

# Stocks or Options: Risk Choices and Compensation Design

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Slides and remarks are our opinions, not necessarily those of the Board of Governors or the Federal Reserve System.

# Bankers' Pay

- Common presumption: Pre-crisis compensation arrangements incentivized excessive risk-taking
- Policy prescriptions are ad hoc
  - Source of the problem?
  - Available models not satisfactory
- First step: Add to standard *one-period* contracting model
  - Bad-tail risk versus the usual moments
  - Minimum bonuses

# (Preliminary) Findings

- Language: “Stocks” and “Options” refer to properties of one-period payoff functions, not real-world devices for achieving sensitivity to information that arrives later.
  - Maybe settings without cash bonus. Venture? Hedge fund?
- Options are more effective delivery vehicles than stock
  - Opposite conclusion from standard models w/o tail risk
- Collar options work in a wider set of circumstances than ordinary calls
  - Roughly, pay-for-performance should operate between tails
  - No bonus for outcomes below a lower target, or no incremental bonus for incremental performance above an upper target
- If mistakenly employed when options should be used, stock may incentivize taking of tail risk

# Not the Model-of-Everything

- The public debate swirls many elements
  - Owner-manager conflicts, CEO-employee conflicts, shareholder-society conflicts; “governance”
  - Labor market competition for high-powered talent
  - Salary versus bonus
  - Deferred versus upfront bonus
  - Duration of deferrals
  - Deferred bonus in stock, cash, something else; retention requirements
  - Partnership vs. employee models
  - Nature of performance measures that drive bonuses
- One thing at a time. First the bonus function. Take off from existing literature.

# Literature

- Extant theory:
  - Some focus on stocks versus options
  - Some attention to risk, but smooth distributions
    - e.g. Smith & Stulz (1985); Carpenter (2000); Russ (2004)
  - Conventional wisdom: Options beget high risk
    - At-the-money calls incentivize higher volatility
- Recent empirical work
  - Some on whether bank compensation practices “caused” the crisis, little on relationship to risk

# Setup

- One period model, all risk-neutral
- Shareholders want to incentivize high effort  $e=h$  and project choices. Non-negative payoffs (no leverage).
- Ordinary-risk project:  $y_o \in [y_L, y_H] \sim f(\cdot | e)$
- Tail-risk project:
  - With probability  $p$ ,  $y_t \in [y_L, y_H] \sim g(\cdot | e)$
  - With probability  $(1-p)$ ,  $d$
- Expected values  $\mu_t^d < \mu_o < \mu_t$
- Wage  $w(y)$  with minimum wage  $w_m$
- Effort boosts expected values, no effect on  $p$  or  $d$
- Manager chooses  $e$  and project ( $o$  or  $t$ )
- Shareholder chooses  $w()$

# Setup

- Three contract forms:
  - “Stock ”  $w(y) = \max\{w_m, \theta y\}$
  - “Option”  $w(y) = w_m + \theta \max\{y - y_f, 0\}$
  - “Collar ”  $w(y) = w_m + \theta \min\{\max\{y - y^f, 0\}, y^c - y^f\}$
- “Option” is special case of collar when  $y^c = y_H$
- “Stock” is special case of option when  $y^f = w_m / \theta$
- Shareholder chooses  $\theta$ ,  $y^f$ , and  $y^c$  to elicit value-maximizing effort and project choice

