Managerial Labor Market Competition and Incentive Contracts

Lunch Seminar, Department of Economics, VU

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Introduction

COMPANY AND CHIEF EXECUTIVE		COMPENSATION (IN MILLIONS) Salary ■ Bonus ■ Perks ■ Stock ■ Options	CHANGE 2016-17	2017 COMPANY PERFORMANCE Revenue (bil.)	Total return	EMPLOYEE PAY Median Pay	CEO Pay Ratio
BROADCOM (AVGO) Hock E. Tan	2017 2016	$103.2 $24.7	+318% RANK: 7	$17.6 RANK: 92	+56% RANK: 19	N.A.	N.A.
FIRST DATA (FDC) Frank J. Bisignano	2017 2016	$102.2 $13.7	+646% RANK: 4	$12.1 RANK: 120	+18% RANK: 105	$50,406 RANK: 120	2028:1 RANK: 7
LIVE NATION ENTERTAINMENT (LYV) Michael Rapino	2017 2016	$70.6 $10.4	+577% RANK: 5	$10.3 RANK: 130	+60% RANK: 16	$24,406 RANK: 147	2893:1 RANK: 5
CBS (CBS) Leslie Moonves	2017 2016	$68.4 $68.6	0% RANK: 123	$13.7 RANK: 108	-6% RANK: 173	$116,654 RANK: 37	595:1 RANK: 27
LIBERTY MEDIA/QURATE RETAIL G... Gregory B. Maffei	2017 2016	$67.2 $29.8	+125% RANK: 19	N.A.	N.A.	N.A.	N.A.
TRANSDIGM GROUP (TDG) W. Nicholas Howley †	2017 2016	$61.0 $18.9	+223% RANK: 8	$3.5 RANK: 172	+4% RANK: 154	N.A.	N.A.
ALTICE USA (ATUS) Dexter Goei	2017 2016	$53.6 -	N.A.	$9.3 RANK: 141	N.A.	N.A.	N.A.
TIME WARNER (TWX) Jeff Bewkes	2017 2016	$49.0 $32.6	+50% RANK: 28	$31.3 RANK: 60	-4% RANK: 168	$75,217 RANK: 80	651:1 RANK: 22
FLEETCOR TECHNOLOGIES (FLT) Ronald F. Clarke	2017 2016	$45.1 $21.7	+107% RANK: 20	$2.3 RANK: 184	+36% RANK: 48	$34,700 RANK: 142	1517:1 RANK: 10

Stylized Facts

- A typical executive compensation package:

```
total pay = salary  +  performance-based pay
  (tdc1)                (bonus, stocks, options, etc.)
            30%                    70%
```

- Performance-based incentives

$$\texttt{delta} = \frac{\Delta \texttt{Wealth(in dollars)}}{\Delta \texttt{Firm Value(in percentage)}}$$

- Data sample: top 5 to 8 executives in U.S. publicly listed firms (S&P 500, MidCap, and SmallCap indices), 1992 to 2016.

Stylized Facts

1. **Firm-size premium in total compensation**
   - Compensation is higher in larger firms.
   - A 1% increase in firm size leads to 0.45% increase in total compensation.

2. **Firm-size premium in compensation growth**
   - Starting with the same total compensation, compensation growth is higher in larger firms.
   - A 1% increase in firm size leads to 10% increase in compensation growth rate.

3. **Firm-size premium in performance-based incentives**
   - Controlling for total compensation, performance-based incentives are higher in larger firms.
   - A 1% increase in firm size leads to a 0.35% increase in performance-based incentives.

Managerial Labor Market Competition

- IBM proxy statement 2018:
  - "battle for talent"
  - targets to the 50th percentile among a large group of benchmark companies inside and outside the industry.
  - further adjust the individual compensation according to "the skills and experience of senior executives that are highly sought after by other companies and, in particular, by IBMs competitors."

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- Johnson & Johnson proxy statement 2018:
  - "competitiveness" as the first guiding principle
  - compare executive compensation against "appropriate peer companies that are of similar size and complexity, ... to attract, retain, and motivate high-performing executives"

Research Questions

- How does the managerial labor market competition impact the incentive contracts?

- Explain empirical puzzles:
    1. Firm-size premium in total compensation
    2. Firm-size premium in compensation growth
    3. Firm-size premium in performance-based incentives

Research Questions

- How does the managerial labor market competition impact the incentive contracts?

- Explain empirical puzzles:
    1. ~~Firm-size premium in total compensation~~
    2. Firm-size premium in compensation growth
    3. Firm-size premium in performance-based incentives

Road Map

1. Model

   - embed dynamic moral hazard into an equilibrium search framework
   - poaching offers impact *compensation level* and *incentives*

2. Data & Reduced-form Evidence

   - examine model assumptions and implications

3. Structural Estimation

   - predict firm-size premiums without targeting on it

4. Policy Implications

Related Literature

- Assignment models
  - on compensation level: Tervio (2008), Gabaix and Landier (2008)
  - on incentives: Edmans et al. (2009), Edmans and Gabaix (2011)
- Moral hazard models
  - Gayle and Miller (2009), Gayle et al. (2015): moral hazard is more severe / the quality of signal (about effort) is poorer in larger firms
- Dynamic contract literature
  - moral hazard: Spear and Srivastava (1987), etc.
  - limited commitment: Thomas Worrall (1988, 1990), etc.
- Labour search literature
  - sequential auction: Postel-Vinay and Robin (2002), etc.

The Model

Set Up: Moral Hazard

Discrete time and infinite periods

Executives:

- risk averse, $u(w) - c(e)$, $e \in \{0,1\}$, $c(1) = c$, $c(0) = 0$,

$$u(w) = \frac{w^{1-\sigma}}{1-\sigma}$$

- effort e stochastically increases executive productivity $z \in \mathcal{Z}$
- z is persistent, follows a discerete Markov Chain process
  - $\Gamma(z'|z)$ when take the effort, $\Gamma^s(z'|z)$ when shirk
- die with $\delta \in (0,1)$, the match breaks up, the job disappears

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Firms:

- firm size $s \in \mathcal{S}$, exogenous and permanent
- production (cash flow) $y(s, z) = \alpha_0 s^{\alpha_1} z$, $\alpha_0, \alpha_1 \in (0, 1]$.

Set Up: Managerial Labor Market

Managerial Labor Market:

- *search frictional* and allows *on-the-job search*
- with $\lambda_1 \in (0,1)$ sample an outside firm s' from $F(s')$

Sequential Auction:

- Bertrand competition between current firm s and outside firm s'
- Each firm has a **bidding frontier**, $\overline{W}(z,s)$, defined by

$$\Pi\left(z, s, \overline{W}(z,s)\right) = 0$$

- $\overline{W}(z,s)$ increases in z and s
- if $s' < s$, renegotiate with the current firm
- if $s' > s$, transit to the poaching firm

Contracting Problem

Firms maximize profits

$$\Pi(z, s, V) = \max_{w, W(z', s')} \sum_{z' \in \mathbb{Z}} \sum_{s' \in \mathbb{S}} \left[y(s, z') - w + \tilde{\beta} \Pi(z', s, W(z', s')) \right] \tilde{F}(s') \Gamma(z'|z)$$

subject to

$$V = u(w) - c + \tilde{\beta} \sum_{z' \in \mathbb{Z}} \sum_{s' \in \mathbb{S}} W(z', s') \tilde{F}(s') \Gamma(z'|z), \qquad \text{(PKC)}$$

$$\tilde{\beta} \sum_{z' \in \mathbb{Z}} \sum_{s' \in \mathbb{S}} W(z', s') \tilde{F}(s') \left(\Gamma(z'|z) - \Gamma^s(z'|z) \right) \geq c, \qquad \text{(IC)}$$

$$W(z', s') \geq \min\{\overline{W}(z', s'), \overline{W}(z', s)\}, \qquad \text{(PC-Executive)}$$

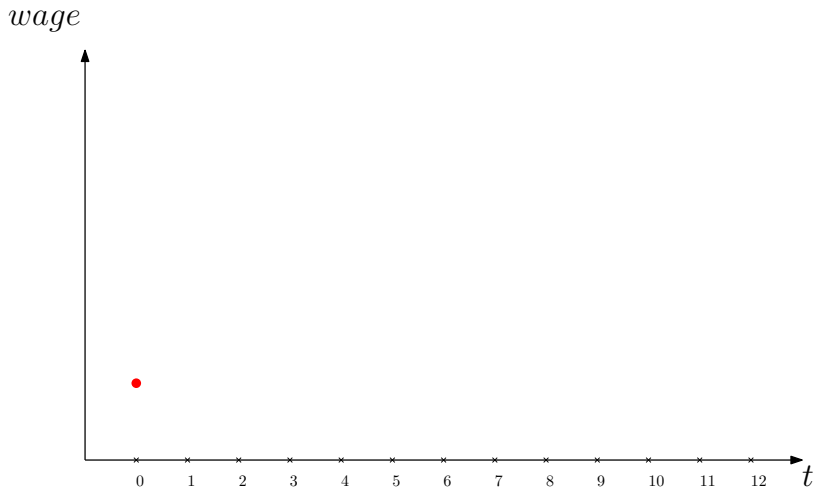$$W(z', s') \leq \overline{W}(z', s). \qquad \text{(PC-Firm)}$$

The Equilibrium

An stationary equilibrium is defined by

- value functions $\{W^0, W, \Pi\}$;
- optimal contracts $\sigma = \{w, W(z', s')\}$ for $z' \in \mathbb{Z}$ and $s' \in \mathbb{S}$;
- $\Gamma(z'|z)$ follows the optimal effort choice;
- a distribution of executives across employment states evolving according to flow equations.

