Government spending and CEO equity incentives:

Evidence from changes in U.S. Senate committee chairs

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ABSTRACT

This study examines the impact of government spending on CEO equity incentives. Using changes in U.S. Senate committee chairs as a source of exogenous variation in state-level federal government spending, we find that firms headquartered in a state whose senator becomes a committee chair significantly reduce the convexity of their CEOs' option-based pay, captured by vega. These reductions are more pronounced for firms with higher government dependence and with more geographically concentrated operations. Overall, our findings suggest that the positive shock to government spending due to a new committee chair reduces a firm's desired level of risk-taking, which discourages offering risk-taking equity incentives to the CEO.

JEL classification E62 · G31 · H32 · J33

Keywords: Government spending, seniority shock, departure shock, risk-taking, CEO incentives

Data Availability: The data used in this study are available from the public sources identified in the paper.

1. Introduction

Researchers in accounting and financial economics have well recognized the importance of incentive contracts in alleviating risk-related agency problems. Specifically, Jensen and Meckling (1976) and subsequent studies demonstrate that firms can structure managerial compensation as a convex function of firm performance (e.g., through stock options) to incentivize managerial risk-taking, as corporate managers share the gains but not all of the losses (Myers 1977; Smith and Stulz 1985; Smith and Watts 1992; Core and Guay 1999). Since then, a growing body of literature has paid much attention to understanding the determinants of incentive compensation design. At the microeconomic level, empirical studies often link a convex compensation scheme to various firm-level attributes. However, relatively little is known about the role of macroeconomic factors such as government spending in shaping the structure of incentive compensation contracts. In this study, we aim to provide large-sample, systematic evidence on whether and, if so, how government spending at the state level affects CEO equity incentives at the firm level. Specifically, utilizing changes in U.S. Senate committee chairs as an exogenous source of variation in state-level federal government spending, we analyze the link between government spending and the convexity of CEOs' option-based pay (or the sensitivity of CEO wealth to stock return volatility), captured by CEO portfolio vega. Given that many advanced economies have recently increased government spending in response to the Covid 19 pandemic, empirical evidence stemming from our study is timely and useful to better understand the relation between public-sector spending and private-sector risk-taking incentives.

Government spending is especially relevant to the design of a CEO's incentive contract for two main reasons. First, it is well recognized in economics that fiscal policies will affect labor participation and productivity in the private sector by altering private–public sector hiring and wage dynamics and the trade-offs between work and leisure (Alesina, Ardagna, Perotti and Schiantarelli 2002; Cohen, Coval and Malloy 2011). These changes in labor market outcomes could affect a private-sector firm's incentive compensation design. Given that human capital is a primitive factor required for a firm's risk-taking (Griliches 1990; Coles, Daniel and Naveen 2006; Barlevy 2007), it is likely that firms anticipate the economic consequences of government spending changes and adjust CEOs' equity incentives accordingly.

Second, prior studies suggest that firms adjust CEOs' equity incentives according to changes in the desired investment (Bizjak, Brickley and Coles 1993; Coles et al. 2006; Gormley, Matsa and Milbourn 2013; Chen, Jung, Peng and Zhang 2021).[1] Government spending can influence a firm's operating environment (e.g., demand and supply conditions), which affects its desired investment. Therefore, by focusing on government spending, one can examine whether and, if so, how firms respond to a change in risk-taking needs from the broad perspective of macroeconomic factors beyond managerial control.

In this study, our analysis focuses mainly on how government spending affects CEOs' equity incentives. A large body of studies in economics suggest that politicians tend to

[1] For example, Gormley et al. (2013) suggest that an increase in workers' carcinogen exposure makes firms prefer to remit unused funds back to shareholders, rather than funding new investments; consequently, the firm no longer needs to provide risk-averse managers with as much pay convexity to incentivize undertaking risky investments.

pursue the interests of their home state and find that political representation from a state is an important determinant of federal spending allocation to that state (e.g., Crain and Tollison 1977, 1981; Kiel and McKenzie 1983; Atlas, Gilligan, Hendershott and Zupan 1995; Hoover and Pecorino 2005; Aghion, Boustan, Hoxby and Vandenbussche 2009; Cohen et al. 2011; Kong 2020). [2] For example, as stated by Aghion et al. (2009, p5) "When he is able to do it, a politician needs to deliver payback to his constituents in return for their support". In this study, we follow prior studies that utilize political shocks from the appointment of a powerful U.S. Senate committee chair to examine the impact of government spending (e.g., Cohen et al. 2011; Snyder and Welch 2017; Kong 2020; Akey, Heimer and Lewellen 2021). Prior studies find that when a senator becomes chair of a powerful committee, it will significantly increase the flow of government funds to that senator's home state including earmark spending, procurement contracts, and grants (Cohen et al. 2011; Kong 2020).[3]

This approach of utilizing an exogenous increase in state-level government spending due to a senator's ascension to a powerful committee chair can address endogeneity concerns. As a new chair is appointed only when the current incumbent relinquishes the position due to election defeat, resignation, or their party losing control of the Senate, these events depend almost entirely on political circumstances in other states. Thus, a senator's

[2] For example, Crain and Tollison (1977, 1981) find that congress membership on the Ways and Means Committee and the Appropriations Committee increase their states' share of expenditures. Atlas et al. (1995) find that states' per capita congressional representation has a positive effect on per capita net federal spending allocations across states.

[3] Cohen et al. (2011) finds that a state whose senator is appointed as the chair of one of a top three Senate committees receives 40%-50% increase in earmark spending, 8.7% increase in federal transfers, and 23.5% increase in total government contracts. Cohen et al. (2011) also find that earmark spending decreases by 33.3% following a chair or ranking member relinquishing a top three Senate committee. Kong (2020) finds that the seniority shock results in 34.3% increase in earmark spending and 6.4% increase in procurement contracts and grants.

ascension to a powerful committee chair creates a positive exogenous shock to the federal funds directed to his or her state (for simplicity, "seniority shock"), which is unlikely to be related to the state's economic conditions and the investment and operational activities of firms residing in the states.

Prior studies suggest that positive government spending shocks could reduce firms' risk-taking incentives, resulting in lower capital investments, R&D expenditure, and innovative activities, and higher investor payout (e.g., Cohen et al. 2011; Kim and Nguyen 2020; Kong 2020). This is because government spending could induce individual leisure and divert labor resources from the private sector to the public sector (e.g., Baxter and King 1993; Finn 1998; Ardagna 2001; Alesina et al. 2002; Cohen et al. 2011; Kim and Nguyen 2020). In effect, this indicates a reduction in labor supply and productivity, which are considered as the primitives for firms' risk-taking, thus weakening a firm's ability to engage in risky activities (Griliches 1990; Coles et al. 2006; Barlevy 2007). Moreover, since government spending increases aggregate demand for overall production, it increases the opportunity costs of diverting resources from non-innovative to innovative production. This process of labor reallocation reduces a firm's potential output or sales that could have otherwise been achieved by investing in non-innovative production (Cooper and Haltiwanger 1993; Caballero and Hammour 1996; Aghion and Saint-Paul 1998; Ouyang 2011).

Taken together, we argue that government spending shocks could lower labor supply and productivity and increase the opportunity cost of firms' risky investment, making firms prefer non-risky investment to risky investment. This induces firms to change the reward structure to lower CEOs' risk-taking incentives. The convexity in incentive compensation design is used to induce CEOs to take appropriate risks and implement investment strategies with the optimal risk level (e.g., Guay 1999; Coles et al. 2006). Accordingly, we predict that as the desired risk-taking level declines, firms no longer need to provide CEO with as much pay convexity as incentives to undertake risky investments.

To test the above prediction, we follow prior studies (Cohen et al. 2011; Snyder and Welch 2017; Kong 2020; Akey et al. 2021) by first identifying firms headquartered in a state that experiences a government spending shock. A shock occurs when a senator of the state becomes chair of one of the top one/three/five U.S. Senate committees. Using a sample of 20,579 firm-year observations from 1992 to 2018, we find that in the years that follow a senator's appointment as chair of a top one (top three and top five) Senate committee, firms headquartered in that senator's state significantly reduce CEO portfolio vega. Specifically, focusing on a senator's accession to a top three Senate committee defined in the same way, we find that CEO portfolio vega falls by roughly $0.013 million, which represents 25% of its mean value. Our dynamic test shows that this drop occurs after the senator's ascension to a powerful committee chair, but that CEO portfolio vega bounces back after the senator relinquishes the chair.

To establish causality, we use U.S. Senate committee chair's unexpected departures that has significantly diminished influence on government spending. The unexpected chair departures reduce the government spending channeled to the chairs' home states, and could increase firms' incentive to engage in risk-taking. Firm thus increase CEOs' pay convexity to encourage their CEOs to undertake risky investments. We find that firms significantly increase CEOs' portfolio vega following a chair's unexpected departure from a powerful

Senate committee. This indicates that exogenous shocks to government spending due to changes in Senate committee chairs causally affects CEOs' portfolio vega.

