Are CEOs paid extra for riskier pay packages?

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Motivation

- Study a fundamental hypothesis in contracting models that is at the heart of how incentives are provided.
- Hypothesis:

  Firms providing incentive pay as a way to reduce principal-agent conflicts incur costs as incentive pay imposes additional risk on the CEO.

- It is a fundamental hypothesis in the sense that it requires:
  - Only assumptions on the expected utility of the agent;
  - No assumptions on the principal's objective function; the production function; the number of available performance metrics, etc.
- It is fundamental also because agency theory continues to be the work-horse model of much of the empirical studies in CEO pay.

Related literature

- Conyon, Core and Guay (2011) and Fernandes, Ferreira, Matos, and Murphy (2013) study the risk premium that a CEO charges for earning under-diversified pay.
  - Exclude volatility in pay from bonus grants; assume CEO's alternative opportunity is fully diversified.
- There is a large literature linking firm volatility to equity incentives, with inconclusive results (see Prendergast, 2002).
  - Cheng, Hong, and Scheinkman (2016) show that whether equity incentives increase or decrease in firm volatility depends on how firm productivity is affected by firm risk. Those assumptions do not alter the risk-return trade-off in pay highlighted here.
- Haubrich (1994) and Dittmann and Maug (2007) solve numerically variants of the principal-agent model.
  - Haubrich shows that optimal equity incentives go rapidly to zero as CEO risk aversion increases. Dittmann and Maug (2007) shows that CEOs should not be given options.

Hypothesis development

- In the classical model (Grossman and Hart, 1983), the principal chooses pay to maximize operating profits net of pay to the CEO

$$max E_t[\pi_t - w_t]$$

subject to the incentive compatibility constraint that the agent's effort is optimal given the pay contract and to the participation constraint

$$E_t[U(w_t, e_t)] \geq \bar{U}$$

- The hypothesis tested in this paper comes (almost) exclusively from the participation constraint. Under weak conditions, this constraint binds at the optimum.

Main hypothesis: Risk and reward trade-off

- With exponential utility and normal shocks à la Holmstrom and Milgrom (1987), the participation constraint is written with the certainty equivalent:

$$E_t(w_t) - \frac{\gamma}{2} V_t(w_t) - \text{disutility of effort} = \bar{u}$$

- ***Hypothesis:*** *All else equal, conditional mean of pay varies positively with conditional volatility of pay.*

- Joint hypothesis on Grossman-Hart's participation constraint binding, on CEO being risk averse, and having expected utility.
- A parallel hypothesis exists in asset pricing models where expected returns are positively related to the variance of returns times risk aversion.

Empirical strategy using Incentive Lab data

- Recall the participation constraint:

$$E_t(w_t) - \frac{\gamma}{2} V_t(w_t) - \text{cost of effort} = \bar{u}$$

- Regression equation is:

$$E_t(w_t) = \lambda V_t(w_t) + X_t' \beta + \varepsilon_t$$

- Hypothesis is: $H_0: \lambda \geq 0.$
- $E_t(w_t)$ and $V_t(w_t)$ constructed via simulation of pay contracts using a Incentive Lab data.
- $X_t' \beta$ captures predictable variation in the cost of effort and in outside utility.
- ε_t captures measurement error.
- Note that we are not looking for a causal relation but rather a correlation, because $E_t(w_t)$ and $V_t(w_t)$ are determined jointly.

Estimate conditional variance using simulated variance from Incentive Lab contract data

Incentive Lab data:
January 2018

Firm A offers contract to CEO Z that pays salary of $500 and cash bonus if and only if sales growth is above 5%, $100 for each additional percentage point

We simulate end-of-2018 sales growth numbers using historical Compustat data

Sales growth = 7%
Pay = $500 + 2*$100
= $700

Sales growth = 6%
Pay = $500 + 1*$100
= $600

Sales growth = 5%
Pay = $500 + 0*$100
= $500

$$E_t(w_t) = \frac{1}{3}\$700 + \frac{1}{3}\$600 + \frac{1}{3}\$500 = \$600$$

$$V_t(w_t) = \frac{1}{3}(\$700 - \$600)^2 + \ldots + \frac{1}{3}(\$500 - \$600)^2$$
$$= \frac{2}{3}\$100^2$$

We have to deal with complexity in CEO pay

- Contracts get really messy very quickly; CEO contracts may have:
  - Grants of bonus, stock, and options in any given year,
  - Potentially, multiple grants of each kind,
  - Multiple performance metrics in the same grant (e.g., two targets may have to be met for a bonus payout),
    - Grant payouts are separable or non-separable across metrics,
  - Multiple performance metrics across grants,
  - Grants and performance metrics change over time for the same CEO/firm.