The Optimal Contract

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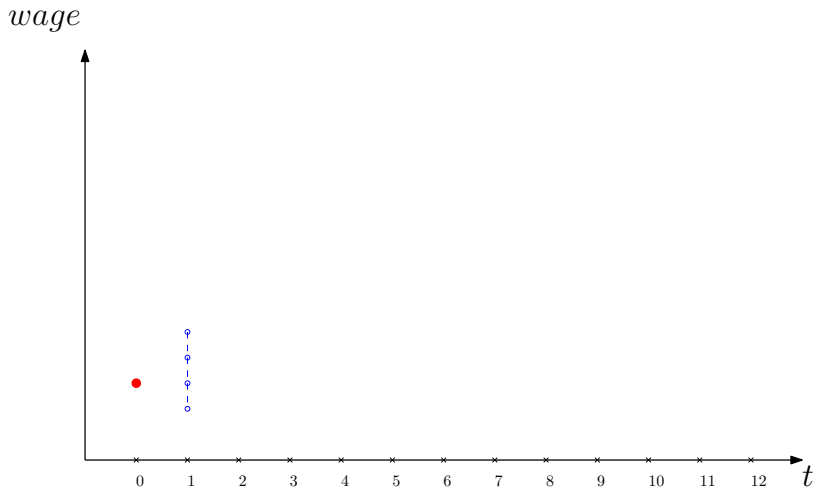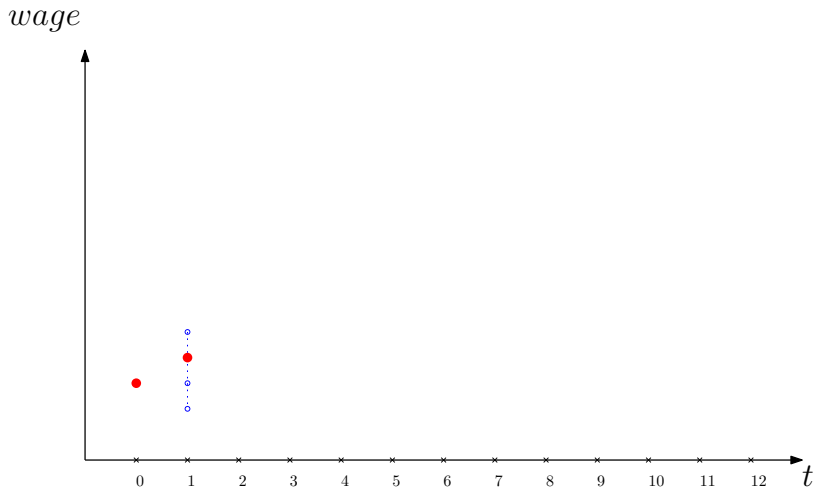

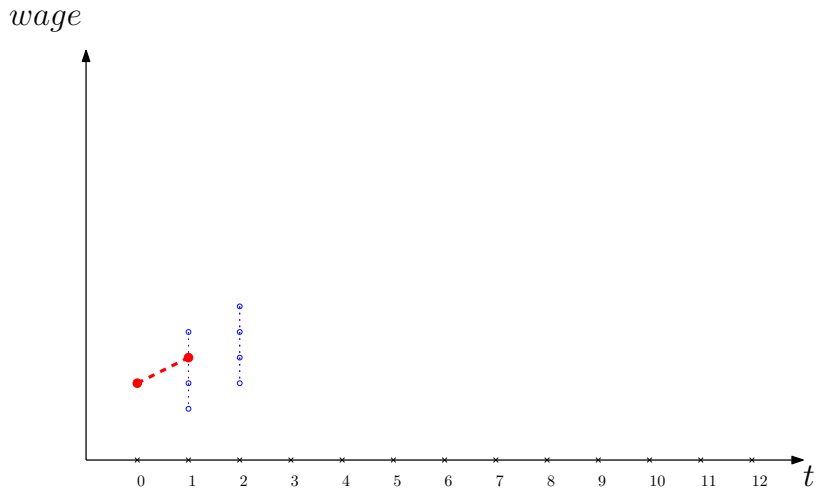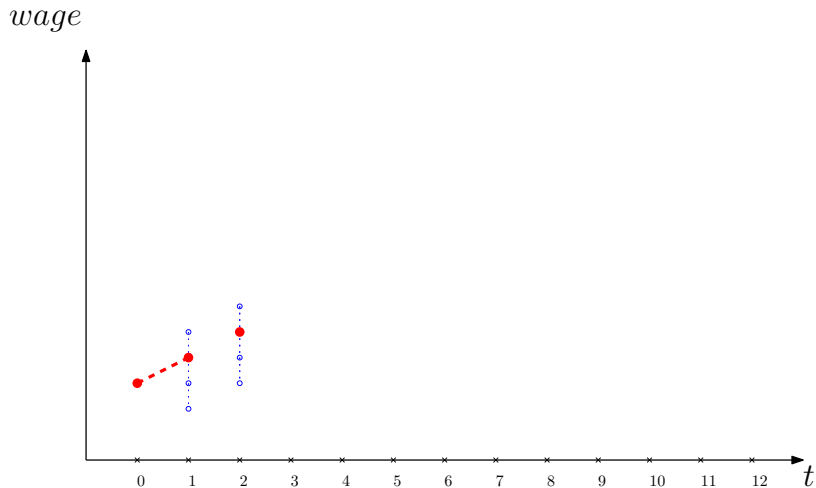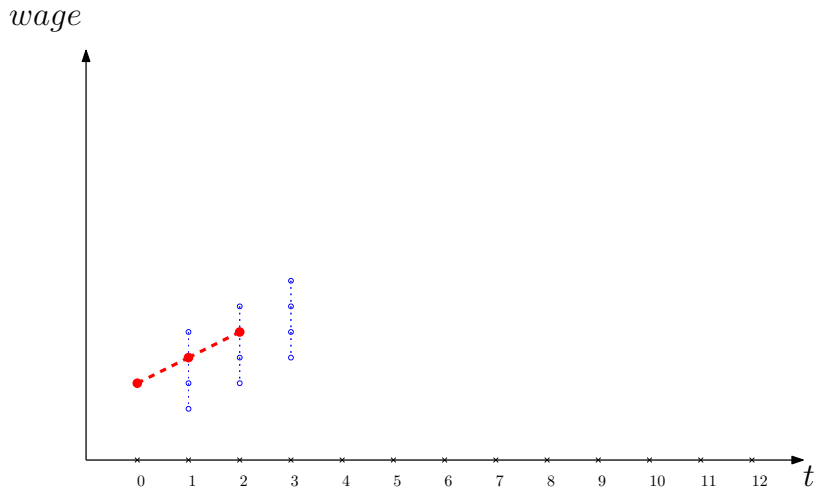induced by sequential auction with outside firm

