	(9) IV
NBER recession	-0.0529*** (-5.15)	-0.0485*** (-4.45)	-0.0418** (-2.43)	-0.0649 (-1.24)	-0.0513 (-0.92)	0.0515 (0.57)	-0.0101* (-1.89)	-0.00622 (-1.10)	0.00647 (0.72)
Beta cash flow Q4	0.00524 (0.74)			-0.000844 (-0.02)			-0.00648** (-2.00)		
NBER rec. × Beta cash flow Q4	-0.0285** (-2.55)			-0.0828 (-1.38)			-0.0100* (-1.78)		
Beta cash flow T3 (ann.)		0.00413 (0.62)			0.0238 (0.71)			-0.00333 (-1.07)	
NBER rec. × Beta cash flow T3 (ann.)		-0.0296*** (-2.75)			-0.0870 (-1.51)			-0.0141** (-2.50)	
Beta asset			-0.00540 (-0.82)			0.0522 (1.54)			0.0114*** (3.34)
NBER rec. × Beta asset			-0.0256** (-1.98)			-0.152** (-2.08)			-0.0182*** (-2.61)
Market leverage	-0.141*** (-5.11)	-0.141*** (-5.09)	-0.161*** (-5.33)	-0.655*** (-4.28)	-0.651*** (-4.25)	-0.712*** (-4.33)	0.105*** (7.25)	0.104*** (7.24)	0.112*** (7.14)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26079	26099	21716	26425	26445	21809	26425	26445	21809
Adjusted R^2	0.19	0.19	0.16	0.30	0.30	0.27	0.13	0.13	0.08
Hansen J -stat p -value			0.35			0.36			0.89

(Continued)

Table 5: – *Continued*

Panel C: Alternative macroeconomic measures									
	b^I			$PPS_{\$}$			$PPS_{\%}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CFNAI slowdown	-0.00247 (-0.32)			-0.0411 (-1.07)			-0.00356 (-0.96)		
Beta cash flow T3	0.0135* (1.75)	0.00955 (1.39)	0.00644 (0.94)	0.0324 (0.86)	0.0191 (0.56)	0.00762 (0.23)	-0.00152 (-0.42)	-0.00334 (-1.04)	-0.00436 (-1.37)
CFNAI slow. \times Beta cash flow T3	-0.0200*** (-2.63)			-0.0693* (-1.85)			-0.00911** (-2.45)		
Recession GDP		-0.0230** (-2.35)			0.00645 (0.13)			-0.00177 (-0.35)	
Rec. GDP \times Beta cash flow T3		-0.0374*** (-3.76)			-0.134*** (-2.60)			-0.0170*** (-3.31)	
Recession GDP (ann.)			-0.0814*** (-6.44)			-0.178*** (-2.63)			-0.0101 (-1.42)
Rec. GDP (ann.) \times Beta cash flow T3			-0.0266** (-2.20)			-0.0842 (-1.31)			-0.0186*** (-2.72)
Market leverage	-0.141*** (-5.11)	-0.141*** (-5.12)	-0.140*** (-5.06)	-0.658*** (-4.30)	-0.657*** (-4.30)	-0.652*** (-4.27)	0.104*** (7.21)	0.104*** (7.22)	0.104*** (7.24)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26079	26079	26079	26425	26425	26425	26425	26425	26425
Adjusted R^2	0.19	0.19	0.19	0.30	0.30	0.30	0.13	0.13	0.13

Appendix for “Executive Compensation, Macroeconomic Conditions, and Cash Flow Cyclicalities”

A Proofs

Proof of Proposition 1. The difference, RS , between Q_{FB} and Q_{Lev} , which is a measure of managerial risk-shifting incentives, is always positive:

$$RS = \frac{(I - H)((\pi_{sG}\theta + (1 - \pi_{sG})/\theta)L - F)}{(H - L)((\pi_{sG}\theta + (1 - \pi_{sG})/\theta)H - F)} > 0, \quad (\text{A.1})$$

given the above assumptions on parameters. ■

Proof of Proposition 2. The partial derivative of (A.1) with respect to π is:

$$\frac{\partial RS}{\partial \pi_{sG}} = \frac{(I - H)F}{(\pi_{sG}(\theta H - F) + (1 - \pi_{sG})(H/\theta - F))^2} \left(\theta - \frac{1}{\theta} \right).$$