Estimate conditional variance using simulated variance from Incentive Lab contract data

- Use extensive compensation contract information from Incentive Lab describing the relation between contracted performance metrics and the corresponding performance-based compensation.
  - Contract data for largest 750 firms in the U.S. collected from proxy statements (DEF 14A) for CEOs and other executives over the period 2006-2016.
- Use Compustat/CRSP data on the performance metrics over past five years to construct conditional distributions:
  - Assume joint normal distribution over all performance metrics.
- Simulate 10,000 firm-year-grant-metric observations for a given CEO-year:
  - At each node, compute CEO pay given the respective performance thresholds and whether contract grants are separable or non-separable;
  - $E_t(w_t)$ is the average of pay and $V_t(w_t)$ is the volatility of pay across all nodes.

Incentive Lab data:
Frequency distribution of performance metrics

Panel A. Metric Level Information

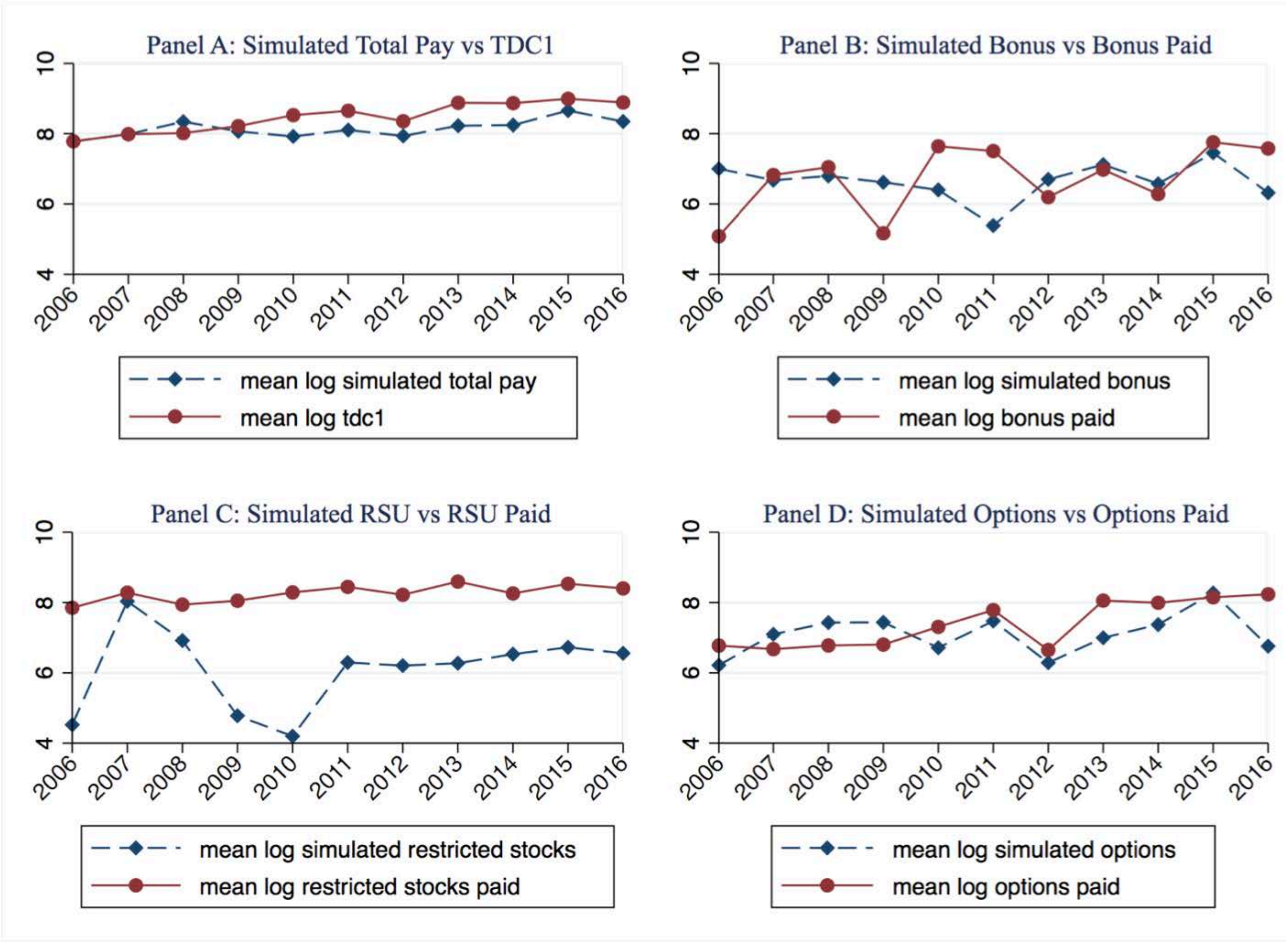
	Clean Sample				Alternative Sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Metric	Bonus	Restricted Stock	Options	Combined	Bonus	Restricted Stock	Options	Combined
Book Value	0	1	0	1	0	2	0	2
Cashflow	13	15	0	28	223	81	0	304
EBIT	7	5	0	12	60	12	0	72
EBITDA	22	13	0	35	160	78	2	240
EBT	16	16	0	32	87	30	0	117
EPS	37	33	0	70	414	287	5	706
Earnings	6	11	0	17	146	47	0	193
FFO	2	1	0	3	22	5	0	27
Operating Income	22	15	0	37	252	94	0	346
Profit Margin	3	3	0	6	53	26	0	79
ROA	1	10	0	11	32	29	0	61
ROE	9	11	0	20	84	83	1	168
ROI	0	1	0	1	7	5	0	12
ROIC	6	13	0	19	88	140	0	228
Sales	32	11	0	43	371	184	1	556
Stock Price	0	7	0	7	10	72	5	87
Time	0	0	290	290	0	0	5,031	5,031
Total (metric level)	**176**	**166**	**290**	**632**	**2,009**	**1,175**	**5,045**	**8,229**