In additional tests, we find that firms actively adjust CEOs' risk-taking incentives by decreasing CEO vega from annual option grants in response to government spending shocks. Consistent with the literature suggesting that the impact of pay-performance sensitivity on managerial risk-taking is ambiguous (e.g., Coles et al. 2006; Low 2009), we also find no evidence of a significant change in CEO delta (the sensitivity of CEOs' wealth to stock price changes) following the government spending shock. Finally, we find that the seniority shocks lead to a decrease in firm risk-taking, as reflected in financial performance volatility. Overall, our findings suggest that the positive shock to government spending reduces a treated firm's desired level of risk-taking, which discourages the treated firm to offer the CEO risk-taking incentives.

We next explore the settings in which we expect the relation between government spending shocks and CEO portfolio vega to vary systematically across firms. First, firms with greater reliance on government spending (i.e., more government contracts) are likely to be large suppliers to the government (Kong 2020). Since an increase in government spending is likely to boost the government's demand for conventional goods, we expect firms with greater reliance on government to experience a greater reduction in vega. Second, firms with more geographically concentrated operations are less likely to shift their operations to other states and less likely to access interstate labor markets (Cohen et al. 2011). Since increased government spending is likely to reduce the availability of certain resources (e.g., skilled labor) required for risk-taking activities such as innovation and R&D, firms with geographically concentrated operations are more compelled to reduce their risky investment in response to government spending shocks (Cohen et al. 2011), compared to firms with geographically diversified operations. We thus expect a greater reduction in vega by the former firms than the latter firms. Consistent with our expectations, we find that the negative impacts of government spending shocks on CEO portfolio vega are stronger for firms with higher government dependence and with more geographically concentrated operations.

We conduct several robustness tests. First, we construct an alternative measure of government spending shock that considers both the chair and ranking minority member of powerful U.S. Senate committees. We find consistent results. Second, we perform a placebo test for falsification. The placebo test results are insignificant.

Our study contributes to the literature in three ways. First, it investigates previously unexamined consequences of government spending. A large body of economics literature examines the impact of government spending on macroeconomic factors such as consumption, employment, and national output. By contrast, our study is most related to the strand of literature that examines how government spending affects private-sector firms (e.g., Alesina et al. 2002; Blanchard and Perotti 2002; Serrato and Wingender 2014; Kim and Nguyen 2020). Prior studies find that government spending shocks can increase real wages and decrease labor productivity and labor supply in the private sector by diverting labor resources to the public sector (e.g., Finn 1998; Ardagna 2001; Alesina et al. 2002; Cohen et al. 2011; Kong 2020; Kim and Nguyen 2020). In particular, Cohen et al. (2011) and Kong (2020) find that firms respond to the seniority shock to government spending by reducing investment activities and innovation. Our study extends this line of research to examine the impact of government spending shocks on the structure of the CEO incentive compensation contract.

Second, our study contributes to the executive compensation literature on executive pay-for-performance sensitivity. Prior studies link firm-specific and market-wide factors (particularly risk factors) to the managerial incentive compensation contract design. Unlike prior studies examining determinants of incentive compensation at the microeconomic level, we focus on a macroeconomic factor that is likely beyond managerial control and thus exogenous. We find that when the headquarters state experiences an increase in government spending, firms respond by curtailing incentive pay to induce CEOs to undertake less risky projects.

Third, prior studies suggest that it is difficult to untangle the relation between option-based incentives and firm risk-taking due to potential endogeneity underlying the relation between compensation convexity and risk (e.g., Coles et al. 2006). Prior study exploits regulatory and legal changes (e.g., Hayes, Lemmon and Qiu 2012; Cohen, Daniel and Naveen 2013; De Angelis, Grullon and Michenaud 2017; Yang, Yu and Zheng 2020; Chen, Jung, Peng and Zhang 2021) to overcome the identification challenge. Our analysis exploits changes in firms' desired risk-taking arising from exogenous shocks to government spending in their headquarters state; such shocks are unlikely to be controlled by managers.

The paper proceeds as follows. Section 2 reviews related literature and develops the study's hypothesis. Section 3 discusses the sample and research design. Section 4 reports the empirical results. Finally, section 5 concludes the paper.

2. Related literature and hypothesis

2.1 Government spending shocks

There is ongoing interest in understanding the impact of government spending on the private sector. Economic theories suggest that government spending can be transmitted to the private sector through various channels, including interest rate, tax, and labor markets (e.g., Buiter 1977; Baxter and King 1993; Finn 1998; Ardagna 2001; Alesina et al. 2002). This is because government spending is financed through borrowing and/or taxation. Increased borrowing raises the demand for loans; as a result, the interest rate rises, causing the private sector to reduce investment (Buiter 1977). Higher taxation reduces individuals' incentives to work and to invest, which induces falling investment and consumption, resulting in a smaller multiplier (Baxter and King 1993). Moreover, increased government spending could lead to higher government employment demand (Finn 1998). This results in employment reallocation from the private sector to the public sector, leading to a fall in private sector employment and marginal productivity. An increase in government employment raises the probability of finding a job in the public sector, and an increase in government wages raises public-sector workers' income; this increases the real wage and reduces profit in the private sector, which in turn depresses private-sector investment (Finn 1998; Ardagna 2001; Alesina et al. 2002).

Consistent with this view, prior studies find that unexpected changes in government spending, such as military spending shocks and tax shocks, have a significant impact on macroeconomic performance indicators, such as GDP, aggregate investment, and unemployment (e.g., Rotemberg and Woodford 1992; Alesina et al. 2002; Blanchard and Perotti 2002; Ramey 2011; Serrato and Wingender 2014; Kim and Nguyen 2020). For example, Blanchard and Perotti (2002) show that an increase in government spending reduces aggregate investment spending. Alesina et al. (2002) find that government spending, particularly its wage component, has a strong negative effect on business investment, suggesting that an increase in government employment creates pressure on wages for private-sector firms. Serrato and Wingender (2014) find that as government spending increases, so does the demand for local labor to provide public services. Stated another way, a government spending shock shifts both the demand for and supply of local labor forces. Relatedly, Kim and Nguyen (2020) find that positive government spending shocks decrease corporate hiring and reduce the flow of workers to the private sector.

Focusing on government spending shocks that are entirely independent of the state's economic events and activities, Cohen et al. (2011) and Kong (2020) show that a seniority shock results in lower corporate innovation output. Cohen et al. (2011) argue that government spending shocks could result in corporate retrenchment and a decline in marginal productivity by encouraging leisure and other personal consumption. Cohen et al. (2011) also find that the reduced investment leave firms with unused funds and firms use that funds to increase shareholder payouts. Kong (2020) argues that government spending shocks induce the diversion of labor resources from innovative activities in the private sector to government contracts.

Overall, the aforementioned studies suggest that government spending shocks contribute to changes in firms' operating environment and, hence, adjustments to their optimal investment policies. Our study investigates a consequence of government spending that prior research has not explored yet. Specifically, we study whether and, if so, how firms alter the provision of managerial equity incentives in response to government spending shocks.

2.2 CEO equity incentives

The standard principal–agent model suggests that a firm designs incentive contracts to incentivize managers to operate in shareholders' interests (Jensen and Meckling 1976; Holmstrom 1979; Shavell 1979). Specifically, because managers have significant human capital tied to the firm, they tend to be less diversified than outside shareholders; consequently, managers have incentives to pass up risk-increasing, positive net present value projects that could benefit shareholders (Smith and Stulz 1985). Prior studies find that firms can structure compensation as a convex function of firm performance and manage the convexity between stock price (a proxy for firm performance) and managers' wealth to mitigate this risk-related agency problem (e.g., Smith and Stulz 1985; Hirshleifer and Suh 1992; Guay 1999; Coles et al. 2006; Bettis, Bizjak, Coles and Kalpathy 2018). For example, Guay (1999) finds a positive association between a firms' stock-return volatility and the convexity in the relation between CEOs' wealth and stock price, suggesting that convex incentive schemes influence CEOs' investing and financing decisions. Similarly, Coles et al. (2006) find that firms with higher pay convexity engage more in risk taking activities including investing relatively more in R&D, less in PPE, and having higher leverage. Bettis et al. (2018) show that the positive relation between pay convexity and firm risks is unaffected by exogenous increase in accounting costs of stock options FASB ASC Section 718. Moreover, using a sample of oil and gas producers, Rajgopal and Shevlin (2002) find evidence that the sensitivity of the value of the CEO's options to stock return volatility has a positive relation with a firm's future exploration risk taking. Focusing on firms' tax policies, Rego and Wilson (2012) find a decrease in the level of the firm's cash effective tax rates in the CEO's risk-taking incentives, suggesting that firms employ risk-taking incentives to encourage CEOs to undertake risky tax strategies.