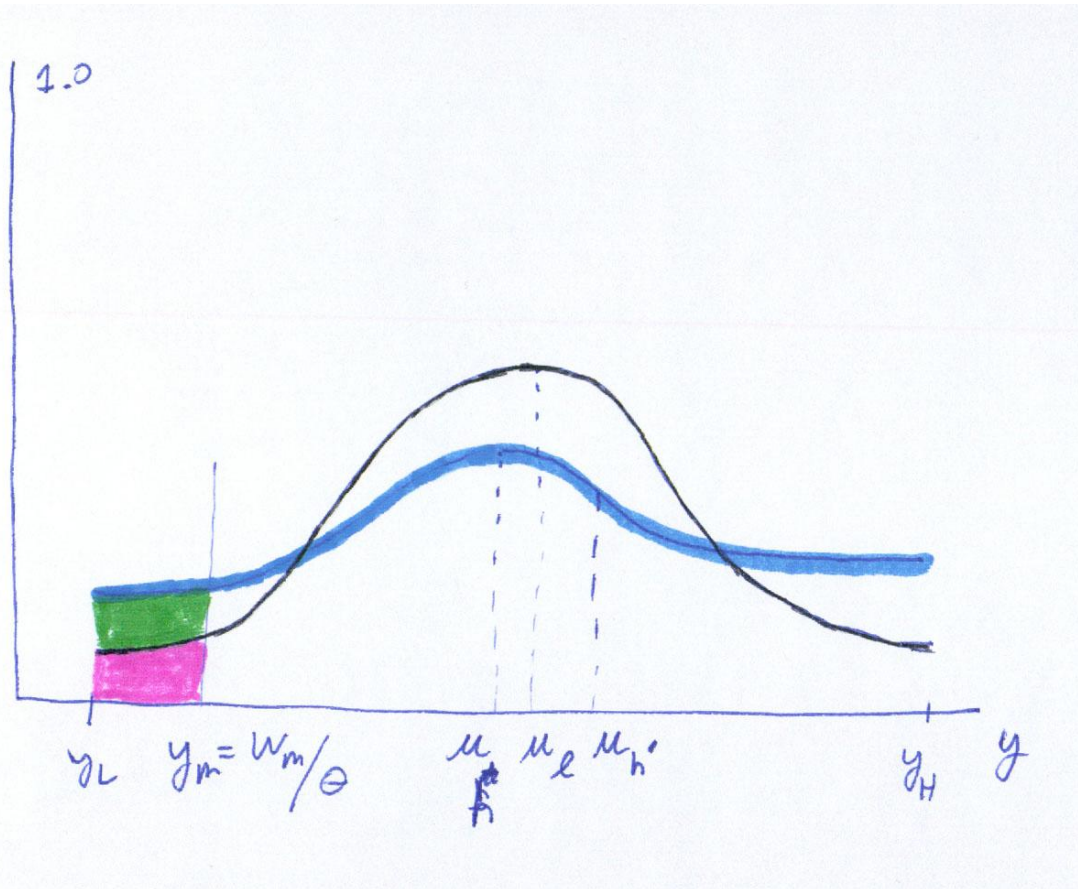
# Intuition

- Two targets (effort, risk) implies two instruments
- $\theta$ , the “piece rate,” incentivizes effort
- Depending on shapes of  $f()$  and  $g()$ , instrument for incentivizing risk choice might be either  $y^f$  or  $y^c$
- Sometimes stocks work, but mostly if, roughly,  $\mu_o$  not too much smaller than  $\mu_t$  ...only instrument is  $\theta$ , increases above no-project-choice optimum reduce  $y_f = w_m/\theta$
- Tradeoff: Either or both of  $y^f > w_m/\theta$  or  $y^c < y_H$  reduces range over which  $\theta$  affects marginal pay, so  $\theta$  must be larger to hit effort target. Costs more, so stocks are better than options if no risk choice