Incentive Lab data:
Frequency distribution of performance metrics

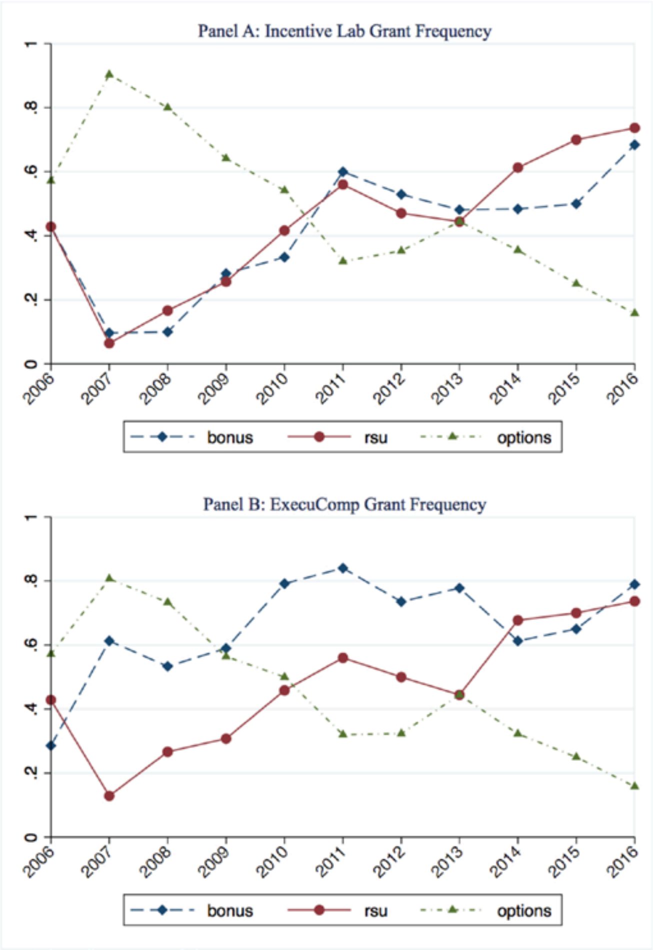
Table 1. Panel B. Grant Level and CEO Level Information

	Clean Sample				Alternative Sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bonus	Restricted Stock	Options	Combined	Bonus	Restricted Stock	Options	Combined
Number of performance metrics per grant/year								
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean	1.43	1.25	1.00	1.16	1.61	1.37	1.00	1.15
Std. Dev.	0.62	0.51	0.00	0.43	0.74	0.61	0.01	0.45
Skewness	1.11	1.97	.	2.76	1.19	1.50	71.00	3.40
Max	3.00	3.00	1.00	3.00	5.00	4.00	2.00	5.00
Number of grants per CEO/year								
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mean	1.10	1.12	2.00	1.90	1.08	1.10	1.14	1.37
Std. Dev.	0.38	0.37	2.92	2.15	0.32	0.34	0.72	0.86
Skewness	5.03	3.30	3.05	4.03	5.07	3.81	10.29	5.75
Max	4.00	3.00	12.00	12.00	4.00	3.00	12.00	12.00