So for a procyclical firm ($\theta > 1$) it is easy to see that this is negative. ■

Proof of Proposition 3. The partial derivative of (A.1) with respect to θ is:

$$\frac{\partial RS}{\partial \theta} = \frac{(H - I)F}{(\pi_{sG}(\theta H - F) + (1 - \pi_{sG})(H/\theta - F))^2} \left(\frac{1 - \pi_{sG}}{\theta^2} - \pi_{sG} \right).$$

By assumption (iii), $\partial RS/\partial \theta$ is always positive (negative) in state B (G). ■

Proof of Proposition 4. The partial derivative of (8) with respect to π_{sG} is:

$$\frac{\partial \hat{\alpha}}{\partial \pi_{sG}} = \frac{\psi L}{(F - L(\pi_{sG} + (1 - \pi_{sG})/\theta))^2} \left(\theta - \frac{1}{\theta} \right),$$

which is positive for a procyclical firm ($\theta > 1$). ■

Proof of Proposition 5. The partial derivative of (8) with respect to θ is:

$$\frac{\partial \hat{\alpha}}{\partial \theta} = \frac{\psi L}{(F - L(\pi_{sG} + (1 - \pi_{sG})/\theta))^2} \left(\pi_{sG} - \frac{1 - \pi_{sG}}{\theta^2} \right).$$

By assumption (iii), $\partial \hat{\alpha}/\partial \theta$ is always negative (positive) in state B (G). ■

B Data appendix

B.1 Compensation measures

The accounting treatment of stock options underwent a major change following the enforcement of FAS 123R in 2005. Because of this, I follow [Hayes, Lemmon, and Qiu \(2012\)](#) in building coherent compensation measures. In particular, whereas until 2005 all the information needed to evaluate current stock option grants was contained in the Stock Option Grants table and the holdings of in-the-money options were reported in the Annual Compensation table, the new Outstanding Equity Awards table introduced with FAS 123R gives full disclosure about outstanding stock options (also out-of-the-money ones), but it does not provide a separate account of new option grants. However, the new Plan Based Awards table contains information only about new grants, so, by matching this table with the Outstanding Equity Awards table, it is possible to identify the new options. To match these tables, I use the four criteria proposed by [Hayes, Lemmon, and Qiu \(2012\)](#):

- (i) $\text{opts_grt} = \text{opts_unex_unearn}$;
- (ii) $\text{opts_grt} = \text{opts_unex_exer} + \text{opts_unex_unexer}$;
- (iii) $\text{opts_grt} = \text{opts_unex_exer}$;
- (iv) $\text{opts_grt} = \text{opts_unex_unexer}$.

These criteria are overlapping, so I drop the duplicate observations generated by the matching procedure.

When computing the option delta, I use the following assumptions to estimate the parameters of the Black-Scholes formula.

- (i) The stock price is set equal to the CRSP fiscal year-end price.
- (ii) The logarithmic dividend yield is computed by taking the natural logarithm of the ratio of the sum of dividends distributed during the fiscal year to the market stock price at fiscal year-end. I winsorize it year-by-year at the 95th percentile in line with [Edmans, Gabaix, and Landier \(2009\)](#).
- (iii) The volatility is computed on the CRSP total monthly returns over the last 36 months (or at least 12 months), and then annualized. I winsorize it year-by-year at the 5th and 95th percentiles in line with [Edmans, Gabaix, and Landier \(2009\)](#).
- (iv) The risk-free rate is the yield to maturity for the constant maturity index for Treasuries released by FRED, St. Louis Federal Reserve Bank with maturity matching that of the option grant.

- (v) The maturity (in years) of options is given by $0.7 \times (\text{exdate} - \text{grant_date})$, where `grant_date` is set to July 1st of the current year as in [Hayes, Lemmon, and Qiu \(2012\)](#). If `exdate` is missing, I assume it comes seven years after `grant_date`, i.e., the manager is assumed to hold the option for 70% of the residual maturity.
- (vi) When exercise price is missing, I use the following proxies in this order: Market price at grant date, market price at the end of fiscal year from Compustat, market price at the end of fiscal year from CRSP.

When the number of options is missing, I set it to zero. I do the same with the number of shares held. I compute the number of restricted stocks awarded during the year as suggested in the appendix of [Li \(2002\)](#).