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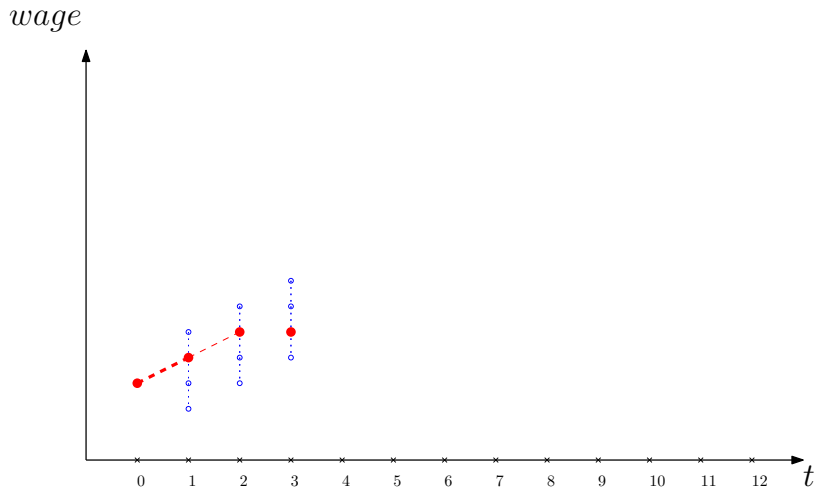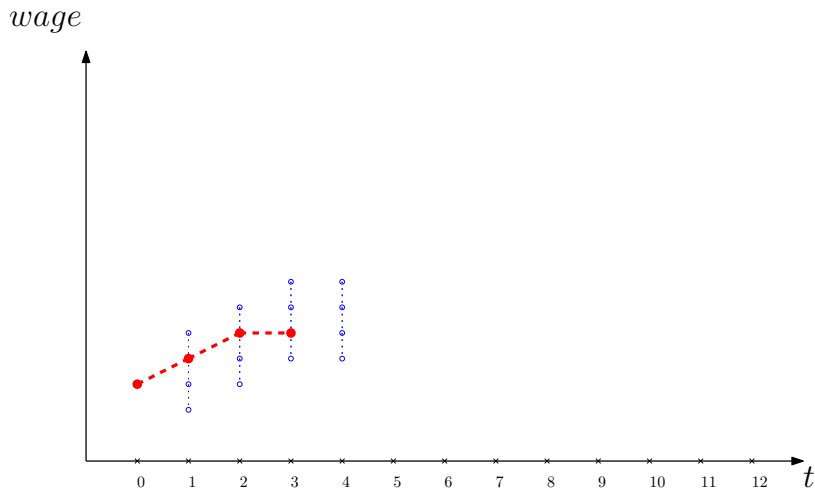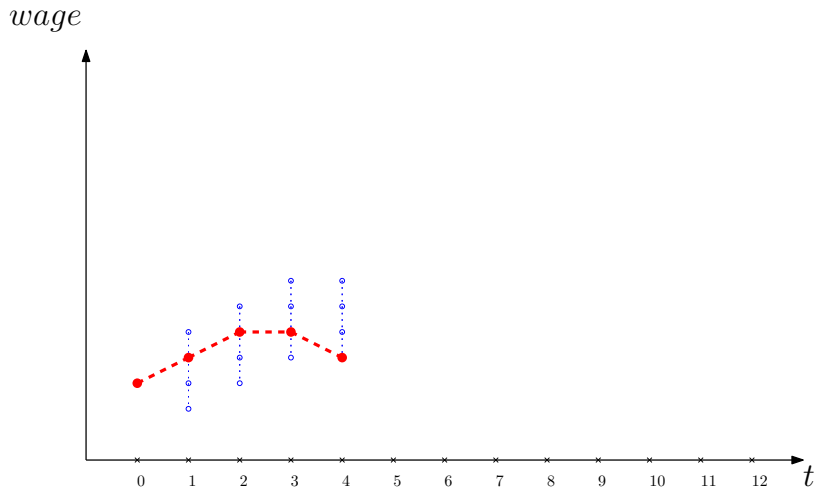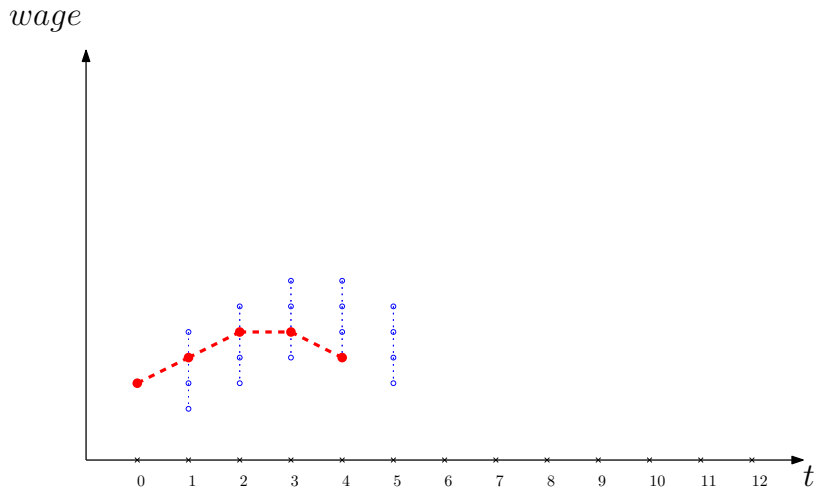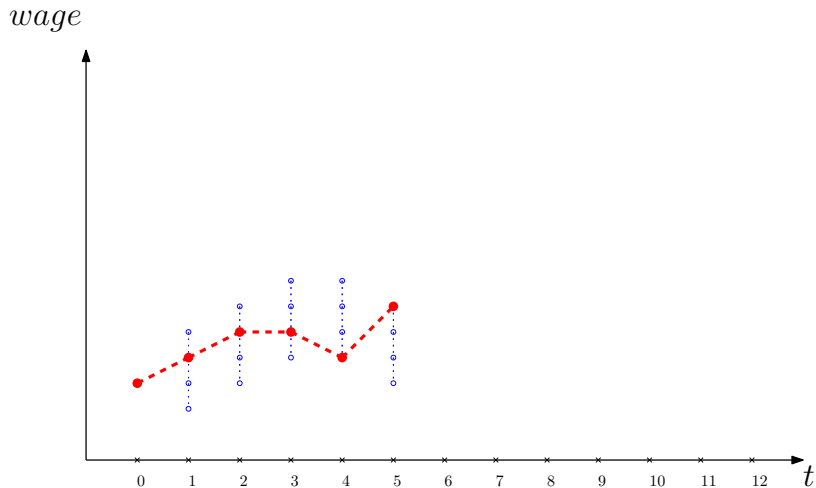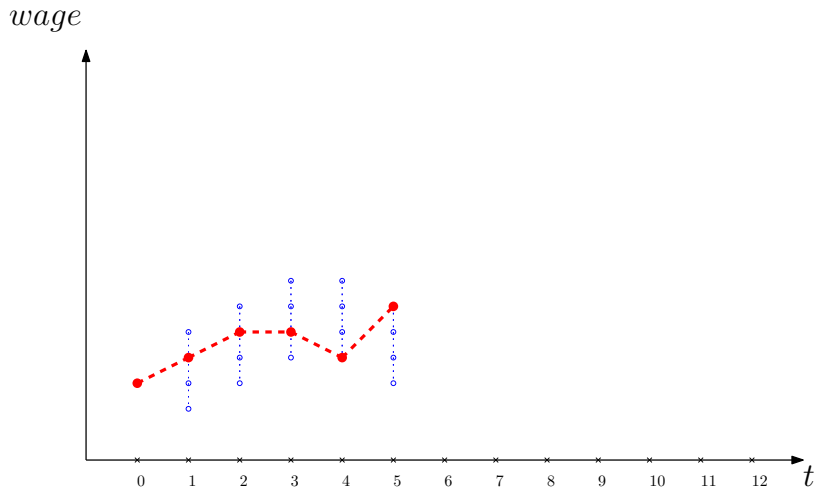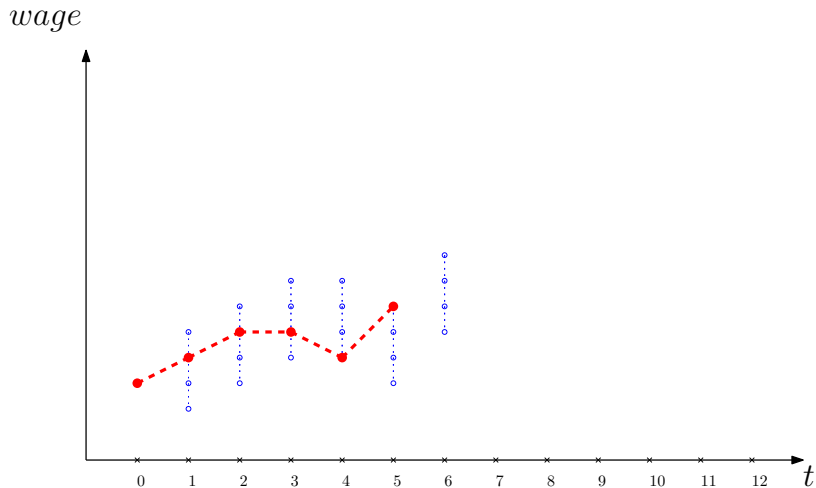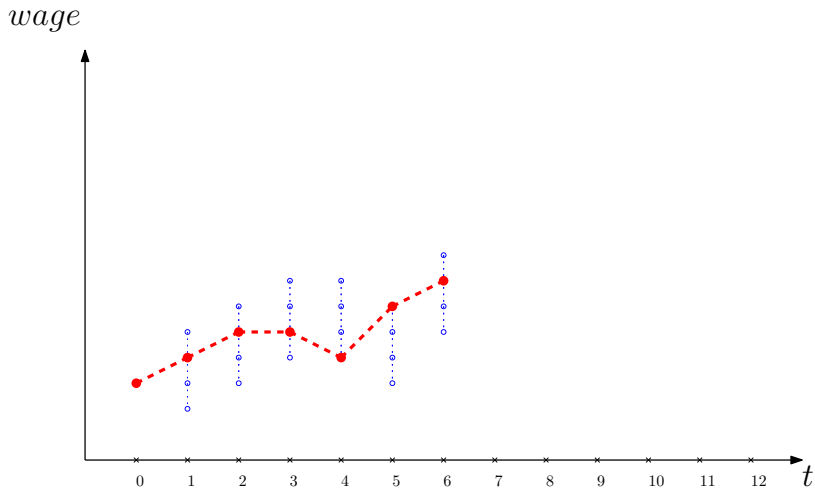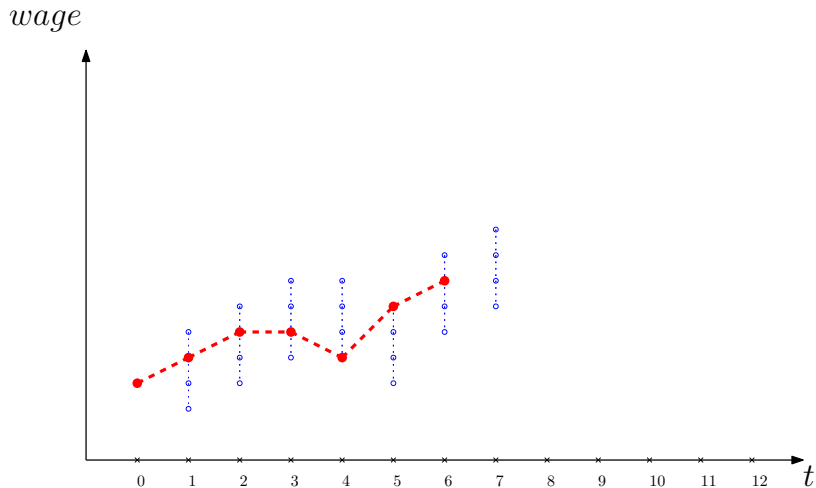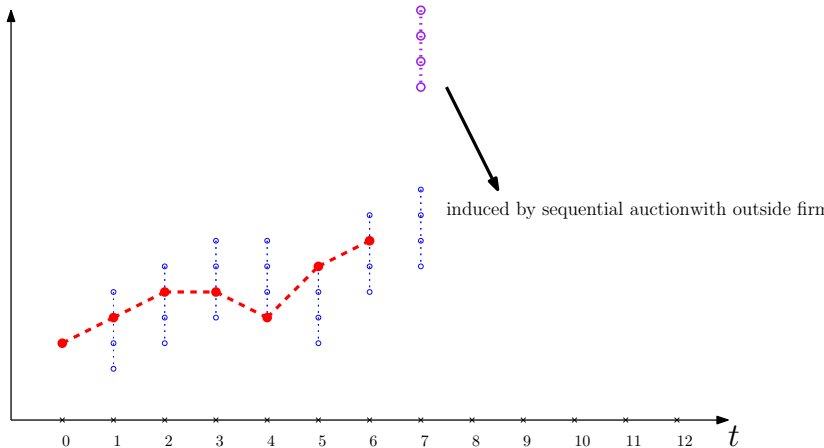