Prior studies have examined various determinants of the convexity in executive compensation. For example, Cohen et al. (2013) find that following the passage of SOX in 2002, there was a significant decline in incentive-based compensation awarded to CEOs. This is attributable to SOX increasing directors' legal and political exposure, discouraging firms from favoring high-risk over low-risk projects. Gormley et al. (2013) find that firms decrease managerial compensation vega after their exposure to legal liability risk increases. De Angelis et al. (2017) find that the removal of short-sale constraints during the Regulation SHO Pilot Program increased the convexity of the compensation payoff. They argue that a drop in short-sale costs can cause a price decline that motivates managers to avoid risky projects. Chen, Leung, Song and Avino (2019) find that, with the onset of CDS trading and consequently reduced creditor monitoring, firms increase managers' incentive compensation to encourage more risk-taking activities. Exploiting the exogenous reduction in litigation threat following a 1999 ruling of the U.S. Ninth Circuit Court of Appeals, Yang et al. (2020) find that firms headquartered in Ninth Circuit states decreased CEOs' equity portfolio vega after the ruling. Exploiting the setting of staggered adoption of the Inevitable Disclosure Doctrine as exogenous restrictions of outside employment opportunities, Chen et al. (2021) find a significant increase in vega in the post period after the IDD adoption.

Overall, these studies suggest that changes in firm and market characteristics will encourage firms to adjust managerial incentive compensation, and hence structure pay convexity to induce managers to take appropriate risks and implement financial and investment policies with the optimal risk level. Our study examines an important macroeconomic factor influencing CEOs' equity incentives, that is, exogenous variation in government spending.

2.3 Link between government spending shocks and CEO equity incentives

Prior studies suggest that positive government spending shocks could reduce firms' risk-taking incentives, leading to firms decreasing capital investments, R&D expenditure, and innovative activities, and increasing shareholder payouts (e.g., Cohen et al. 2011; Kim and Nguyen 2020; Kong 2020). There are two main explanations for this.

First, government spending shocks may reduce labor productivity and labor supply, thereby restricting firms' ability to take risks (Baxter and King 1993; Finn 1998; Ardagna 2001; Alesina et al. 2002; Cohen et al. 2011; Kim and Nguyen 2020). Cohen et al. (2011) present a model of labor–leisure choice in which individuals allocate their time between labor and leisure activities as a response to positive shocks to government spending. They argue that when the flow of government funds into a state unexpectedly increases with no change to borrowing or taxation, residents' wealth rises, which induces them to work less, enjoy more leisure time, and consume more; this in turn lowers the marginal productivity of capital, including intellectual capital, in the state. The decreased marginal productivity of capital compels firms to scale back investment, including R&D expenditure, and to increase shareholder payouts (Cohen et al. 2011).

Moreover, an increase in government spending may increase the demand for skilled labor in the public sector (Finn 1998; Ardagna 2001; Alesina et al. 2002). Since the labor supply in a state is mostly inelastic (Almazan, De Motta and Titman 2007), the increased demand for government employment makes it more difficult for firms to compete for scarce employable and skilled workers in the private sector; this could lead to a decrease in labor available to firms (Ardagna 2001; Cohen et al. 2011; Serrato and Wingender 2014; Kim and Nguyen 2020). For example, Serrato and Wingender (2014) find that an increase in government spending can lead to a rise in the demand for local labor to provide public services. Kim and Nguyen (2020) find that government spending shocks reduce firms' hiring of employees as well as the movement of workers from the public to the private sector. Prior studies suggest that a firm's optimal investment policy relies on primitives such as general and firm-specific human capital (Griliches 1990; Coles et al. 2006; Barlevy 2007). Government spending shocks reduce the marginal productivity of human capital and curtail the supply of workers available to the private sector, which in turn lowers firms' incentives and ability to take risks.

Second, increased government spending in a state boosts aggregate demand for skilled labor, which increases firms' opportunity cost of risky investment and, consequently, discourages risk-taking activities in the private sector. This is because risky investments tend to require resources reallocation, such as retraining and diverting workers from existing production activity to the new productivity- or growth-enhancing activity. Such a process is very costly during periods of high aggregate demand because it reduces firms' output or sales below what could have otherwise been achieved by investing in non-innovative production (Cooper and Haltiwanger 1993; Caballero and Hammour 1996; Aghion and Saint-Paul 1998; Ouyang 2011). Firms thus have incentives to reduce risk-taking activities by reallocating resources from innovative to non-innovative activities. Consistent with an increase in firms' opportunity cost of risky investment, Ouyang (2011) shows that a positive demand shock causes a reduction in industry-level R&D spending.

Similarly, Kong (2020) finds a reduction in firms' patents and the citations of these patents following a government spending shock.

Taken together, we argue that positive shocks to government spending make firms prefer non-risky (or less risky) investment over risky (or riskier) investment as increased government spending lowers labor supply and productivity in the private sector and increases firms' opportunity cost of risky investment, thereby curtailing incentives for risk-taking activities. These reduced risk-taking incentives lead firms to avoid risky investment to a greater degree. Prior studies find that the convexity of stock options determines the sensitivity of CEO wealth to equity risk (e.g., Guay 1999; Coles et al. 2006). For example, Guay (1999) finds a positive relation between a firm's stock return volatility and the convexity of its CEO's full compensation package. Therefore, we expect that with a decline in firms' risk-taking following a government spending shock, these firms no longer need to offer high compensation convexity to incentivize their CEOs to undertake risky projects. To provide systematic evidence on this prediction, we propose and test the following hypothesis, stated in alternative form:

> HYPOTHESIS. *Following a senator's ascension to a powerful committee chair, there is a decrease in CEO compensation convexity for firms headquartered in the senator's home state, all else equal.*

3. Sample and research design

3.1 Sample selection

We collected data from several sources. We used Standard & Poor's ExecuComp database to identify firms' CEOs for 1992–2018. We obtian necessary financial, stock trading, and executive compensation data from Compustat, CRSP, and ExecuComp, respectively. To calculate compensation convexity, we also obtained the risk-free rate based on Treasury securities from the Federal Reserve and the Consumer Price Index for All Urban Consumers (CPI-U) from the Bureau of Labor Statistics.[4] To identify the majority party chairs of U.S. Senate committees, we collected data on congressional committee memberships from Charles Stewart's Congressional data page.[5] Finally, to link firms' historical headquarters state to the senator' home state, we collected data on firms' historical headquarters state from Bill McDonald's website.[6] Following previous studies (e.g., Coles et al. 2006; Low 2009; Armstrong and Vashishtha 2012), we excluded financial firms (SIC codes: 6000–6999) and utility firms (SIC codes: 4900–4999). We required each firm-year observation to have the necessary data from the sources mentioned to calculate our research variables. Our final sample comprised 20,579 firm-year observations.

3.2 Measuring compensation convexity

Consistent with prior research (e.g., Core and Guay 2002; Coles et al. 2006; Coles et al. 2013; Bettis et al. 2018), we use vega, the sensitivity of compensation to stock return volatility, to proxy for the compensation convexity. Specifically, we define vega as the change in the dollar value of the CEO's wealth for a 0.01 change in the annualized standard deviation of a firm's stock return. Prior studies suggest that vega reflects managerial incentive to invest in risky projects; compensation packages with higher vega are related to the implementation of riskier policy choices (e.g., Coles et al. 2006).

[4] Data on the risk-free rate are available at: https://www.federalreserve.gov/releases/h15/data.htm#fn11; data on the annual average CPI-U are available at: https://www.bls.gov/data/.
[5] These data are available online on Charles Stewart's Congressional Data Page: http://web.mit.edu/17.251/www/data_page.html
[6] These data are available online on Bill McDonald's website: https://www3.nd.edu/~mcdonald/

We follow Guay (1999), Core and Guay (2002), and Coles et al. (2013) to calculate vega. Specifically, we rely on the Black–Scholes (1973) option valuation model as modified by Merton (1973) to account for dividend payouts. Following Guay (1999) and Coles et al. (2013), we use the vega of the option portfolio to measure the total vega of the equity portfolio. Vega is expressed in millions of dollars, consistent with Coles et al. (2006) and Bettis et al. (2018), and adjusted for inflation using the annual average CPI-U, consistent with Gormley et al. (2013).