Finally, to estimate wealth-for-performance sensitivities, I follow the implementation of [Core and Guay \(2002\)](#) described by [Edmans, Gabaix, and Landier \(2009\)](#). Their procedure is devised to deal with pre-FAS 123R compensation data, but it can be easily extended to post-FAS 123R, as explained above.

B.2 Definition of variables

See Table [B.1](#).

C Repricing behavior

In the main analysis, I focus on how firms manage executives' pay-for-performance sensitivity. An alternative line of inquiry is to examine firms' adjustments to outstanding equity incentives, i.e., option repricing events. Execucomp does not provide data about repricings after 2005. Because of this, I identify 133 option repricing events for the period 2005 to 2010, searching for SEC filings in Capital IQ. Consistently with [Larcker, McCall, and Ormazabal \(2013\)](#), I gather exchange offer SC-TO-I forms, which announce these operations.²⁸ Thus, I have data on the features of repricings only over this period, whereas only an indicator variable for whether a firm carried out a repricing operation in a given year is available over the period 1992 to 2004.

Panel A of Table [C.1](#) illustrates that firms perform option repricing operations in only 1.7% of firm-years for the period 1992 to 2010, with no significant difference between expansion and recession periods. Panel B of Table [C.1](#) documents that a similar result holds for the period 2005 to 2010. In this case, the difference between recessions and expansions is statistically significant, but economically small. Moreover, executive officers are among the eligible option holders only in 21.1% of these offers.²⁹ In 62.4% of the events, firms offer to exchange outstanding options for new amended options. In 27.1% and 13.5% of the cases, restricted stock units and cash payments are offered, respectively.

²⁸I do not consider the closing of these operations as reported in SC-TO-I/A forms, as the original offer in SC-TO-I is arguably a better proxy for board and shareholders' intentions.

²⁹Because of the small number of repricings open to executive officers, I do not to pursue a regression analysis, and rely on descriptive statistics.

Quite interestingly, in recession firm-years the frequency of cash payments is double, and these are clearly wealth-for-performance sensitivity decreasing offers. With regard to the reasons and purposes of repricings listed on SC-TO-I forms, most of the offers (57.9%) are intended to deal with the underwater options problem caused by stock price declines. A substantial fraction of repricings (37.6%), clustered in 2007 and early 2008, has fiscal reasons: These were operations meant to curb tax disadvantages related to options granted in-the-money, generally raising the exercise price, to make them at-the-money. Finally, in many cases, these offers reduce the number of shares purchasable on exercise, limiting so the risk of dilution of incumbent shareholders (35.3%).

With regard to the contractual terms of the new options and restricted stock offered for exchange, Panel C of Table C.1 shows that in 36.1% and 88.9% of the cases there is an extension of the vesting schedule, respectively. Amended new options exhibit an increase in exercise prices to the at-the-money level in 54.9% of the cases (this adjustment is generally made to avoid negative fiscal consequences, as pointed out above), whereas they are characterized by a decrease in exercise prices to the at-the-money level in 41.1% of the cases, usually to deal with underwater options.

To sum up, as already pointed out by [Hall and Knox \(2004\)](#), I find that option repricing is a relatively marginal phenomenon, and that repricing operations are rarely open to executives.