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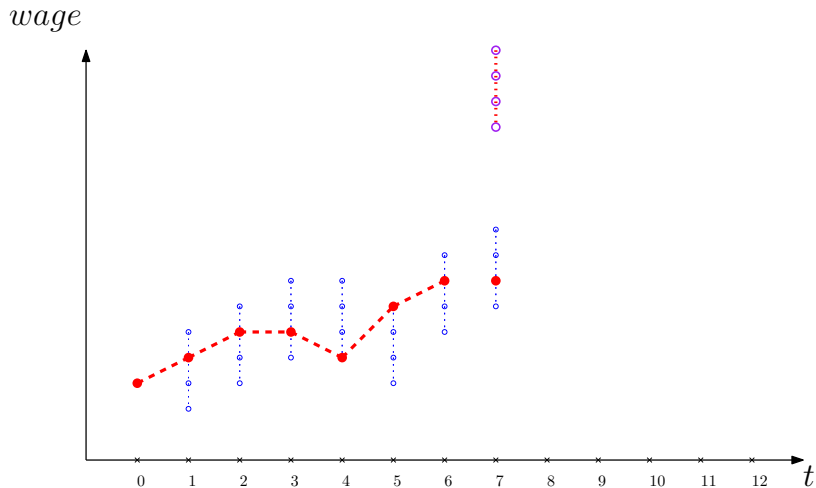
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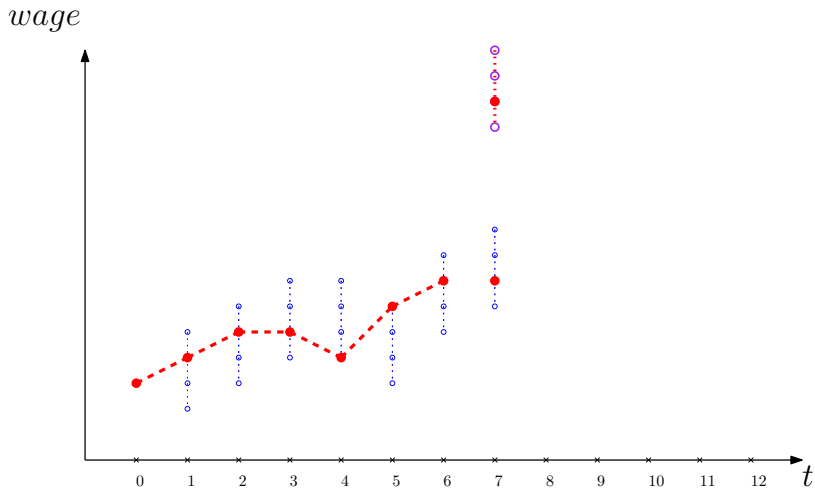
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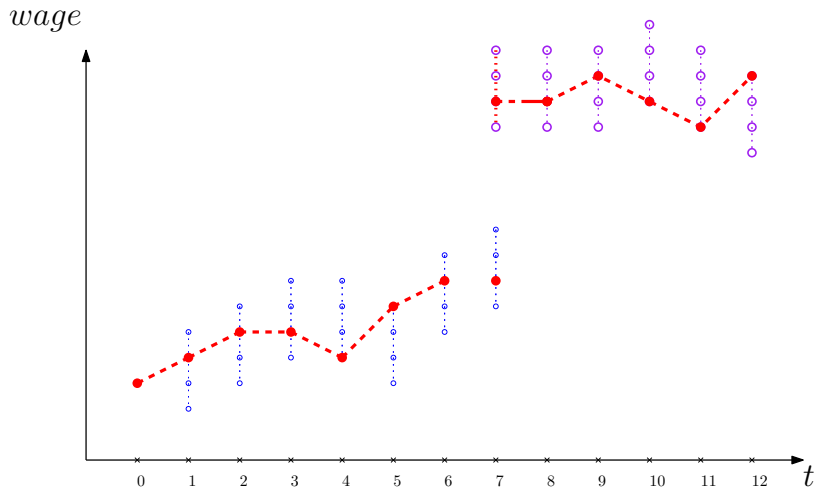
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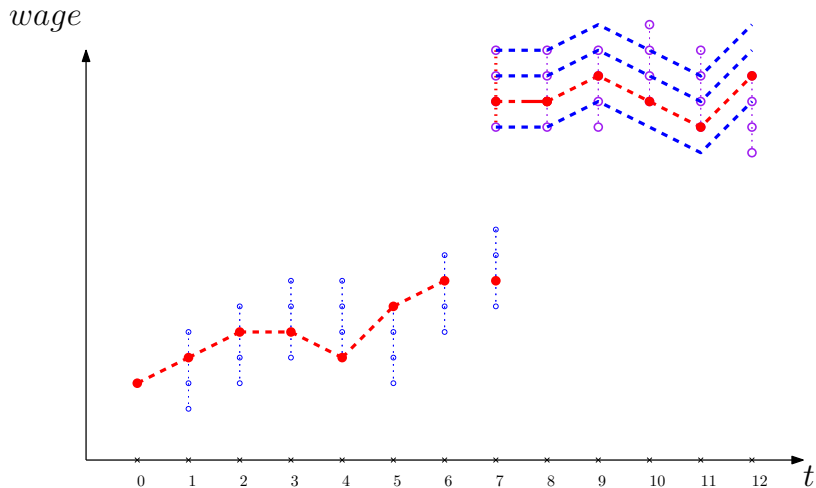
Why does compensation grow faster in larger firms?