3.3 Measuring government spending shock

We measure the seniority shock using an indicator variable that equals 1 if the senator of a given state becomes the chair of a powerful U.S. Senate committee. In so doing, we adopt two alternative methods of coding a seniority shock, developed by Cohen et al. (2011) and Snyder and Welch (2017), respectively. There are three main differences in their coding choices. First, Cohen et al. (2011) apply each seniority shock if a senator of a state who was not a ranking minority member of a powerful Senate committee first becomes the chair of the powerful Senate committee. There is no second seniority shock applied to a state when a senator of the state was already a chair of a powerful Senate committee. Snyder and Welch (2017) apply each seniority shock when a senator of the state was the chair of a powerful Senate committee. Second, Cohen et al. (2011) apply the shocks as lasting for six years (term of a senator) from the year of the senator's ascension, while Snyder and Welch (2017) apply the shocks for the duration of the senator's actual tenure as a chair of a powerful Senate committee. Third, Cohen et al. (2011) apply these shocks to firms that must have been alive in the year of the senator's ascension. Snyder and Welch (2017) apply these shocks to all firms in the state-years. [7]

Following prior studies (Cohen et al. 2011; Cohen and Malloy 2014; Battaglini and Patacchini 2018; Kong 2020; Cuny, Kim, and Mehta 2020), we define powerful Senate committees by using Edwards and Stewart's (2006) list of top five influential committees in the Senate (in descending order): Finance, Veterans Affairs, Appropriations, Rules, and Armed Services. To take into account the power differences across these five committees, we follow prior studies (Cohen et al. 2011; Kong 2020) by categorizing shocks into various groups based on the committee rankings. For example, following Cohen et al. (CCM: 2011), *Top1ChairCCM* means that the senator who was not a ranking minority member first becomes chair of the top one Senate committees (Finance). Accordingly, *Top3ChairCCM* and *Top5ChairCCM* mean that the senator who was not a ranking minority member first becomes chair of one of the top three and the top five Senate committees, respectively. The shocks are coded as starting in the year of appointment and are applied for six years (term of a senator). The shocks are applied to firms who have been alive in the year of the senator's ascension. Alternatively, following Snyder and Welch (SW: 2017), *Top1ChairSW* means that the senator becomes chair of the top one Senate committees (Finance). Similarly, *Top3ChairSW*and *Top5ChairSW* mean that the senator becomes chair of one of the top three and the top five Senate committees, respectively. The shocks are applied for the duration of the senator's actual tenure and to all firms in the state-years. As

[7] For example, Maxwell Sieben Baucus (D-MT) was appointed to be chair of the Senate Committee on Finance in 2001, 2007, 2009, 2011, and 2013, respectively. He was not a ranking member of a Senate Committee before his first appointment in 2001. Cohen et al. (2011) apply the seniority shock to firms headquartered in Montana when Maxwell Sieben Baucus (D-MT) first became the chair of the senate Committee on Finance in 2001 and the shock lasts for six years (2001-2006). Snyder and Welch (2017) apply the seniority shock to firms headquartered in Montana for the duration of Maxwell Sieben Baucus (D-MT)'s tenure of being a chair of the senate Committee on Finance (2001-2002; 2007-2013).

a robustness check, we also construct an alternative measure of seniority shock by considering both the chairs and the ranking minority members of the influential committees.[8]

3.4 Empirical model

We follow Cohen et al. (2011), Snyder and Welch (2017), Kong (2020) and Akey et al. (2021) to estimate various ordinary least squares specifications of the following regression model:

$$\begin{aligned} Vega_{it} = {} & \beta_0 + \beta_1 Shock_{it} + \beta_2 Size_{it} + \beta_3 MB_{it} + \beta_4 Leverage_{it} + \beta_5 R\&D_{it} + \beta_6 CAPEX_{it} \\ & + \beta_7 CashFlow_{it} + \beta_8 StockReturn_{it} + \beta_9 ROA_{it} + \beta_{10} CashCompensation_{it} \\ & + \beta_{11} Population_{it} + \beta_{12} Income_{it} + \beta_{13} GDP_{it} + Firm\ Fixed\ Effects \\ & + Year\ Fixed\ Effects + \varepsilon_{it} \end{aligned} \tag{1}$$

where *i* indexes firms and *t* indexes years. *Vega* is defined as the change in the dollar value of the CEO's wealth for a 0.01 change in the annualized standard deviation of a firm's stock return. *Shock* represents the government spending shock, and is measured by one of six indicator variables: *Top1ChairCCM*, *Top3ChairCCM*, Top5ChairCCM, *Top1ChairSW*, *Top3ChairSW*, and *Top5ChairSW*. These variables take the value of 1 if a senator of a state becomes a chair of top one, and one of the top three, and top five Senate committees, respectively, and 0 otherwise. The coefficient on *Shock* captures the incremental change in CEO portfolio vega for firms headquartered in the state that experiences a positive shock to government spending relative to other firms. A negative and significant coefficient for *Shock* ($\beta_1 < 0$) supports the hypothesis that government spending shocks decrease CEO compensation convexity.

[8] The ranking member is the most senior member of a congressional committee from the minority party.

We include a set of control variables known to affect CEO portfolio vega. *Size* is the log of a firm's total assets. *MB* is a firm's market value of equity divided by its book value of equity, and proxies for growth opportunities (Smith and Watts 1992). *Leverage* is total debt divided by total assets, which has been found to affect managerial risk-taking incentives (e.g., Coles et al. 2006). *R&D* is research and development expenditure divided by total assets. *CAPEX* is net capital expenditure divided by total assets. *R&D* and *CAPEX* are controlled to capture variations in investment opportunities. *CashFlow* is cash flows divided by total assets, and proxies for firms' cash constraints: firms prefer equity-based pay to cash compensation if they face cash constraints (Dechow, Hutton and Sloan 1996; Core and Guay 1999). *StockReturn* is a firm's stock return of the last 12-month fiscal period. *ROA* is income before extraordinary items scaled by lagged total assets. *StockReturn* and *ROA* are used to control for firm performance (Core and Guay 1999). *CashCompensation* is the sum of salary and bonus, and proxies for the CEO's level of risk aversion: CEOs with high cash compensation tend to be wealthier and better diversified, which makes them less risk-averse (Berger, Ofek and Yermack 1997; Guay 1999). *CashCompensation* is expressed in millions of dollars and adjusted for inflation using the annual average CPI-U. *Population* is the log of a state's total population; *Income* is the log of per capita income in a state; and *GDP* is the log of GDP per capita in a state. Details on the construction of all variables are presented in the Appendix.

Finally, firm and year fixed effects are included to control for time-invariant unobservable firm characteristics and common economy-wide shocks that vary over time, and standard errors are clustered at the state-year level. Untabulated results show that my findings of main tests are robust if I: 1) cluster standard errors by state; or 2) cluster standard errors by state and year.

4. Empirical results

4.1 Descriptive statistics

Table 1 presents the summary statistics of the main variables used in our regression analysis. All dollar values are expressed in millions of dollars and adjusted for inflation using the annual average CPI-U. To control for outliers, we winsorize continuous variables at the bottom and top 1%. Table 1 indicates that, on average, 1.4% (3.3% and 3.6%) of firm-year observations experienced the shock of a senator of the headquarters state becoming chair of the top one (top three and top five) Senate committee based on Cohen et al. (2011)'s coding choice; on average, 1.0% (3.1% and 6.9%) of firm-year observations experienced the shock of a senator of the headquarters state becoming chair of the top one (top three and top five) Senate committee based on Snyder and Welch (2017)'s coding choice. The mean value of vega is $0.053 million, indicating an average increase of $53,000 in the dollar value of CEO wealth for a 0.01 increase in the annualized standard deviation of a firm's stock price. The mean value of cash compensation is $0.512 million. Overall, the descriptive statistics of all the variables are largely similar to those reported in previous studies (e.g., Coles et al. 2006; Cohen et al. 2011; Gormley et al. 2013; Bettis et al. 2018; Kong 2020).

[Insert Table 1 Here]

4.2 Main tests on government spending shock and compensation convexity

Table 2 presents the results of our main analysis using the multivariate regression in Eq. (1). Columns (1)–(3) report the regression results using *Top1ChairCCM*, *Top3ChairCCM*, and *Top5ChairCCM*, respectively, as the key test variable. Columns (4)–(6) report the regression results using *Top1ChairSW*, *Top3ChairSW*, and *Top5ChairSW*, respectively, as the key test variable. As shown in Table 2, the coefficients on seniority shock measures are negative and statistically significant, suggesting that government spending shock causes a significant decrease in CEO portfolio vega. In terms of economic significance, the coefficient on *Top3ChairCCM* is −0.013 (t = −4.072), which translates into a $0.013 million decrease in CEO portfolio vega, representing about 25% of the mean value of vega in our sample ($0.053 million). We also find that, consistent with Cohen et al. (2011), the effect of seniority shocks on CEO portfolio vega weakens but remains statistically significant as we broaden the group of powerful committees (e.g., from top one to top three and top five). This is because broadening the group results in the inclusion of chairs of less powerful committees. To the extent that senators chairing less powerful committees are less able to deliver government spending to their states, there is less of a shock to government spending; consequently, the effect of government spending on vega and a firm's risk-taking diminishes.

The coefficient estimates of the control variables are generally consistent with those of prior studies (e.g., Guay 1999; Coles et al. 2006; Croci and Petmezas 2015). We find that vega is positively related to firm size, market-to-book ratio, R&D, ROA, and cash compensation, and negatively related to leverage, cash flow, and stock return. Overall, these results support our hypothesis that following a senator's ascension to a powerful committee chair, there is a decrease in CEO portfolio vega for firms headquartered in the senator's state. These results suggest that the positive shocks to government spending due to new committee chairs reduce treated firms' desired level of risk-taking, which discourages offering CEOs risk-taking incentives.

