Managerial Labor Market Competition and Incentive Contracts

Lunch Seminar, Department of Economics, VU
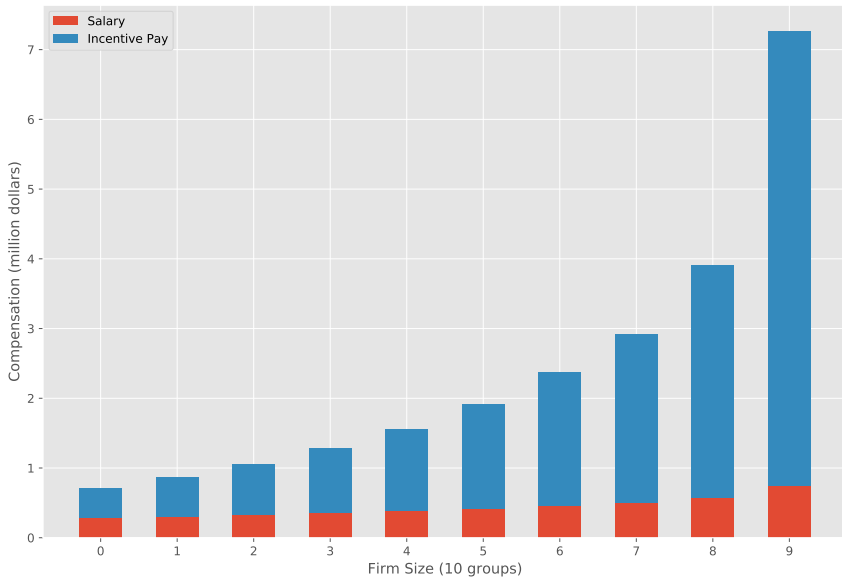
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Introduction

Stylized Facts

Stylized Facts

- A typical executive compensation package:

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

- Performance-based incentives

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

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:
  - Firm-size premium in total compensation
  - Firm-size premium in compensation growth
  - Firm-size premium in performance-based incentives

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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 them