Three sets of poaching offers

Three sets of outside firms s':

$\mathcal{M}_1 : s' \geq s,$ lead to job turnovers

$\mathcal{M}_2 : s' < s,$ improve compensation, no job turnovers

$\mathcal{M}_3 :$ other or no outside firms

The continuation value of an executive is

$$\underbrace{\sum_{s' \in \mathcal{M}_1} F(s')\mathbb{E}[\overline{W}(z', s)] + \sum_{s' \in \mathcal{M}_2} \mathbb{E}[\overline{W}(z', s')]F(s')}_{\text{labor market driven}} + \underbrace{\sum_{s' \in \mathcal{M}_3} F(s')\mathbb{E}[W(z')]}_{\text{promise driven}}$$

$\overline{s}$

s_1

$\mathcal{M}_2 : \Delta w > 0$

$s(w)$

$\mathcal{M}_3 : \Delta w = 0$

$\underline{s}$

$\overline{s}$

$\overline{s}$

s_1

s_2

$\mathcal{M}_2 : \Delta w > 0$

$\mathcal{M}_2 : \Delta w > 0$

$s(w)$ $s(w)$

$\mathcal{M}_3 : \Delta w = 0$

$\mathcal{M}_3 : \Delta w = 0$

$\underline{s}$

$\underline{s}$

$\overline{s}$ $\overline{s}$

s_2

s_1

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$s(w)$

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$\underline{s}$ $\underline{s}$
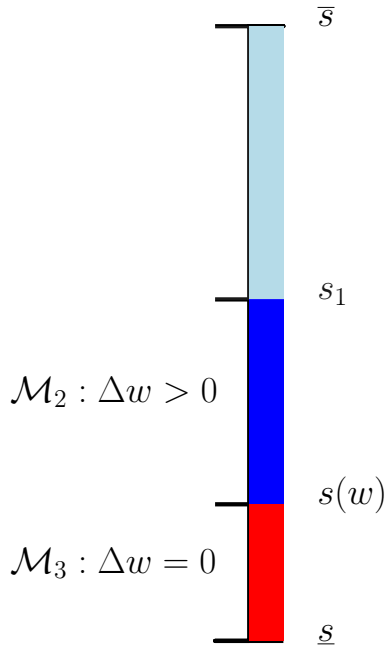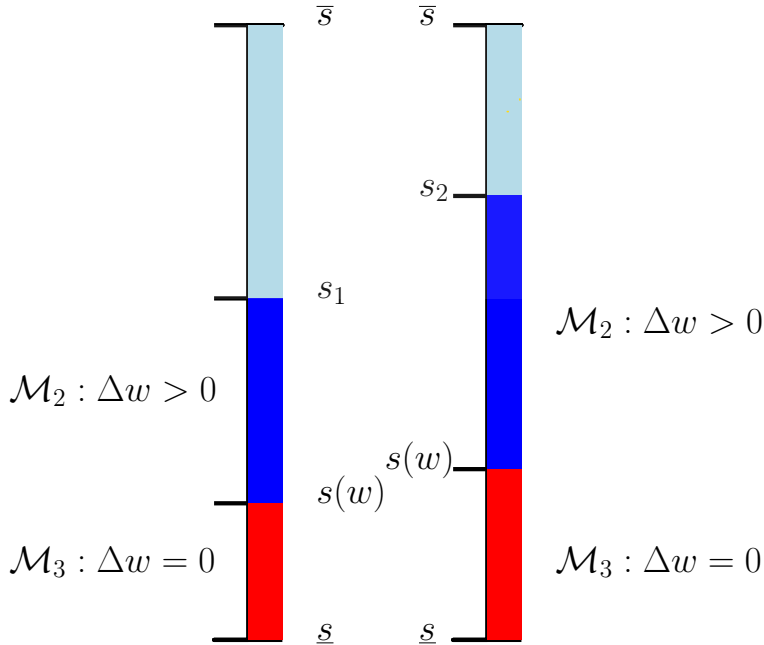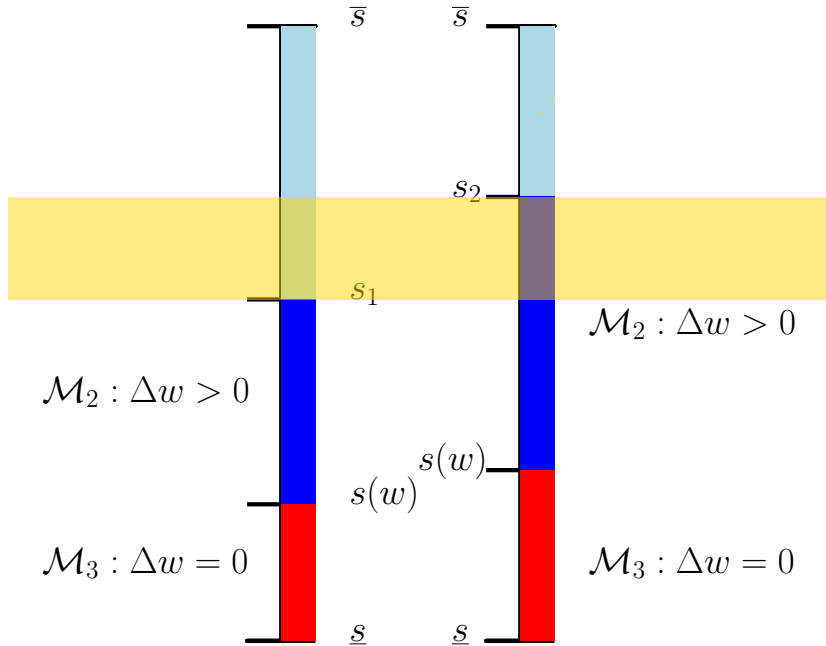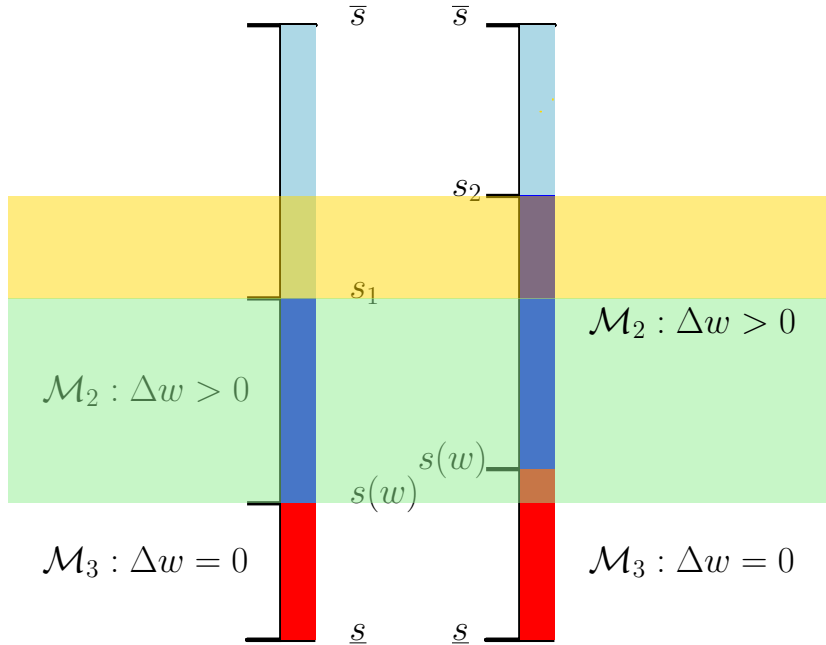
Why do performance-based incentives increase in firm size?

Incentive Compatibility Constraint

What is the incentive out of $W(z')$?

$$\mathcal{I}[W(z')] \equiv \tilde{\beta} \left\{ \sum_{z'} W(z') \Gamma(z'|z) - \sum_{z'} W(z') \Gamma^s(z'|z) \right\}.$$

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Sets of outside firms s':

$\mathcal{M}_1 : s' \geq s,$ lead to job turnovers

$\mathcal{M}_2 : s' < s,$ improve compensation, no job turnovers

$\mathcal{M}_3 :$ other or no outside firms

The incentive compatibility constraint is

$$\underbrace{\sum_{s' \in \mathcal{M}_1} F(s') \mathcal{I}[\overline{W}(z',s)] + \sum_{s' \in \mathcal{M}_2} \mathcal{I}[\overline{W}(z',s')] F(s')}_{\text{Labor Market Incentives}} + \underbrace{\sum_{s' \in \mathcal{M}_3} F(s') \mathcal{I}[W(z')]}_{\text{Performance-based Incentives}} \geq c.$$

$\overline{s}$ $\overline{s}$

$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_1)]$ $\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_2)]$

s_2

s_1

$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$

$s(w)$

$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$

$s(w)$

$\mathcal{M}_3 : 0$ $\mathcal{M}_3 : 0$

$\underline{s}$ $\underline{s}$

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$\overline{s}$ $\overline{s}$

$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_1)]$ $>$ $\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_2)]$