[Insert Table 2 Here]

4.3 Identification tests using senate committee chair departure shock

The evidence provided thus far shows that CEOs' portfolio vega is associated with a senator's ascension to a powerful committee chair. Some omitted variables such as local economy could explain both the senator ascension and a decrease in vega. In this section, we use chair departures to examine the impact of the unexpected departure shocks on CEOs' portfolio vega. Departure from a powerful Senate committee dramatically reduce the chair's influence on government spending directed to his or her home state. For example, Cohen et al. (2011) find that earmark spending decreases by 33.3% following the departure of a committee chair. The unexpected negative shocks to government spending could increase firms' need for risky investment. We thus expect that firms increase CEOs' pay convexity to incentivize their CEOs to undertake risky projects following chair departure, all else equal.

Following Cuny et al. (2020), we choose chair departure cases from a top five Senate committee due to death while in office or another position appointment. This is because these two types of departure is likely unrelated with local economy that could affect vega. There are two position appointments and three deaths in office cases during our sample period.[9] For these five chair departure cases, we identify 39 treatment firms in our sample.

[9] The five chair departure from a top five Senate committee cases are: Lloyd Millard Bentsen Jr. (D-TX) is appointed to Clinton's cabinet as Secretary of the Treasury in 1993; Robert Carlyle Byrd (D-WV) died in office due to natural causes in 2010; Daniel Ken Inouye (D-HI) died in office due to respiratory complications in 2012; Maxwell Sieben Baucus (D-MT) is appointed as Ambassador to China in 2014; John Sidney McCain III (R-AZ) died in office due to brain cancer in 2018.

We also use a propensity-score-matching to identify control firms. We require control firms that do not experience chair departure shocks and match firms based on *Size*, *Leverage, R&D, CAPEX, CashFlow, StockReturn, CashCompensation, Population, Income,* and *GDP* at one year prior to a chair departure shock with one-on-one match. The matched control sample consist of 37 firms. We then create *ChairDeparture* that equals one for the treatment firms, and zero for the control firms. We include industry and year fixed effect in the model to control for time-invariant unobservable industry characteristics and common economy-wide shocks that vary over time, respectively. Standard errors are clustered at the state-year level.[10] As shown in Table 3, the coefficient on *ChairDeparture* is positive and significant, indicating that following an unexpected chair departure, firms significantly increase CEO's portfolio vega. The results suggest that exogenous shocks to government spending due to changes in Senate committee chairs causally affects the structure of CEO equity incentives.

[Insert Table 3 Here]

4.4 Robustness tests using chair and ranking minority member

As a robustness check, we construct an alternative measure of government spending shock that takes into account both the chair and ranking minority member of powerful U.S. Senate committees. The ranking minority member is the highest ranking (usually the most senior and longest serving) member of a Senate committee from the minority party. We construct six new indicator variables. Following Cohen et al. (2011), *Top1Chair&RankCCM* is an indicator variable that equals 1 if a senator of a state first becomes either chair or the

[10] The untabulated results show that the treatment and control firms' covariates in the year before the chair departure shock are balanced.

ranking minority member of the top one Senate committee, and 0 otherwise. Similarly, *Top3Chair&RankCCM* and *Top5Chair&RankCCM* are indicator variables that equal 1 if a senator of a state who was not a ranking member of the state first becomes either chair or the ranking minority member of a top three and top five Senate committee, respectively, and 0 otherwise. The shocks are coded as starting in the year of appointment and are applied for six years (term of a senator). The shocks are applied to firms who have been alive in the year of the senator's ascension. Following Snyder and Welch (2017), *Top1Chair&RankSW* is an indicator variable that equals 1 if a senator of a state becomes either chair or the ranking minority member of the top one Senate committee, and 0 otherwise. Similarly, *Top3Chair&RankSW* and *Top5Chair&RankSW* are indicator variables that equal 1 if a senator of a state becomes either chair or the ranking minority member of a top three and top five Senate committee, respectively, and 0 otherwise. The shocks are applied for the duration of the senator's actual tenure and to all firms in the state-years. We then replace *Shock* in Eq. (1) with these alternative measures and test the effect of government spending shock on CEO portfolio vega.

As shown in Table 4, the coefficients on alternative measures of seniority shock including both the chair and ranking minority member are negative and significant. The results support our hypothesis that following a senator's ascension to a powerful committee chair, there is a decrease in CEO portfolio vega.

[Insert Table 4 Here]

4.5 Dynamic tests on government spending shock and compensation convexity

To address the concern that a change in CEO portfolio vega may precede the seniority shock, we decompose the seniority shock into separate time periods and examine the multiperiod dynamic effect of government spending shocks on CEO portfolio vega. Specifically, we re-estimate our baseline model in Eq. (1) after replacing *Top3ChairCCM* and *Top3ChairSW* by ten indicator variables. For example, *Top3ChairCCM(−k)* and *Top3ChairSW(−k),* where k = 2 and 1, is an indicator variable that equals 1 for observations in year k before the seniority shock defined as Cohen et al. (2011) and Snyder and Welch (2017), respectively, and 0 otherwise; *Top3ChairCCM(k)* and *Top3ChairSW(k),* where k = 1, 2,…,6, is an indicator variable that equals 1 for observations in the years of six-year chair appointment being effective defined as Cohen et al. (2011) and Snyder and Welch (2017), respectively, and 0 otherwise; *Top3ChairCCM(+k)* and *Top3ChairSW(+k),* where k = 1 and 2, is an indicator variable that equals 1 for observations in year k after the seniority shock defined as Cohen et al. (2011) and Snyder and Welch (2017), respectively, and 0 otherwise. Therefore, the ten year indicators capture two years before the seniority shock (k = −2, −1), six years of a state experiencing the seniority shock (k = 1, 2, …, 6), and two years after the seniority shock (k = +1, +2).

Figure 1A and 1B summarizes the results of the dynamic tests using the seniority shock defined as Cohen et al. (2011) and Snyder and Welch (2017), respectively. The results show that CEO portfolio vega does not decrease before a seniority shock but begins to fall immediately in the year of the chair's appointment; it then remains largely stable for the subsequent 5 years, before finally bouncing back following the home state senator relinquishing the chair.

[Insert Figure 1 Here]

4.6 Falsification tests on government spending shock and compensation convexity

To alleviate concerns that the negative relation in our main test is spurious or reflects a general trend, we perform a falsification test. Specifically, we construct a falsification shock (*Top3ChairCCM_Falsification* and *Top3ChairSW_Falsification*), which is applied to the two years before the top three seniority shock as defined in Cohen et al. (2011) and Snyder and Welch (2017), respectively. We then replace *Top3ChairCCM* (*Top3ChairSW*) with *Top3ChairCCM_Falsification* (*Top3ChairSW_Falsification*) to perform the falsification test.

As shown in of Table 5, the coefficients on *Top3ChairCCM_Falsification* and *Top3ChairSW_Falsification* are insignificant, which indicates that the falsification shock does not affect CEO portfolio vega. In summary, the falsification test suggests that the decline in compensation vega is unlikely to be driven by chance or a general trend.

[Insert Table 5 Here]

4.7 Cross-sectional tests on government dependence and geographic concentration

In our next set of tests, we explore the settings in which we expect the relation between government spending shocks and CEO portfolio vega to vary across firms. First, when a firm's business is more exposed to government procurement, we expect a government spending shock to have a stronger effect on CEO portfolio vega. In other words, we expect that the increased demand from government due to a government spending shock will have a greater impact on government contractors. This is because these contractors are more likely to have resources that could be diverted away from risk-taking activities, such as innovations and R&D, when government spending increases aggregate demand for conventional goods (Kong 2020); consequently, these firm are more likely to reduce their

CEOs' risk-taking incentives. To test this hypothesis, we use the firm-level government dependence measure developed by Baker, Bloom and Davis (2016). This measure is derived using two steps. Specifically, firms' revenue from federal contracts and firms' total revenue are first aggregated for each three-digit SIC industry by year to obtain the ratio of federal purchases to revenues – an industry-level measure of government dependency. A firm's dependence on government purchases is then measured as its each business segment revenue-weighted mean of the industry-level measures calculated in the first step. This government dependence measure captures the extent to which a firm's ex ante revenues are exposed to changes in government purchases. Baker et al. (2016) show that firms with greater exposure to government purchases experience greater stock price volatility when policy uncertainty is high.