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

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

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

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

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

The Equilibrium

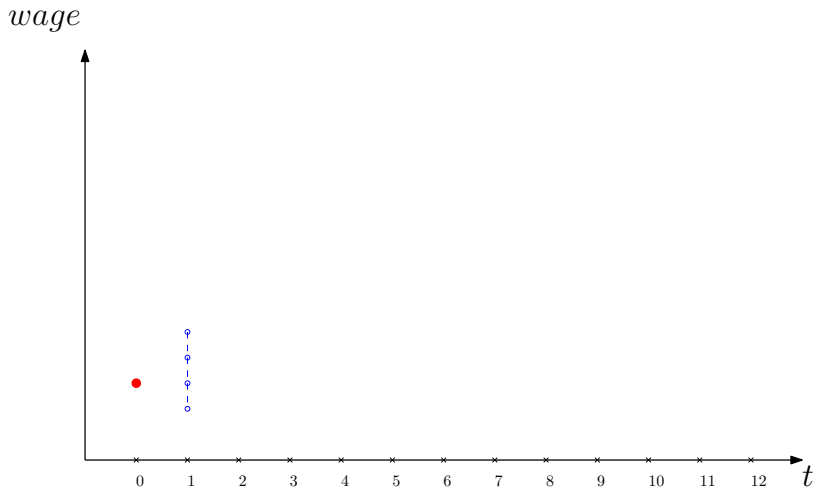An stationary equilibrium is defined by