Table B.1: Definition of variables

Variable	Definition
b^I	Ex ante pay-for-performance sensitivity measure defined as the ratio of the value of annual equity to total annual compensation. It can be decomposed in its stock and option parts. I use the variable <code>tdc1</code> in <code>Execucomp</code> to proxy for total annual compensation. Refer to Appendix B.1 for further details.
$PPS_{\$}$	Ex ante pay-for-performance sensitivity defined as dollar change in executive's annual compensation given a 1% change in firm value. It can be decomposed in its stock and option parts. Refer to Appendix B.1 for further details.
$PPS_{\%}$	Ex ante pay-for-performance sensitivity defined as dollar change in executive's annual compensation given a \$1 change in firm value. It can be decomposed in its stock and option parts. Refer to Appendix B.1 for further details.
$PPS_{\%}$ non-weighted	$PPS_{\%}$ measure computed without weighting stock options by their deltas.
$PPS_{\%}$ grant-date	$PPS_{\%}$ measure evaluated at grant-date.
B^I	Ex ante wealth-performance sensitivity measure introduced by Edmans, Gabaix, and Landier (2009) , computed following Core and Guay (2002) . I use the variable <code>tdc1</code> in <code>Execucomp</code> to proxy for total annual compensation. Refer to Appendix B.1 for further details.
$WPS_{\$}$	Ex ante wealth-performance sensitivity defined as dollar change in executive's wealth given a 1% change in firm value, computed following Core and Guay (2002) . Refer to Appendix B.1 for further details.
$WPS_{\%}$	Ex ante wealth-performance sensitivity defined as dollar change in executive's wealth given a \$1 change in firm value, computed following to Core and Guay (2002) . Refer to Appendix B.1 for further details.
Mean b^I top five	Mean of b^I across the firm's top five executives in a given firm-year.
Mean $PPS_{\$}$ top five	Mean of $PPS_{\$}$ across the firm's top five executives in a given firm-year.
Mean $PPS_{\%}$ top five	Mean of $PPS_{\%}$ across the firm's top five executives in a given firm-year.
Median b^I top five	Median of b^I across the firm's top five executives in a given firm-year.
Median $PPS_{\$}$ top five	Median of $PPS_{\$}$ across the firm's top five executives in a given firm-year.
Median $PPS_{\%}$ top five	Median of $PPS_{\%}$ across the firm's top five executives in a given firm-year.
CEO age	CEO's age defined as <code>age</code> in <code>Execucomp</code> . If missing, I replace it with <code>page</code> -(Current year - year). If still missing, I replace it with the CEOs' median age.
CEO tenure	Number of years since the executive was appointed as CEO based on <code>becameceo</code> in <code>Execucomp</code> . The <code>Execucomp</code> indicator variable <code>ceoann</code> does not identify a CEO for each firm-year. Indeed, as pointed out by Himmelberg and Hubbard (2000) , it is often missing in the first year the firm enters the sample. Because of this, I construct an indicator for CEOs using <code>EXECUCOMP</code> variables <code>becameceo</code> and <code>leftofc</code> that allows me to detect some additional CEOs. For the remaining firm-years without a CEO, I assume that the executive officer with highest total compensation, <code>tdc1</code> , is the CEO.
CEO turnover	Indicator variable equal to one if the CEO is replaced, based on the <code>Execucomp</code> executive identification number <code>co_per_rol</code> .
Exogenous CEO turnover	Indicator variable equal to one if the CEO is replaced and the CEO change is classified as exogenous. In line with Pan, Wang, and Wang (2013) , a turnover is classified as exogenous if the resigning CEO is older than 65 years, or if <code>Execucomp</code> variable <code>reason</code> reports her as "deceased". Unlike Pan, Wang, and Wang (2013) , I do not complement this sample of events with a news search of CEO departures due to death or health conditions.
NBER recession	Indicator equal to one if the economy is in recession during the last quarter of the fiscal year according to the NBER.
CFNAI slowdown	Indicator variable equal to one if CFNAI is negative is negative (i.e. economy growth below its historical trend) in the last fiscal quarter.
Recession GDP	Indicator equal to one if real GDP decreased during the last fiscal quarter.
Recession GDP (annual)	Indicator equal to one if real GDP decreased during the fiscal year.
Beta cash flow	Beta of the cash flow scaled by asset (<code>oibdpq/atq</code>) at the three-digit SIC code industry level with respect to the aggregate cash flow scaled by assets across the Compustat universe (excluding financial institutions and utilities) over the last ten years, using Compustat quarterly data. I remove industries with less than five firms.
Beta cash flow T3	Indicator variable equal to one if a three-digit SIC code industry-year belongs to the top tercile of <i>Beta cash flow</i> , where the tercile threshold is obtained year-by-year over the Compustat universe (excluding financial institutions and utilities).

(Continued)