Furthermore, government spending shocks may reduce firms' desired level of risk-taking by reducing labor productivity and diverting workers away from innovative activities. This likely changes labor market outcomes in the new chair's home state. Under this maintained assumption, we expect that firms with geographically concentrated operations are more likely to implement a large reduction in CEOs' pay convexity. This is because when firms with concentrated operations experience a government spending shock, they have limited ability to access the labor market in, and hence shift their risky investments to, other states (Cohen et al. 2011). Conversely, firms with diversified operations in many states can more easily shift operations out of state and are less compelled to reduce their risky investments. Thus, if geographically concentrated firms face higher pressure to reduce their risk-taking activities after a government spending shock, they have stronger incentives to decrease CEO vega. To test this hypothesis, we follow Smith (2016) by measuring a firm's geographic concentration as the number of mentions of its headquarters state relative to the number of mentions of all other states in its 10-K filing at the SEC. We use the SeekiNF database to source information on the number of mentions of each state in a firm's 10-K.[11]

Consistent with prior studies (e.g., Byard, Li and Yu 2011; Irani and Oesch 2013, 2016; Masli, Peters, Richardson and Sanchez 2010), we classify treatment firm-years into two groups based on government dependence and geographic concentration. Specifically, we construct two sets of indicator variables for government dependence: *Top3ChairCCM_HighGovernDep (Top3ChairCCM_LowGovernDep)* equals 1 if the treated firm in the year before a top three seniority shock as defined in Cohen et al. (2011) had higher (lower) government dependence than the respective industry median, and 0 otherwise. *Top3ChairSW_HighGovernDep (Top3ChairSW_LowGovernDep)* equals 1 if the treated firm in the year before a top three seniority shock as defined in Snyder and Welch (2017) had higher (lower) government dependence than the respective industry median, and 0 otherwise.

Similarly, we construct two sets of indicator variables for geographic concentration: *Top3ChairCCM_HighGeoConcen* (*Top3ChairCCM_LowGeoConcen*) equals 1 if the treated firm in the year before a top three seniority shock as defined in Cohen et al. (2011) had higher (lower) geographically concentrated operations than the respective industry median, and 0 otherwise. *Top3ChairSW_HighGeoConcen* (*Top3ChairSW_LowGeoConcen*) equals 1 if the treated firm in the year before a top three seniority shock as defined in Snyder and Welch (2017) had higher (lower) geographically

[11] The SeekiNF database provides a means to search and extract information from public SEC filings, and is available through subscription from SeekEdgar (2019).

concentrated operations than the respective industry median, and 0 otherwise. We re-estimate Eq. (1) after replacing *Top3ChairCCM* or *Top3ChairSW* with the four sets of indictor variables.

As shown in Table 6, the coefficients on *Top3ChairCCM_HighGovernDep* and *Top3ChairCCM_HighGeoConcen,* and *Top3ChairSW_HighGovernDep* and *Top3ChairSW_HighGeoConcen* are negative and statistically significant, while the coefficients on *Top3ChairCCM_LowGovernDep* and *Top3ChairCCM_LowGeoConcen,* and *Top3ChairSW_LowGovernDep* and *Top3ChairSW_LowGeoConcen* are statistically insignificant. As shown in the row of *High* vs. *Low* p-value, the differences in coefficient magnitude between *Top3ChairCCM_High*- and *Top3ChairCCM_Low-variables,* and between Top3ChairSW_*High*- and *Top3ChairSW_Low*-variables in each set are also statistically significant. These results lend further support to our conjecture that the negative impact of government spending shocks on CEO portfolio vega is stronger for firms with higher government dependence and with more highly geographically concentrated operations.

[Insert Table 6 Here]

4.8 Additional tests on government spending shock and annual vega and portfolio delta

As supplementary tests, we also analyze the effect of government spending shocks using an alternative measure of vega, specifically the vega of *new* options granted to CEOs during the current year. Prior studies suggest that firms should consider CEOs' equity portfolio to determine the appropriate level of risk-taking incentives to be given to them (Core and Guay 1999; Coles et al. 2006). While portfolio vega is a comprehensive and precise measure of managers' risk-taking incentives and captures the overall effect of aggregate holdings following a government spending shock, examining the vega of annual option grants provides more insight into whether changes in CEO portfolio vega are attributable to changes in the vega of *new* options granted to CEOs during the current year and whether government spending shocks have an immediate impact on CEOs' pay convexity.

Following prior study (e.g., Gormley et al. 2013; Yang et al. 2020), we examine how treated firms adjust CEO vega from annual option grants following a government spending shock. As shown in Column (1) and (2) of Table 7, the coefficients on *Top3ChairCCM* and *Top3ChairSW* are negative and statistically significant. Consistent with existing literature (e.g., Core and Guay 1999; Ellul, Wang and Zhang 2015), we find that firms actively adjust CEOs' risk-taking incentives by decreasing CEO vega from annual option grants in response to government spending shocks.

We then replace vega with delta and investigate whether government spending shocks affect CEO portfolio delta. Prior studies suggest that delta could incentivize managers to change firm risk, though its directional effect is ambiguous (e.g., Coles et al. 2006; Low 2009; Armstrong and Vashishtha 2012). We measure *Delta* as the change in the dollar value of the CEO's wealth for a 1% change in a firm's stock price. Delta is expressed in millions of dollars, consistent with Coles et al. (2006) and Bettis et al. (2018), and adjusted for inflation using the annual average CPI-U, consistent with Gormley et al. (2013). As shown in Column (3) and (4) of Table 7, the coefficients on *Top3ChairCCM* and *Top3ChairSW* are statistically insignificant. Thus, we find no evidence of a significant change in delta following government spending shocks.

[Insert Table 7 Here]

4.9 Additional tests on government spending shock on firm performance volatility

Exploiting changes in U.S. Senate committee chairs as exogenous shocks in government spending, Cohen et al. (2011) and Kong (2020) find that positive government spending shocks could reduce firms' risky investment, such as capital investment, R&D expenditure, and innovative activities. Using the population count revisions in census years as exogenous shocks, Kim and Nguyen (2020) find that an increase in federal spending reduces firms' investment, R&D spending, and firm-level equity volatility. To provide additional evidence supporting our argument that increased government spending reduces firms' desired level of risk-taking, we test whether changes in Senate committee chairs lead to a decrease in firm risk-taking, as reflected in financial performance volatility. To this end, we use three volatility measures: *ROAVolatility*, measured as the standard deviation of a firm's quarterly ROA over a year; *LnTotalRisk*, measured as the log of the annualized variance of monthly stock returns over the future three years; *LnIdioRisk*, measured as the log of the annualized variance of the residuals from the market model using monthly stock returns over the future three years. We include *Size*, *MB*, *Leverage*, *R&D, CAPEX*, *CashFlow*, *StockReturn*, *ROA*, *Segments*, *SaleHerf*, *Population*, *Income*, and *GDP* in the regression. *Segments* is the number of a firm's business segments; *SaleHerf* is the Herfindahl index of segment sales, measured as the sum of the squared ratio of a firm's segment sales to total segment sales.

As shown in Table 8, the coefficients on *Top3ChairCCM* and *Top3ChairSW* are negative and significant, which is in line with the findings of a decrease in risky investment following positive government spending shocks (Cohen et al. 2011; Kong 2020; Kim and

Nguyen 2020). The above results buttress and enrich our main findings on the inverse relation between seniority shocks and CEO vega.

[Insert Table 8 Here]

5. Conclusions

This study examines the impact of government spending on CEO equity incentives. By exploiting the appointments of U.S. Senate committee chairs as an exogenous shock to government spending, we find that firms significantly reduce CEO portfolio vega following a senator's ascension to a powerful committee chair. We further show that the reduction is more pronounced for firms with higher government dependence and with more geographically concentrated operations. Overall, our findings suggest that the positive shock to government spending due to a new committee chair reduces treated firms' desired level of risk-taking, which discourages them from giving CEOs' risk-taking equity incentives.

This study contributes to the literature on the impact of government spending. Prior studies find that government spending affects interest rates, labor markets, and firm investment. Our findings suggest that government spending also impacts CEO equity incentives or the structure of CEO incentive compensation contracts. This study also contributes to the literature on the determinants of incentive compensation. Prior studies link various firm- and market-specific factors to the managerial incentive compensation scheme. We extend this line of research by examining how government spending affects CEO equity incentives. Finally, this study contributes to the literature on the casual relation between compensation convexity and risk-taking. Prior studies use simultaneous equations, instrumental variables, regulatory changes, and changes in firms' legal risk to overcome the identification challenge. We extend this work by exploiting changes in firms' desired level of risk-taking arising from positive exogenous shocks to government spending in the headquarters state. We find that firms significantly reduce the convexity in their CEOs' incentive compensation in response to government spending shocks.