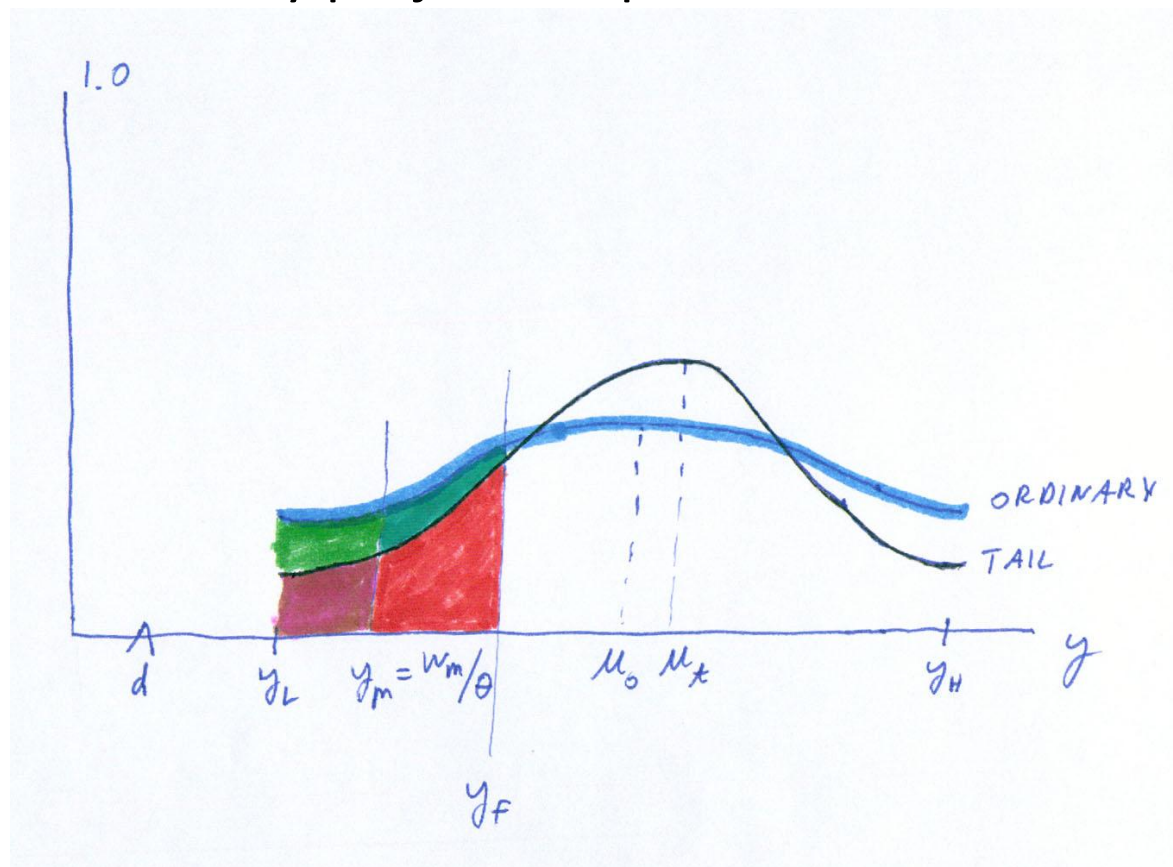
# Intuition: No tail risk

- No tail risk, no  $w_M$ , risk neutral implies stocks align incentives
- With  $w_M$ ,  $\theta$  hits both targets only if  $y_M$  not too high and  $\mu_h - \mu_l$  not too big



# Intuition: With tail risk

- If stock, shareholder prefers ordinary, manager tail. Reduce  $E(w(y_t))$  more than  $E(w(y_0))$ . Floor can work if continuous tails fatter for ordinary project. Cap can work if fatter for tail proj.



# Generality: Proposition 3

- Ordinary options incent effort and project choice if the tail-risk project second-order stochastically dominates the ordinary risk project (above floor)

**Proposition 3** *A necessary and sufficient condition under which options can be used to deter tail risk project choice is*

$$\int_{y^*}^{\bar{y}} F_o(y)dy \leq \int_{y^*}^{\bar{y}} F_t(y)dy, \quad (4)$$

*Thus, a sufficient condition for options to be optimal is the value generated from the tail risk project second-order stochastically dominates that from the ordinary risk project above the exercise price.*

# Application

- To hit effort target, HR manager can experiment with bonus per unit of net revenue. Conceivable in repeated game.
- To hit effort and risk target, HR and risk managers can set cap or floor. But need to know whether tail risk exists, and shape of payoff distributions in ordinary states of world. Inconceivable.
- How does ex ante risk adjustment fit?

# Other results

- Stocks may incentivize tail-risk-taking
  - Can't make  $\theta$  smaller than the no-project-choice case. As  $\theta$  increases,  $y^f$  falls, so stocks can work only if a small portion of the tail needs to be cut off
- If the principal can monitor project choice, then the more effective the monitoring, the less the need for options

# Externalities

- We usually restrict attention to “interesting” cases where the shareholder does not want the tail risk project
- Represent externalities as a worsening of the disaster payoff.
  - Then shareholders like some tail risk projects that the planner doesn’t
- The planner can get the socially desirable outcome by dictating contract terms, but the information (and power) requirements are large
- Planner needs to take action in limited circumstances

# Translations, Speculations, Caveats

- One interpretation: Performance targets in annual reviews should sometimes have caps as well as floors. Details should differ across businesses...one size does not fit all
- In our model, outcomes are known at pay date
  - We have not modeled an upfront cash portion of the bonus combined with deferred compensation