$>$ s_2

s_1

$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$

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$s(w)$

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$\underline{s}$ $\underline{s}$
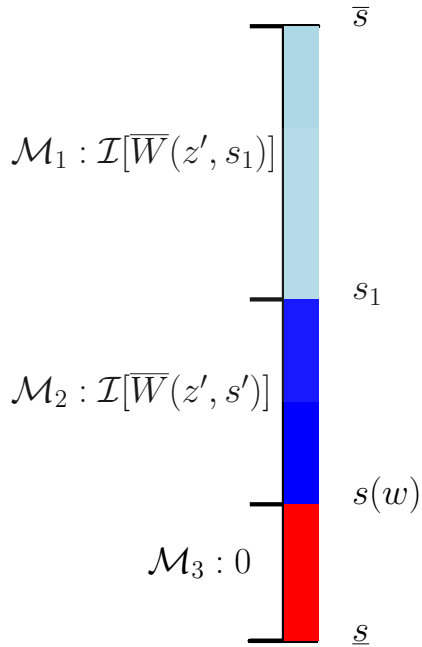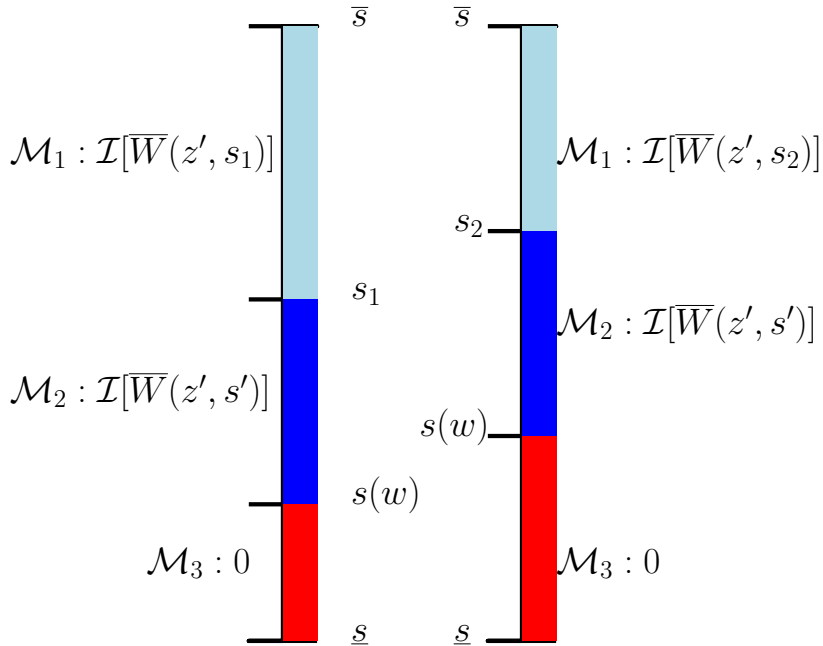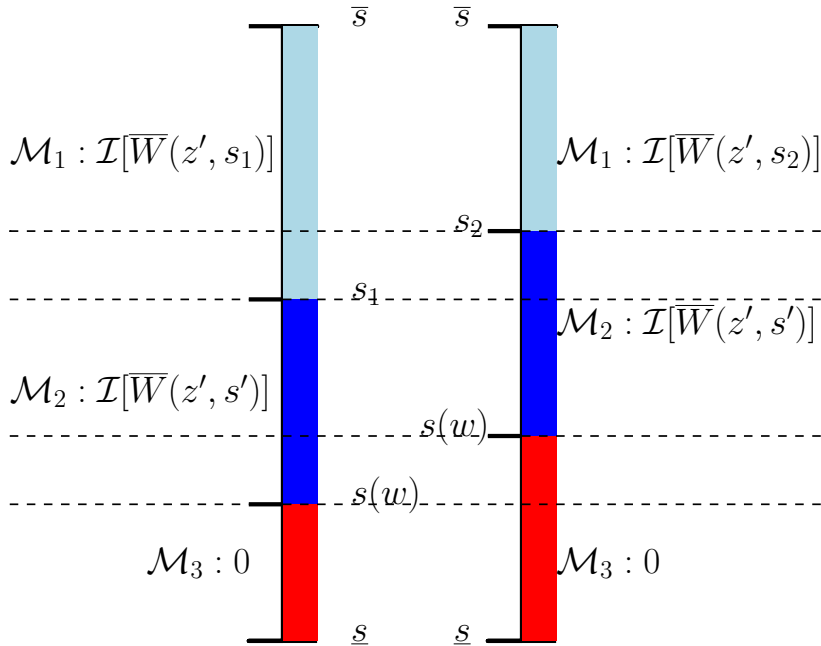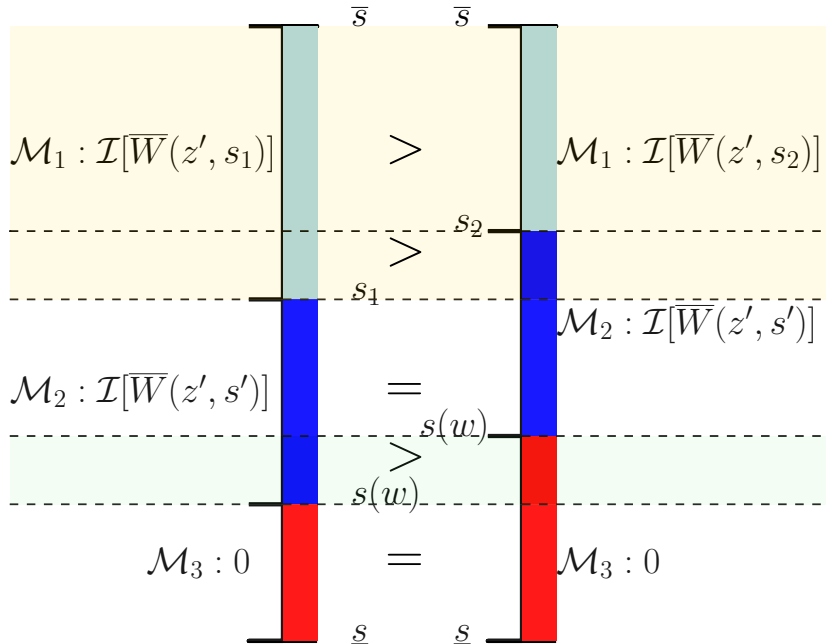
Incentives from $\overline{W}(z', s)$ decrease in s
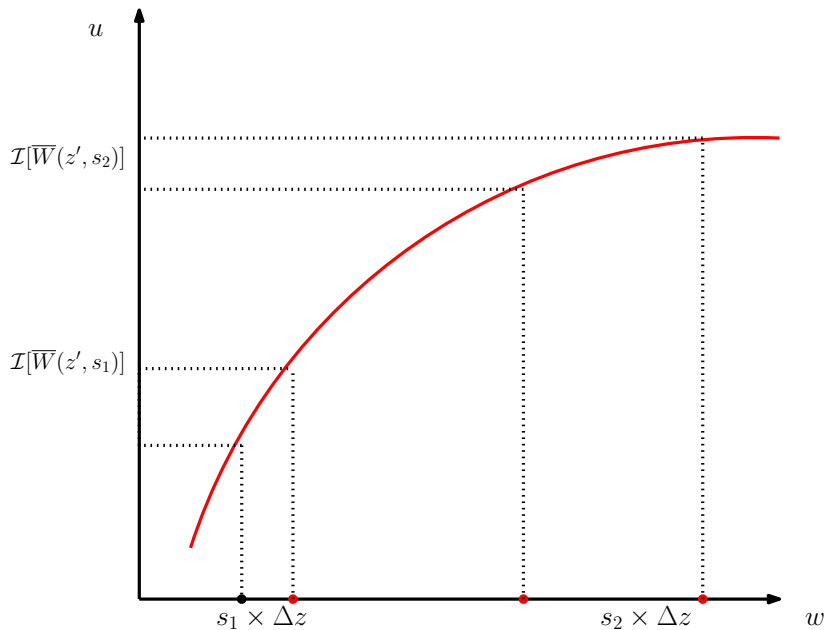
Incentives from $\overline{W}(z', s)$ decrease in s

Proposition

Suppose the executives' utility is of the CRRA form and the cost of effort $c = \overline{c}(s)$, then $\mathcal{I}\left(\overline{W}(z', s)\right)$ decreases in s if

$$\sigma > 1 + \frac{s^{1-\alpha_1}}{\alpha_1}\psi'(s), \tag{1}$$

where $\psi(s)$ is a function of s that is positive and increasing in s.

Intuition

- a higher s leads to higher certainty equivalent of $\overline{W}(z', s)$
- a higher certainty equivalent leads to lower marginal utility of extra wealth

Summary

- How does the managerial labor market competition impact the incentive contracts?
  Competition impacts both compensation level and incentives.

- Why does compensation grow faster in larger firms?
  Larger firms are more capable of countering outside offers.

- Why do performance-based incentives increase in firm size?
  Poaching offers generate labor market incentives that substitute for performance-based incentives.

Data & Reduced-form Evidence

Data

Assemble a new dataset

- merge ExecuComp and BoardEX + hand-collected data in LinkedIn
- ExecuComp: annual records on top executives' compensation
- BoardEX: detailed executive employment history
- Final sample: 35,088 executives, 218,168 executive-year obs., spanning the period 1992 to 2016.

Define job turnovers

- Job-to-job transition: leaves the current firm, and starts to work in another firm within 180 days.
- Exit: otherwise.

Reduced-form Evidence

1. Managerial labor market is active. (Details)

   - job-to-job transition rate 5%
   - stable over years and across industries

2. Executives climb job ladders towards larger firms. (Details)

   - about 60% of job-to-job transitions are towards larger firms
   - for the rest, 20% of them are promotions from non-CEO to CEO

3. Executives in larger firms have less job-to-job transitions. (Details)

   - Cox model, a 1% increase in firm size leads a 8.3% lower hazard of job-to-job transitions.

Reduced-form Evidence

4. Firm-size growth premium is higher in industries where managerial labor market is more active. `Growth Premium`

- job-to-job transition rate (industry-year level)
- genearl ability index (Custódio et al. 2013)
- fraction of insider CEO (Martijn Cremers and Grinstein 2013)

5. Firm-size incentive premium is higher in industries where managerial labor market is more active. `Incentive Premium`

Estimation

Model Specifications

- utility function of CRRA form

$$u(w) = \frac{w^{1-\sigma}}{1-\sigma}$$

- production function (cash flows)

$$y(s, z) = e^{\alpha_0} s^{\alpha_1} z$$

- productivity process by $AR(1)$, discretized by Tauchen (1989)

$$z_t = \rho_0(e) + \rho_z z_{t-1} + \epsilon_t$$

- poaching firm distribution by truncated log-normal $F(s)$

Parameters

Parameters	Description
δ	the death probability
λ_1	the offer arrival probability
ρ_z	the AR(1) coefficient of productivity shocks
μ_z	the mean of productivity shocks for $e = 1$
σ_z	the standard deviation of productivity shocks
μ_s	the mean of F(s)
σ_s	the standard deviation of F(s)
c	cost of efforts
σ	relative risk aversion
α_0, α_1	production function parameters

Moments and Estimation

A. Targeted Moments

Moments	Data	Model	Estimates	Standard Error
Exit Rate	0.0691	0.0691	$\delta = 0.0695$	0.0127
J-J Transition Rate	0.0498	0.0473	$\lambda_1 = 0.3164$	0.0325
$\hat{\rho}_{profit}$	0.7683	0.6299	$\rho_z = 0.8004$	0.0366
$Mean(profit)$	0.1260	0.1144	$\mu_z = 0.0279$	0.0014
$Var(profit)$	0.0144	0.0160	$\sigma_z^2 = 0.1198$	0.0044
$Mean(\log(size))$	7.4515	7.4806	$\mu_s = 1.2356$	0.0365
$Var(\log(size))$	2.3060	2.1610	$\sigma_s = 2.5795$	0.1211
$Mean(\log(wage))$	7.2408	7.2665	$\alpha_0 = -1.5534$	0.0147
$Var(\log(wage))$	1.1846	0.8960	$\alpha_1 = 0.5270$	0.0217
$\beta_{wage-size}$	0.3830	0.2822		
$\beta_{delta-wage}$	1.1063	1.1997	$\sigma = 1.1038$	0.0030
$Mean(\log(delta))$	8.4994	8.478	$c = 0.0814$	0.0259
$Var(\log(delta))$	3.4438	3.35872		

Predictions on the empirical puzzles

B. Untargeted Moments

Moments	Data	Model	Description
$\beta_{\Delta wage-size}$	0.112	0.1450	Firm-size growth premium
$\beta_{delta-size}$	0.3473	0.3122	Firm-size incentive premium, tdc1 controlled
$\beta_{delta-size-nowage}$	0.6044	0.6507	Firm-size incentive premium, tdc1 not controlled

- These moments are not targeted.
- They are predicted by the estimated model.
- The model quantitatively captures the two premiums. `Details`

Policy Implication

Policy: Spillover effects

- spillover effect: more fierce bid from a group of firms
    1. boosts the executive pay in those firms
    2. increases the pay in all firms that are higher on the job ladder
- more effective lower the willingness to bid in small and medium firms
- via more independent compensation committee, greater mandatory pay (or pay ratio) disclosure, say-on-pay legislation, etc.