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Appendix
Variable definitions

Variable	Definition
Vega	The change in the dollar value of the CEO's wealth (expressed in millions of dollars) for a 0.01 change in the annualized standard deviation of a firm's stock return.
Top1ChairCCM (Top3ChairCCM, Top5ChairCCM)	Following Cohen et al. (2011), it is defined as a dummy variable that equals 1 if a senator of a state first becomes chair of the top one (a top three, and a top five) Senate committee, and 0 otherwise. The shocks are coded as starting in the year of appointment and are applied for six years (term of a senator). The shocks are applied to firms who have been alive in the year of the senator's ascension.
Top1ChairSW (Top3ChairSW, Top5ChairSW)	Following Snyder and Welch (2017), it is defined as a dummy variable that equals 1 if a senator of a state becomes chair of the top one (a top three, and a top five) Senate committee, and 0 otherwise. The shocks are applied for the duration of the senator's actual tenure and to all firms in the state-years.
ChairDeparture	A dummy variable that equals 1 if one of top five Senate committee chair departs from the committee, and 0 otherwise. We restrict the departure cases that occur due to death in office or position appointment.
Top1Chair&RankCCM (Top3Chair&RankCCM, Top5Chair&RankCCM)	Following Cohen et al. (2011), it is defined as dummy variable that equals 1 if a senator of a state first becomes either chair or the ranking minority member of the top one (a top three, and a top five) Senate committee, and 0 otherwise. The shocks are coded as starting in the year of appointment and are applied for six years (term of a senator). The shocks are applied to firms who have been alive in the year of the senator's ascension.
Top1Chair&RankSW (Top3Chair&RankSW, Top5Chair&RankSW)	Following Snyder and Welch (2017), it is defined as a dummy variable that equals 1 if a senator of a state becomes chair and ranking member of the top one (a top three, and a top five) Senate committee, and 0 otherwise. The shocks are applied for the duration of the senator's actual tenure and to all firms in the state-years.
Top3ChairCCM_Falsification	The falsification shock is applied to the two years before the top three Chair seniority shock. The top three Chair seniority shock is defined in the same way as Cohen et al. (2011).
Top3ChairSW_Falsification	The falsification shock is applied to the two years before the top three seniority shock. The top three Chair seniority shock is defined in the same way as Snyder and Welch (2017).
Top3ChairCCM_HighGovernDep (Top3ChairCCM_LowGovernDep)	A dummy variable that equals 1 if the treated firm in the year before the top three seniority shock had government dependence higher (lower) than the industry median, and 0 otherwise. The top three Chair seniority shock is defined in the same way as Cohen et al. (2011).
Top3ChairCCM_HighGeoConcen (Top3ChairCCM_LowGeoConcen)	A dummy variable that equals 1 if the treated firm in the year before the top three seniority shock had geographically

	concentrated operations higher (lower) than the industry median, and 0 otherwise. The top three Chair seniority shock is defined in the same way as Cohen et al. (2011).
Top3ChairSW_HighGovernDep (Top3ChairSW_LowGovernDep)	A dummy variable that equals 1 if the treated firm in the year before the top three seniority shock had government dependence higher (lower) than the industry median, and 0 otherwise. The top three Chair seniority shock is defined in the same way as Snyder and Welch (2017).
Top3ChairSW_HighGeoConcen (Top3ChairSW_LowGeoConcen)	A dummy variable that equals 1 if the treated firm in the year before the top three seniority shock had geographically concentrated operations higher (lower) than the industry median, and 0 otherwise. The top three Chair seniority shock is defined in the same way as Snyder and Welch (2017).
VegaNew	Vega from new options granted to CEO during the current year.
Delta	The change in the dollar value of the CEO's wealth (expressed in millions of dollars) for 1% change in a firm's stock price.
ROAVolatility	The standard deviation of a firm's quarterly ROA over a year.
LnTotalRisk	The log of the annualized variance of monthly stock returns over the future three years.
LnIdioRisk	The log of the annualized variance of the residuals from the market model using monthly stock returns over the future three years.
Size	The log of firms' total assets.
MB	The market value of equity divided by the book value of equity.
Leverage	Total debt divided by total assets.
R&D	Research and development expenditure divided by total assets.
CAPEX	Net capital expenditure divided by total assets.
CashFlow	Cash flows divided by total assets.
StockReturn	Stock return of the last 12-month fiscal period.
ROA	Income before extraordinary items divided by lagged total assets.
CashCompensation	The sum of salary and bonus (expressed in millions of dollars).
Population	The log of a state's total population.
Income	The log of per capita income in a state.
GDP	The log of GDP per capita in a state.
Segments	The number of a firm's business segments.
SaleHerf	The Herfindahl index of segment sales, measured as the sum of the squared ratio of a firm's segment sales to total segment sales.

TABLE 1
Summary Statistics

	Mean	S.D.	Median
Vega	0.053	0.085	0.005
Top1ChairCCM	0.014	0.116	0.000
Top3ChairCCM	0.033	0.179	0.000
Top5ChairCCM	0.036	0.186	0.000
Top1ChairSW	0.010	0.102	0.000
Top3ChairSW	0.031	0.174	0.000
Top5ChairSW	0.069	0.254	0.000
Size	6.987	1.616	5.811
MB	3.776	3.960	1.706
Leverage	0.183	0.162	0.018
R&D	0.055	0.070	0.005
CAPEX	0.052	0.044	0.022
CashFlow	0.125	0.114	0.076
StockReturn	0.191	0.573	-0.145
ROA	0.051	0.122	0.018
CashCompensation	0.512	0.424	0.255
Population	16.238	0.861	15.615
Income	10.492	0.296	10.273
GDP	10.751	0.267	10.645
N		20,579	

This table reports descriptive statistics for the variables in the main tests. All dollar values are expressed in millions of dollars and adjusted for inflation using annual average CPI-U. See the Appendix for variable definitions.

TABLE 2

The Impact of Seniority Shocks on CEOs' Portfolio Vega

	Vega					
	(1)	(2)	(3)	(4)	(5)	(6)
Top1ChairCCM	-0.017***					
	(-3.044)					
Top3ChairCCM		-0.013***				
		(-4.072)				
Top5ChairCCM			-0.011***			
			(-3.746)			
Top1ChairSW				-0.008***		
				(-2.653)		
Top3ChairSW					-0.005**	
					(-2.531)	
Top5ChairSW						-0.003*
						(-1.770)
Size	0.023***	0.023***	0.024***	0.023***	0.023***	0.023***
	(16.915)	(16.919)	(16.939)	(16.901)	(16.900)	(16.907)
MB	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(4.581)	(4.645)	(4.622)	(4.541)	(4.555)	(4.545)
Leverage	-0.031***	-0.031***	-0.031***	-0.031***	-0.031***	-0.031***
	(-6.659)	(-6.639)	(-6.629)	(-6.636)	(-6.640)	(-6.632)
R&D	0.060***	0.061***	0.061***	0.061***	0.061***	0.061***
	(4.225)	(4.239)	(4.230)	(4.279)	(4.271)	(4.263)
CAPEX	0.005	0.004	0.004	0.006	0.006	0.006
	(0.450)	(0.335)	(0.369)	(0.484)	(0.479)	(0.528)
CashFlow	-0.009**	-0.009**	-0.009**	-0.009**	-0.009**	-0.009**
	(-2.086)	(-2.079)	(-2.094)	(-2.129)	(-2.122)	(-2.117)
StockReturn	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(-4.944)	(-5.014)	(-4.999)	(-4.937)	(-4.939)	(-4.910)
ROA	0.028***	0.028***	0.028***	0.028***	0.028***	0.028***
	(5.957)	(6.058)	(6.041)	(6.022)	(6.029)	(6.025)
CashCompensation	0.041***	0.041***	0.041***	0.041***	0.041***	0.040***
	(13.100)	(13.068)	(13.066)	(12.988)	(12.982)	(12.976)
Population	-0.007***	-0.007***	-0.007***	-0.008***	-0.008***	-0.008***
	(-3.470)	(-3.475)	(-3.516)	(-3.691)	(-3.738)	(-3.737)
Income	-0.007	-0.014	-0.014	-0.009	-0.012	-0.012
	(-0.323)	(-0.671)	(-0.640)	(-0.439)	(-0.541)	(-0.570)
GDP	-0.013	-0.008	-0.009	-0.010	-0.009	-0.007
	(-0.699)	(-0.445)	(-0.480)	(-0.562)	(-0.473)	(-0.401)
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.600	0.600	0.600	0.600	0.600	0.600
N	20,579	20,579	20,579	20,579	20,579	20,579

This table reports the regression results of the impact of Senate committee chair appointment shocks on CEOs' portfolio vega. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.

TABLE 3

The Impact of Senate Committee Chair Departure Shocks on CEOs' Portfolio Vega

	Vega
	(1)
ChairDeparture	0.138***
	(6.637)
Controls	YES
Industry FE	YES
Year FE	YES
State FE	YES
Adjusted R^2	0.579
N	76

This table reports the regression results of the identification test. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.

TABLE 4

The Impact of Seniority Shocks on CEOs' Portfolio Vega: Including Chair and Ranking Minority

	Vega					
	(1)	(2)	(3)	(4)	(5)	(6)
Top1Chair&RankCCM	-0.014***					
	(-3.107)					
Top3Chair&RankCCM		-0.009***				
		(-4.131)				
Top5Chair&RankCCM			-0.007***			
			(-3.744)			
Top1Chair&RankSW				-0.008**		
				(-2.542)		
Top3Chair&RankSW					-0.007***	
					(-3.864)	
Top5Chair&RankSW						-0.006***
						(-4.157)
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.600	0.600	0.600	0.600	0.600	0.600
N	20,579	20,579	20,579	20,579	20,579	20,579

This table reports the regression results of the impact of seniority shocks on CEOs' portfolio vega using an alternative measure of government spending shock. Standard errors are clustered at the state-year level. *t*-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See the Appendix for variable definitions.