Clean Sample Simulated Pay Versus Actual Pay



Clean Sample Grant Frequency Incentive Lab Versus ExecuComp



Simulated Conditional Volatility (Incentive Lab data)

	Clean Sample (No Options)		Clean Sample (With Options)		Alternative Sample (No Options)		Alternative Sample (With Options)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay	log Simulated Mean Pay
Log Simulated Variance of Pay	0.148***	0.091***	0.212***	0.151***	0.140***	0.108***	0.171***	0.137***
	(5.40)	(4.24)	(7.52)	(3.89)	(11.19)	(11.04)	(23.25)	(14.62)
Constant	6.080***		5.165***		6.166***		5.641***	
	(15.01)		(12.32)		(35.51)		(56.79)	
Observations	143	99	287	204	1,671	1,508	5,202	5,072
Adj. R-squared	0.505	0.668	0.592	0.694	0.390	0.689	0.481	0.694
Firm and Year FE	NO	YES	NO	YES	NO	YES	NO	YES
Cluster s.e.	Firm	Firm/Year	Firm	Firm/Year	Firm	Firm/Year	Firm	Firm/Year

Cross-Sectional Analysis Using Simulated Conditional Volatility for Risk Aversion

	Low Risk Aversion		High Risk Aversion		
	(1)	(2)	(3)	(4)	(5)
VARIABLES	MediumFatality	Pilot	Depression	Female	Married
Log simulated variance	0.226***	0.163***	0.158***	0.161***	0.129***
	(10.82)	(15.37)	(14.48)	(14.60)	(7.60)
Simulated skewness	0.030***	0.015***	0.016***	0.016***	0.008
	(4.87)	(6.06)	(4.68)	(6.35)	(1.76)
Risk aversion	1.598***	0.588*	-0.358	-0.636	-0.628*
	(4.08)	(2.15)	(-1.41)	(-1.67)	(-1.97)
Risk aversion*variance	**-0.099*** **	**-0.050** **	**0.038** **	**0.040**	**0.047* **
	(-3.93)	(-2.39)	(2.33)	(1.43)	(2.03)
Risk aversion *skewness	-0.020**	-0.007	0.056	0.010	0.012**
	(-2.94)	(-1.36)	(1.37)	(1.36)	(2.26)
Expected sign on Risk aversion*variance coefficient	-	-	+	+	+
1-sided p-value statistic	0.00	0.02	0.02	0.09	0.04
Observations	1,211	5,054	3,962	4,570	3,267
Adjusted R-squared	0.732	0.709	0.705	0.704	0.737

Economic significance of estimated elasticity

- We use the fact that growth in incentive pay has dominated growth in pay as documented in Jensen and Murphy (2018).
- We ask: what is the implication of the estimated elasticity , using a linear contract, if all variation in mean pay and variance of pay over time and across firms is due to variation in incentives.
  - The estimated elasticity implies that pay-at-risk should be 20%-40% of total pay; instead it is 75%! I.e., the estimated elasticity is too small.
- What explains this significant discrepancy in pay?
- Interpretation 1: Risk aversion is low and has declined over time.
- Interpretation 2: CEOs have incentive-saturation: CEOs get pay-at-risk for which they are not fully compensated.

Section 162(m) of the IRS may be responsible for growth in incentive pay

- Part of the recent growth in pay at risk originates in the deductibility rules of Section 162(m) of the IRS Code:
  - These rules kept salaries capped at around $1 million for CEOs for the last two decades (see Rose and Wolfram, 2002).
  - The growth in pay over the years has come from incentive pay that was not affected by the Section (Murphy and Jensen, 2018).
  - As a result, the tax code may have created an inefficiency in pay by overexposing CEOs to risk for which they were not compensated.
  - With the repeal of this Section starting in 2018, we may see a greater rebalancing between salary and incentive pay.