Spillover effects
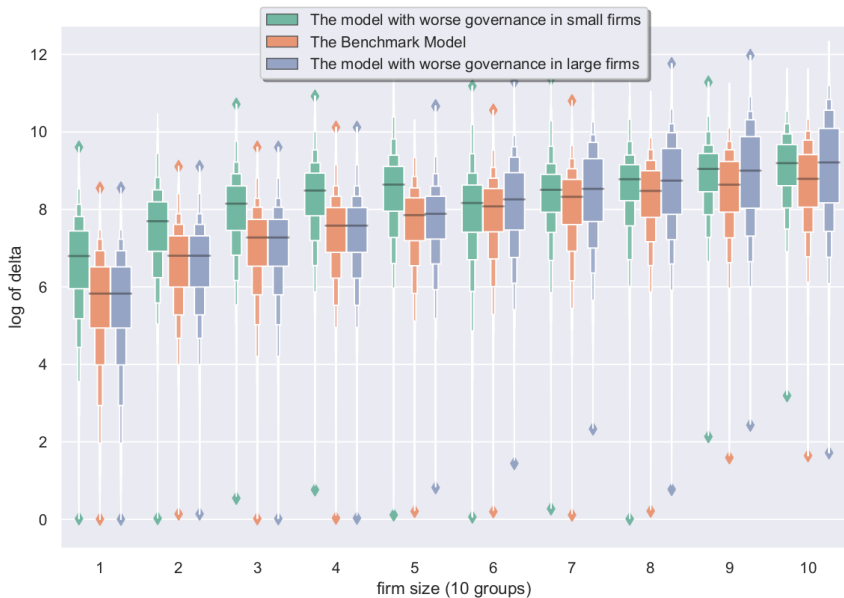
Spillover effects
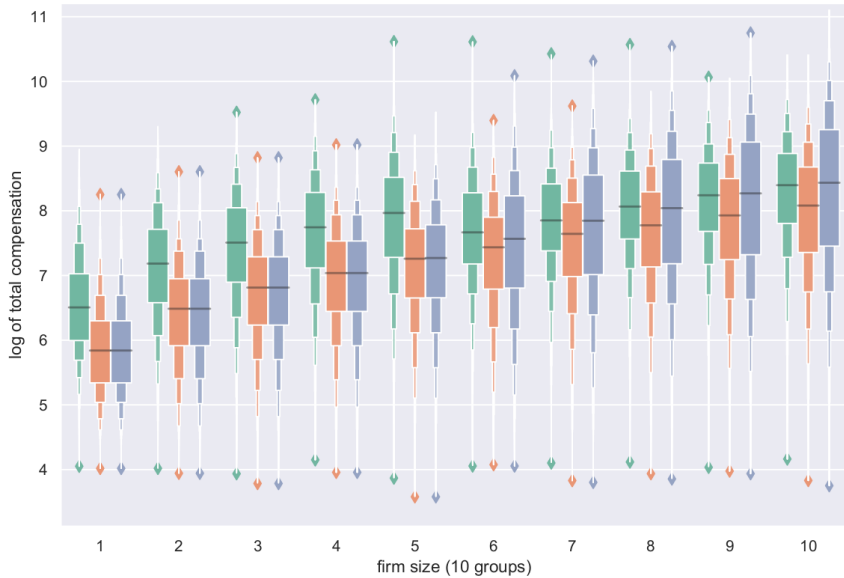
Conclusion

Conclusion

- Managerial labor market competition impacts the incentive contracts: level and incentives.

   1. Larger firms are more capable of countering outside offers.

   2. Poaching offers generate labor market incentives which decrease in firm size.

- Structure estimates show the model captures the firm size premium in compensation growth and performance-based incentives.

Thanks you for your attention.

http://bohuecon.github.io

No Moral Hazard, Full Commitment
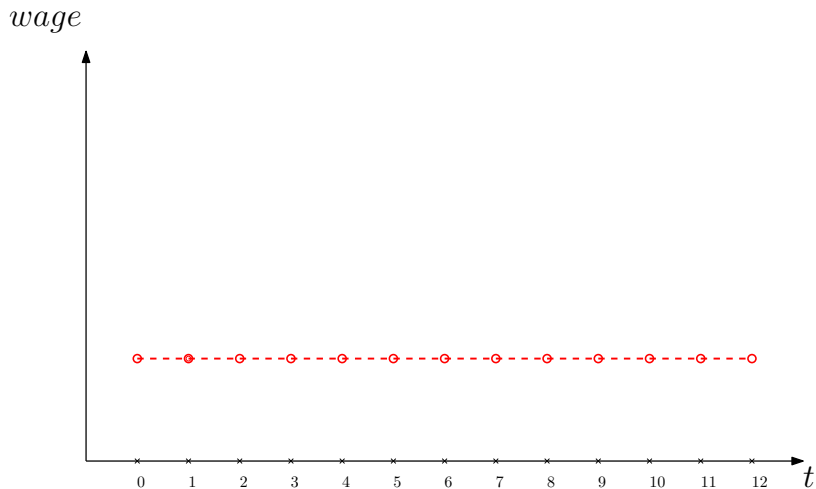
Only Moral Hazard
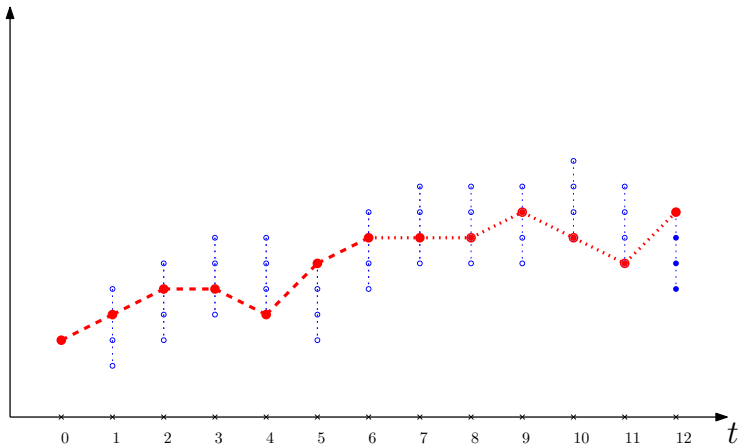
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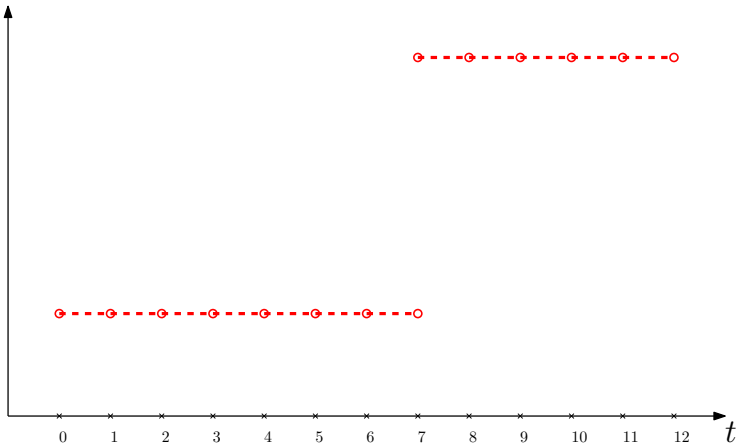
Optimal Contract
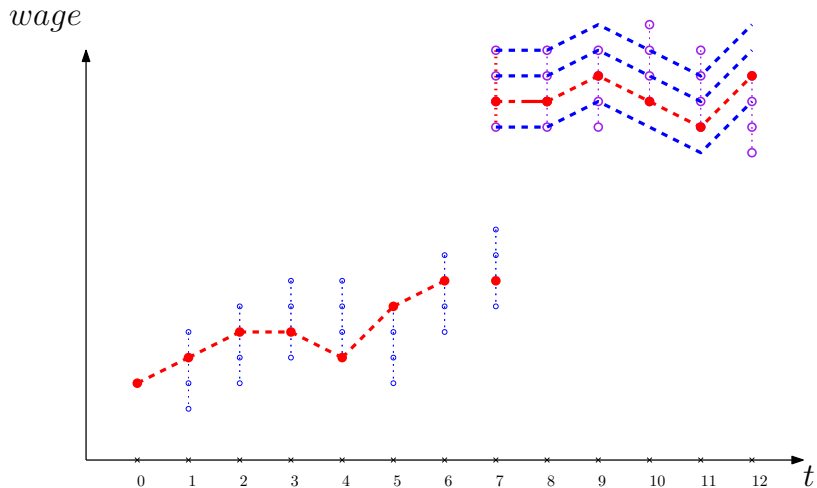
Job-to-job transition rate over age
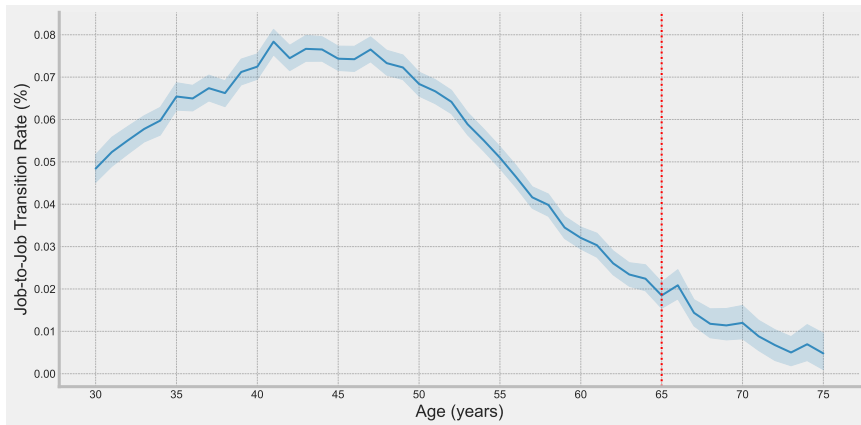
Back