Table B.1: – *Continued*

Beta cash flow Q4	Indicator variable equal to one if a three-digit SIC code industry-year belongs to the top tercile of <i>Beta cash flow</i> , where the quartile threshold is obtained year-by-year over the Compustat universe (excluding financial institutions and utilities).
Beta cash flow (annual)	Beta of the cash flow scaled by asset ($oibdpq/atq$) at the three-digit SIC code industry level with respect to the aggregate cash flow scaled by assets across the Compustat universe (excluding financial institutions and utilities) over the last ten years, using Compustat annual data. I remove industries with less than five firms.
Beta cash flow T3 (annual)	Indicator variable equal to one if a three-digit SIC code industry-year belongs to the top tercile of <i>Beta cash flow (annual)</i> , where the tercile threshold is obtained year-by-year over the Compustat universe (excluding financial institutions and utilities).
Beta equity	Firm-level equity beta estimated using the last 36 (or at least 12) monthly CRSP total returns.
Beta asset	Unlevered <i>Beta equity</i> following the procedure of Kemsley and Nissim (2002) .
Market leverage	Long-term book leverage defined as $(dlc+dltt)/at$ in Compustat.
Long-term market leverage	Long-term book leverage defined as $dltt/at$ in Compustat.
Total market leverage	Market leverage defined as $1-prcc.f \times csho/at$ in Compustat, in line with John, Mehran, and Qian (2010) .
Total book leverage	Book leverage defined as $1-ceq/at$ in Compustat, in line with John, Mehran, and Qian (2010) .
Assets	Book value of assets in Compustat, at .
Market-to-book ratio	Market-to-book ratio defined as $(at-ceq+prcc.f \times csho)/at$ in Compustat.
R&D expenses	Research and development expenses intensity defined as xrd/at in Compustat. I set it to zero if missing.
Missing R&D expenses	Indicator equal to one if xrd is missing.
Advertising expenses	Advertising expenses intensity defined as xad/at in Compustat. I set it to zero if missing.
Missing advertising expenses	Indicator equal to one if xad is missing.
Capital expenditures	Investment intensity defined as $(capx-sppe)/at$ in Compustat. I set it to zero if missing.
ROA	Accounting return on assets defined as $oibdp/at$ in Compustat.
Sales growth	Annual sales growth based on the Compustat variable $sale$.
Cash holdings	Cash balance defined as che/at in Compustat.
E-index	Entrenchment index defined as in Bebchuk, Cohen, and Ferrell (2009) , using IRRC (2000-2006) and Riskmetrics (2007-2012) data.
SA index	Measure of financial constraints computed following the procedure described by Hadlock and Pierce (2010) and Li (2011) .

Table C.1: Stock option repricing activity

This table reports summary statistics about stock option repricing programs. This information has been hand-collected from exchange offer SC-TO-I forms. Panel A shows the frequency and distribution across different macroeconomic states of stock option repricing programs for the period 1992 to 2010. Panel B shows the frequency and distribution across different macroeconomic states of stock option repricing programs for the period 2005 to 2010. It also reports several characteristics of these programs, such as eligibility of executive officers to participate, the type of securities offered in exchange, the presence of an exercise price floor, and the reason of the exchange offer. Panel C provides information about the characteristics of the securities offered in exchange for the period 2005 to 2010. Two-group test of proportions are conducted to test whether the frequency of each variable in Panels A and B differs significantly between expansion and recession periods. Significance at the 10%, 5%, and 1% level is indicated by *, **, ***, respectively. Refer to Table B.1 for detailed variable definitions.

Panel A: Time distribution of repricing programs (1992-2010)

	Total	NBER recession	Expansion	Difference
Number of repricings	421	51	370	
Frequency of repricings	0.017	0.018	0.017	0.001

Panel B: Time distribution and characteristics of repricing programs (2005-2010)

	Total	NBER recession	Expansion	Difference
Number of repricings	133	51	82	
Frequency of repricings	0.017	0.021	0.015	0.005*
Open to executives	0.211	0.255	0.183	0.072
<i>Exchange for</i>				
Options	0.624	0.667	0.598	0.069
Restricted stock	0.271	0.176	0.329	-0.153*
Cash	0.135	0.196	0.098	0.099
Exercise price floor	0.579	0.451	0.659	-0.208**
<i>Reasons/purposes</i>				
Reaction to price decline	0.579	0.471	0.646	-0.176**
Fiscal	0.376	0.490	0.305	0.185**
Dilution	0.353	0.255	0.415	-0.160*
M&A	0.038	0.039	0.037	0.003
Long-term incentive/retention	0.609	0.510	0.671	-0.161*

(Continued)

Table C.1: – *Continued*

Panel C: Characteristics of offered securities (2005-2010)							
	Vesting	Exercise price			Expiration date		
		Increased to ATM	Decreased to ATM	Unchanged	Increased	Decreased	Unchanged
Amended options	0.361	0.549	0.390	0.049	0.183	0.049	0.768
Restricted stock	0.889						

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