Robustness to other aspects of the participation constraint

- CEO prudence
  - *Proxy*: Skewness of pay (Hemmer, Kim and Verrecchia (2000), Ross (2004), and Chaigneau (2015)).
- CEO entrenchment
  - *Proxy:* Co-opted board proxy for entrenchment (Coles et al., 2014)
- CEO overconfidence
  - *Proxy:* Indicator variable that equals one if value of vested unexercised options is at least 67% of average strike price (Humphery-Jenner et al., 2014).
- Non-separable utility in consumption and leisure
  - *Proxies:* firm size, firm volatility, business segments, age, tenure.
- Time-varying CEO outside opportunities
  - *Proxies:* lagged own-firm performance (Oyer, 2004), lagged industry performance (Himmelberg and Hubbard, 2000)

➔ Elasticity of mean pay to volatility of pay still small.

Empirical Strategy II
-Estimate conditional variance using realized variance

- As a second approach, we estimate $V_t(w_t)$ for every t using a rolling window of the last 5 years of compensation

$$\sigma_t^2 = \frac{1}{5}\sum_{s=0}^{4}(w_{t-s} - \bar{w}_t)^2$$

- In the linear model of pay, commonly estimated, $w_t = m_0 + m_1 r_t$, conditional volatility of pay equals $m_1^2\, V_t(r_t)$.
  - Schwert (1989) and Andersen and Bollerslev (1998) show that realized volatility of returns is a consistent estimate of the conditional volatility of stock returns.
  - Realized volatility of pay has more information than realized volatility of stock returns since m_1 is firm specific.
  - In more general settings, when pay entails risk from other performance metrics, realized volatility of pay may not even be proportional to realized volatility of stock returns.
- Main advantage over IL data: more data since it uses all ExecuComp firms and allows for a long list of controls in the regressions.
- Main disadvantage over IL data: potentially less efficient because it does not structurally model the variance of pay.

Risk and Reward trade off in Pay Using Realized Volatility

VARIABLES	(1) log of TDC1	(2) log of TDC1	(3) log of CEO wealth	(4) log of CEO wealth
Lag log realized var(TDC1)	0.246***	0.046***		
	(38.92)	(6.29)		
Lag log realized var(CEO Wealth)			0.260***	0.099***
			(9.20)	(5.32)
Constant	4.789***		5.526***	
	(54.75)		(10.43)	
Observations	16,769	16,522	11,971	11,744
Adjusted R-squared	0.405	0.760	0.366	0.811
Firm and Year FE	NO	YES	NO	YES
Cluster s.e.	Firm	Firm/Year	Firm	Firm/Year

Empirical Strategy III
-Estimate conditional variance using ARCH

- Because $E_t(w_t)$ and $V_t(w_t)$ are endogenously determined in the model, we can estimate an ARCH-in-mean model:

$$w_t = \lambda\sigma_t^2 + X_t'\beta + \varepsilon_t$$

$$\sigma_t^2 = \alpha + \delta\varepsilon_{t-1}^2$$

where the variance equation parameters obey non-negativity constraints $\alpha, \delta \geq 0$ and a stationarity constraint $\delta < 1$.

- Model is estimated using panel of firms in ExecuComp.
- Use of these models has a long tradition in economics since Engle (1982). Ramey and Ramey (1995) used them to explain how volatility and growth in GDP were related, and Bollerslev et al. (1988) used these models in the context of stock return data.

Risk and Reward trade off in Pay Using ARCH Conditional Volatility

VARIABLES	(1) TDC1	(2) TDC1	(3) CEO wealth	(4) CEO wealth
Lag log var(TDC1)	128.0***	150.0***		
	(12.02)	(12.41)		
Lag log var(CEO Wealth)			-96.9***	-27.6
			(-5.48)	(-1.46)
Constant	-87.0	-2242.4***	10843***	44033***
	(-0.52)	(-3.39)	(26.49)	(18.42)
Industry and Year FE	NO	YES	NO	YES

Conclusion

- This paper focuses on a fundamental hypothesis of the contracting model—the workhorse model to describe CEO pay.
- The hypothesis states that CEOs that have riskier packages receive higher average pay.
- Our main findings:
  - *Estimated elasticity of total pay to the variance of pay is positive, but appears small.*
  - *Possible interpretation: CEOs are over-incentivized*

- Alternative hypotheses to the static contracting model:
  - Dynamic models, e.g., with career concerns à la Gibbons and Murphy (1992);
  - Agent heterogeneity, e.g., models with adverse selection in agent type or models of assortative matching as in Tervio, 2008, and Edmans, Gabaix and Landier, 2009); participation constraint holds only for one agent.

Simulated Pay Versus Actual Pay by GICS 4-digit Indust