Figure 1 The Dynamic Tests of Seniority Shocks on CEOs' Portfolio Vega

Figure 1A and 1B summarizes the results of the dynamic tests using top three Senate committee chair appointment shocks defined as Cohen et al. (2011) and Snyder and Welch (2017), respectively. The numbers (τ) on the horizontal axis indicate the τth year relative to top three Senate committee chair appointment shocks. For example, −1 means one year before a state in seniority shock; 1 means the first year of a state in seniority shock; +1 means one year after the seniority shock has ceased in a state. Therefore, the ten-year dummies capture up to two years before the chair appointment, six years of being a chair and two years after the chairman relinquishment.

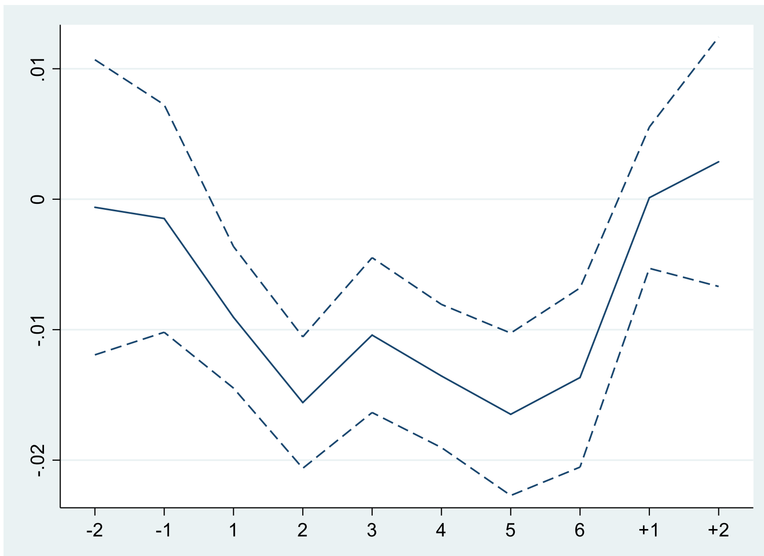

Figure 1A Coefficient 90% Confidence

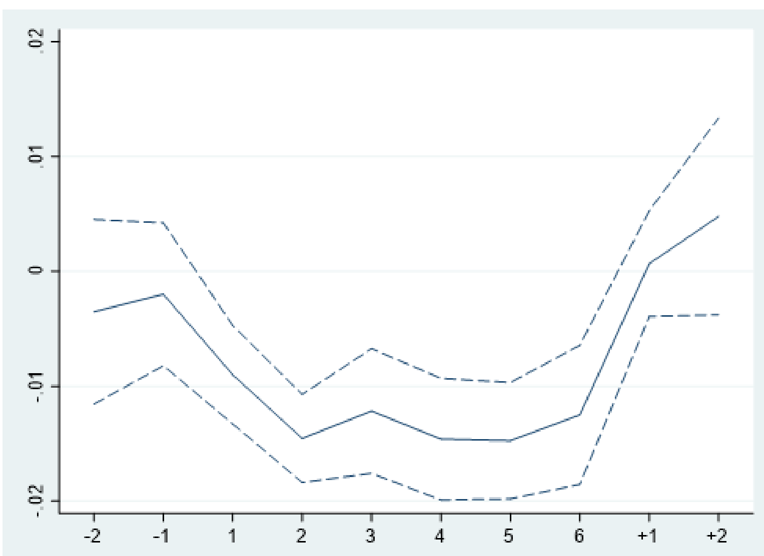

Figure 1B Coefficient 90% Confidence

TABLE 5

The Falsification Tests of Seniority Shocks on CEOs' Portfolio Vega

	Vega	
	(1)	(2)
Top3ChairCCM_Falsification	0.005	
	(1.187)	
Top3ChairSW_Falsification		0.001
		(0.305)
Controls	YES	YES
Firm FE	YES	YES
Year FE	YES	YES
Adjusted R^2	0.600	0.600
N	20,579	20,579

This table reports the regression results of the falsification test using top three Senate committee chair appointment shocks. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.

TABLE 6

The Cross-Sectional Tests of Seniority Shocks on CEOs' Portfolio Vega

	Vega			
	(1)	(2)	(3)	(4)
Top3ChairCCM_HighGovernDep	-0.021***			
	(-4.001)			
Top3ChairCCM_LowGovernDep	-0.002			
	(-0.553)			
Top3ChairCCM_HighGeoConcen		-0.026***		
		(-2.997)		
Top3ChairCCM_LowGeoConcen		-0.003		
		(-0.813)		
Top3ChairSW_HighGovernDep			-0.014***	
			(-2.913)	
Top3ChairSW_LowGovernDep			0.003	
			(1.051)	
Top3ChairSW_HighGeoConcen				-0.013**
				(-2.521)
Top3ChairSW_LowGeoConcen				0.002
				(0.747)
High vs. Low *p-value*	0.0009	0.0133	0.0012	0.0119
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Adjusted R^2	0.634	0.619	0.634	0.619
N	17,539	18,152	17,539	18,152

This table reports the regression results of the cross-sectional tests using top three Senate committee chair appointment shocks. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.

TABLE 7

The Impact of Seniority Shocks on CEOs' Annual Vega and Portfolio Delta

	VegaNew		*Delta*	
	(1)	(2)	(3)	(4)
Top3ChairCCM	-0.004***		-0.031	
	(-2.844)		(-1.537)	
Top3ChairSW		-0.002**		-0.021
		(-1.994)		(-1.373)
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Adjusted R^2	0.417	0.416	0.572	0.572
N	20,579	20,579	20,579	20,579

This table reports the regression results of the additional tests using top three Senate committee chair appointment shocks. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.

TABLE 8
The Impact of Seniority Shocks on Firm Performance Volatility

	ROAVolatility		*LnTotalRisk*		*LnIdioRisk*	
	(1)	(2)	(3)	(4)	(5)	(6)
Top3ChairCCM	-0.048*		-0.003***		-0.002***	
	(-1.710)		(-3.559)		(-2.910)	
Top3ChairSW		-0.055**		-0.002**		-0.002**
		(-2.200)		(-2.141)		(-2.119)
Size	-0.033**	-0.032**	-0.004***	-0.004***	-0.004***	-0.004***
	(-2.100)	(-2.059)	(-8.349)	(-8.297)	(-10.826)	(-10.803)
MB	0.007**	0.007**	-0.000***	-0.000***	-0.000***	-0.000***
	(2.391)	(2.391)	(-5.223)	(-5.204)	(-6.672)	(-6.662)
Leverage	-0.436***	-0.438***	0.020***	0.020***	0.018***	0.018***
	(-6.275)	(-6.291)	(11.421)	(11.371)	(11.783)	(11.759)
R&D	-0.141	-0.139	0.017***	0.017***	0.017***	0.017***
	(-0.675)	(-0.667)	(4.095)	(4.121)	(4.712)	(4.732)
CAPEX	0.157	0.159	0.020***	0.021***	0.014***	0.014***
	(0.802)	(0.813)	(3.690)	(3.727)	(2.684)	(2.704)
CashFlow	-0.439***	-0.440***	-0.012***	-0.012***	-0.010***	-0.010***
	(-5.378)	(-5.383)	(-6.797)	(-6.845)	(-6.381)	(-6.422)
StockReturn	0.037***	0.037***	-0.003***	-0.003***	-0.003***	-0.003***
	(2.982)	(2.972)	(-5.760)	(-5.746)	(-7.408)	(-7.391)
ROA	-0.771***	-0.771***	-0.009***	-0.009***	-0.007***	-0.007***
	(-9.700)	(-9.708)	(-5.813)	(-5.844)	(-5.133)	(-5.157)
Segments	-0.133***	-0.133***	0.001*	0.001*	0.001**	0.001**
	(-4.646)	(-4.659)	(1.821)	(1.796)	(2.204)	(2.183)
Saleherf	-0.428***	-0.428***	0.009***	0.009***	0.004***	0.004***
	(-4.817)	(-4.824)	(4.888)	(4.874)	(2.602)	(2.594)
Population	0.003	0.001	0.000	-0.000	-0.000	-0.000
	(0.087)	(0.031)	(0.015)	(-0.105)	(-0.323)	(-0.416)
Income	-0.707**	-0.684**	0.019**	0.021**	0.013	0.014*
	(-2.069)	(-2.003)	(2.013)	(2.141)	(1.617)	(1.725)
GDP	0.543**	0.541**	-0.033***	-0.034***	-0.026***	-0.026***
	(2.064)	(2.058)	(-3.774)	(-3.656)	(-3.513)	(-3.422)
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Adjusted R^2	0.320	0.320	0.584	0.584	0.584	0.584
N	45,887	45,887	47,569	47,569	47,569	47,569

This table reports the regression results of the additional tests on firm performance volatility using top three Senate committee chair appointment shocks. Standard errors are clustered at the state-year level. t-statistics are reported in parentheses. ***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels, respectively. See Appendix for variable definitions.