- 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.
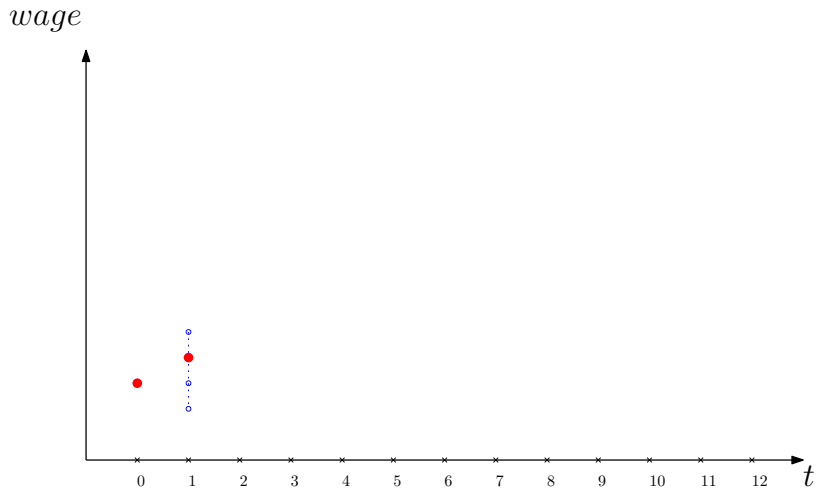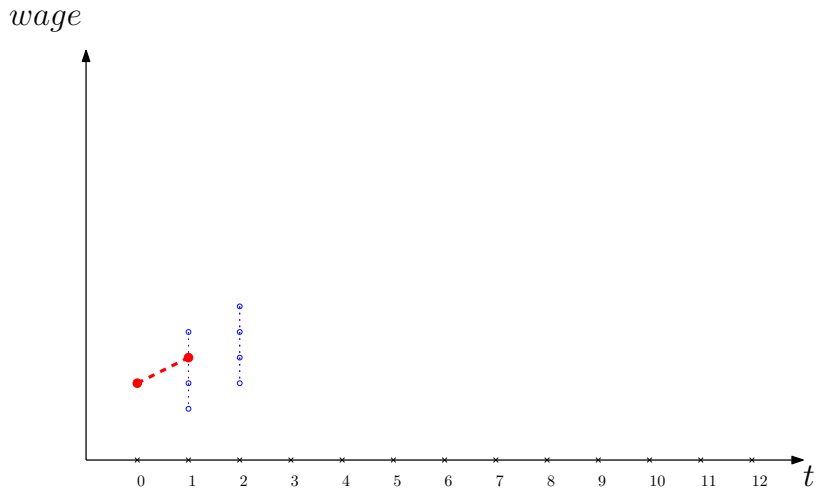
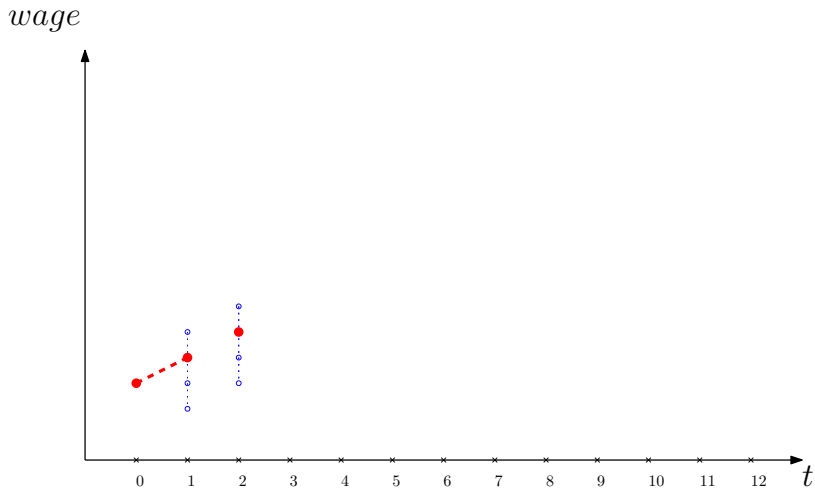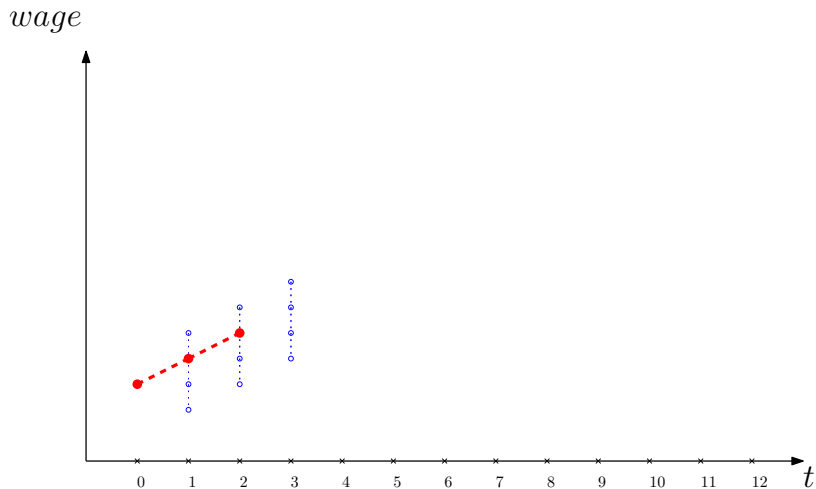# The Optimal Contract
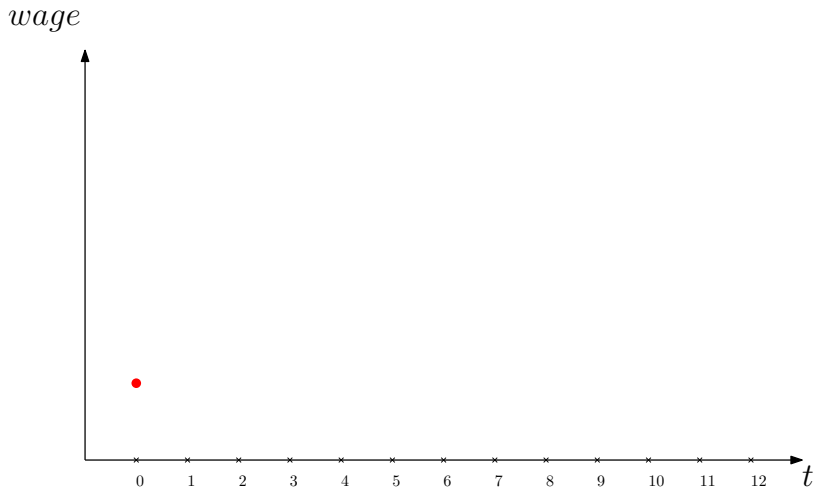
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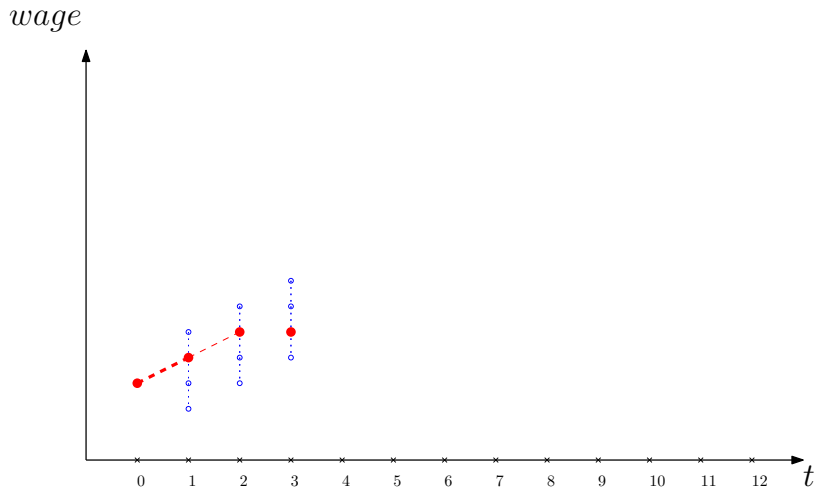# The Optimal Contract