Exit rate over age
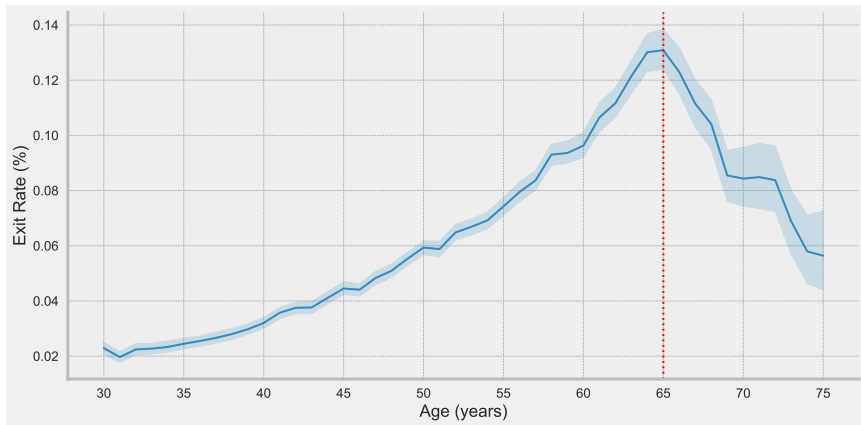
Climb the Job Ladder

Table 3: Change of firm size upon job-to-job transitions

Panel A: All executives

Firm size proxy	Total obs.	Firm size decrease obs. (%)	Firm size increase obs. (%)
Market Cap	2567	985 (39%)	1582 (61%)
Sales	2617	1051 (40%)	1566 (60%)
Book Assets	2616	1038 (40%)	1578 (60%)

Panel B: Across age groups

Age groups	Total obs.	Firm size decrease obs. (%)	Firm size increase obs. (%)
≤ 40	100	34 (34%)	66 (66%)
[40, 45)	381	135 (35%)	246 (65%)
[45, 50)	701	262 (37%)	439 (63%)
[50, 55)	766	304 (40%)	462 (60%)
[55, 60)	261	179 (43%)	82 (67%)
[60, 65)	73	52 (39%)	21 (61%)
[65, 70)	30	7 (25%)	23 (75%)
≥ 70	6	1 (16%)	5 (84%)

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Table 4: Job-to-Job Transitions and Firm Size

| | Job-to-Job Transition | |
	(1)	(2)
log(Firm Size)	0.917****	0.972*
	(0.0109)	(0.0139)
Age	0.985****	0.967***
	(0.00273)	(0.0112)
log(tdc1)		0.830****
		(0.0150)
Market-Book Ratio	0.942****	0.939****
	(0.0150)	(0.0157)
Market Value Leverage	1.033**	1.035**
	(0.0139)	(0.0142)
Profitability	0.913****	0.905****
	(0.0197)	(0.0199)
Year FE	Yes	Yes
Industry FE	Yes	Yes
N	154635	118119
chi2	496.1	491.4

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Table 1: Compensation growth increases with firm size

	(1)	(2)	(3)	(4)	(5)	(6)
				$\Delta \log(tdc1)$		
$log(firm\ size)_{-1}$	0.112***	0.154***	0.108***	0.107***	0.141***	0.127***
	(0.00903)	(0.0129)	(0.00183)	(0.00189)	(0.00177)	(0.00489)
$log(firm\ size)_{-1}$ $\times\ EE90$			0.0711*			
			(0.0403)			
$log(firm\ size)_{-1}$ $\times\ EE190$				0.0759**		
				(0.0353)		
$log(firm\ size)_{-1}$ $\times\ gai$					0.0233***	
					(0.00546)	
$log(firm\ size)_{-1}$ $\times\ inside\ CEO$						-0.000232***
						(0.0000696)
$log(tdc1)_{-1}$	-0.290***	-0.390***	-0.251***	-0.251***	-0.304***	-0.253***
	(0.0200)	(0.0262)	(0.00173)	(0.00173)	(0.00267)	(0.00173)
Dummies	X	X	X	X	X	X
Other contorls		X	X	X	X	X
Observations	129068	106819	106820	106820	58188	106820
adj. R^2	0.157	0.216	0.260	0.260	0.233	0.262

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Table 2: Performance-based incentives increases with firm size

	log(delta)					
	(1)	(2)	(3)	(4)	(5)	(6)
log(firm size)	0.604*** (0.0141)	0.347*** (0.0247)	0.525*** (0.00512)	0.529*** (0.00499)	0.561*** (0.00310)	0.571*** (0.0139)
log(firm size) × EE90			0.359* (0.118)			
log(firm size) × EE190				0.415** (0.101)		
log(firm size) × gai					0.0648*** (0.00156)	
log(firm size) × inside CEO						-0.000458* (0.000202)
log(tdc1)		0.609*** (0.0350)	-0.251*** (0.00173)	-0.251*** (0.00173)	-0.304*** (0.00267)	-0.253*** (0.00173)
Dummies	X	X	X	X	X	X
Other contorls		X	X	X	X	X
Observations	146747	128006	125858	125858	75747	125858
adj. R^2	0.442	0.514	0.521	0.521	0.531	0.521

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If labor market incentives are ignored ...
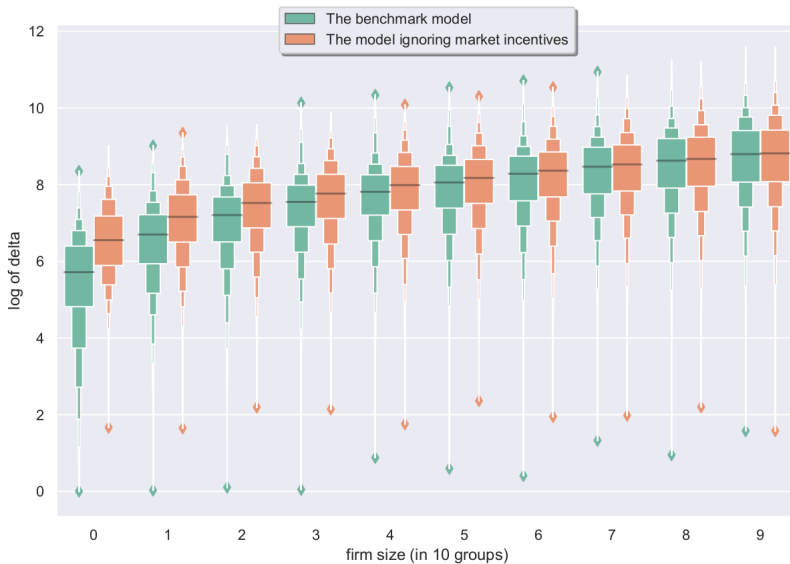
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  CEO's of "Small Firms" in S&P 500
+----------------------------------------------------------------+
  tdc1: total compensation
  delta: dollar-percentage incentive
+----------------------------------------------------------------+
|                     Company    Market Cap       tdc1      delta |
|                                   millions      000's    000's/%|
|----------------------------------------------------------------|
|                  INCYTE CORP     446.408   2432.9734  60.939838 |
|                  WESTROCK CO     547.828    2800.668  130.96215 |
|      ENVISION HEALTHCARE CORP    678.6906   1777.991    217.729 |
|           PRICELINE GROUP INC    886.0817   1775.531  165.73476 |
|                     LKQ CORP     889.9763   2602.093  473.70974 |
|     REGENERON PHARMACEUTICALS    897.3801   3094.134  566.14187 |
|        SKYWORKS SOLUTIONS INC   1113.547    2638.243  128.10688 |
|                 CENTENE CORP    1130.155    4584.605  344.02299 |
|          ALASKA AIR GROUP INC   1194.977     950.098  99.525198 |
|                  HOLOGIC INC    1276.448    2709.708  428.10996 |
|             ACUITY BRANDS INC   1328.171    1102.528  133.42285 |
|                    ANSYS INC    1368.129    3738.803  431.01562 |
|                  GARTNER INC    1474.909    8945.338  158.65569 |
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CEO's of "Large Firms" in S&P 500

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+-------------------------------------------------------------------+
  tdc1: total compensation
  delta: dollar-percentage incentives
+-------------------------------------------------------------------+
|                     Company   Market Cap       tdc1       delta |
|                                 millions      000's     000's/%|
|-------------------------------------------------------------------|
|               TIME WARNER INC    79965.89  18545.215   1212.9513 |
|                CONOCOPHILLIPS    80163.26  35442.729   4520.5571 |
|    UNITED PARCEL SERVICE INC    82439.55   3120.042   340.01132 |
|   VERIZON COMMUNICATIONS INC    83233.88      19425   861.09722 |
|                HOME DEPOT INC     86128.2  35750.103   2014.3633 |
|                       AT&T INC    94944.89  17283.529   1666.3201 |
|                  COCA-COLA CO    95494.39   12781.61   425.62199 |
|                   PEPSICO INC    97836.48  15268.415   2919.7995 |
|             CISCO SYSTEMS INC    121238.4   16269.85   5981.3853 |
|                  CHEVRON CORP     126749.6  13125.882   1106.6351 |
|   INTL BUSINESS MACHINES CORP    129381.2  21693.615   1298.8777 |
|                    INTEL CORP    147738.2   6101.835   1874.5755 |
|           WAL-MART STORES INC    192048.2  16652.894   1465.7708 |
|               EXXON MOBIL CORP    344490.6  48922.808    3843.027 |
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