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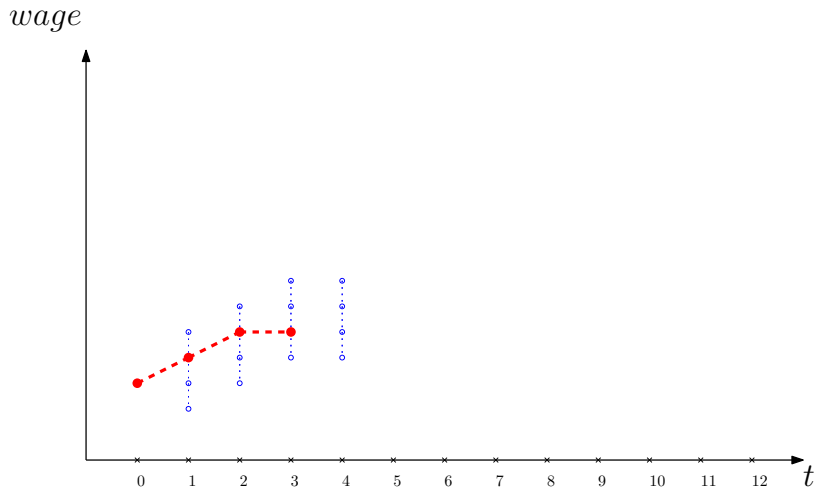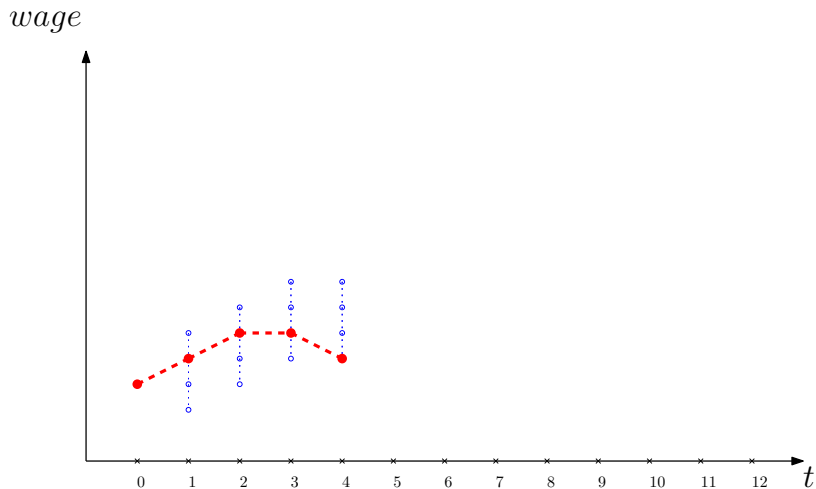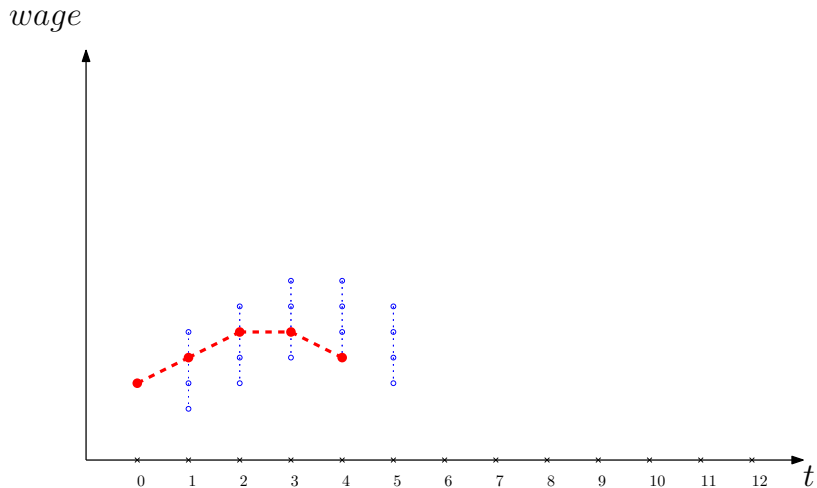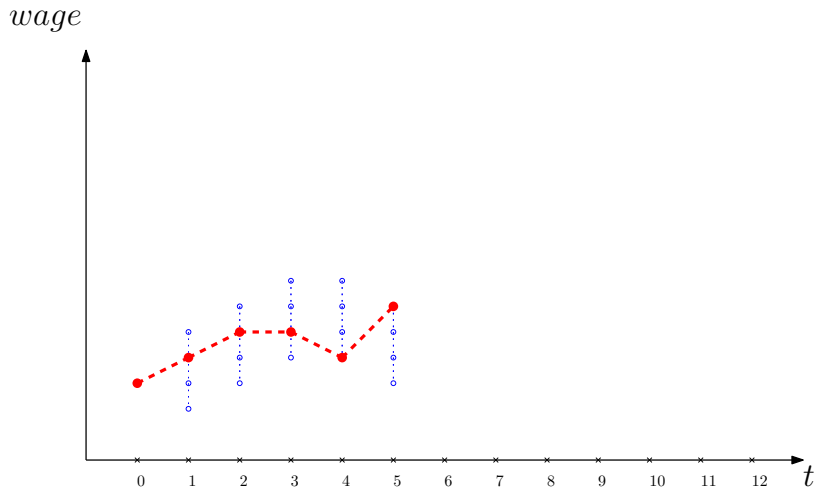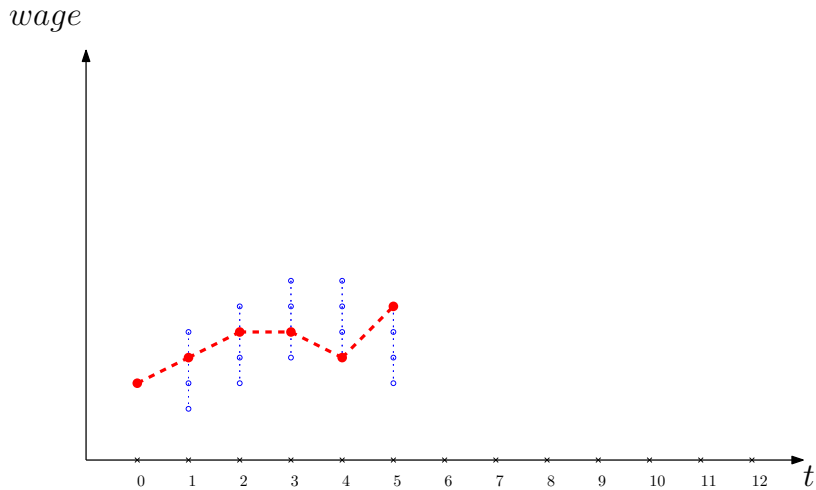induced by sequential auction with outside firm
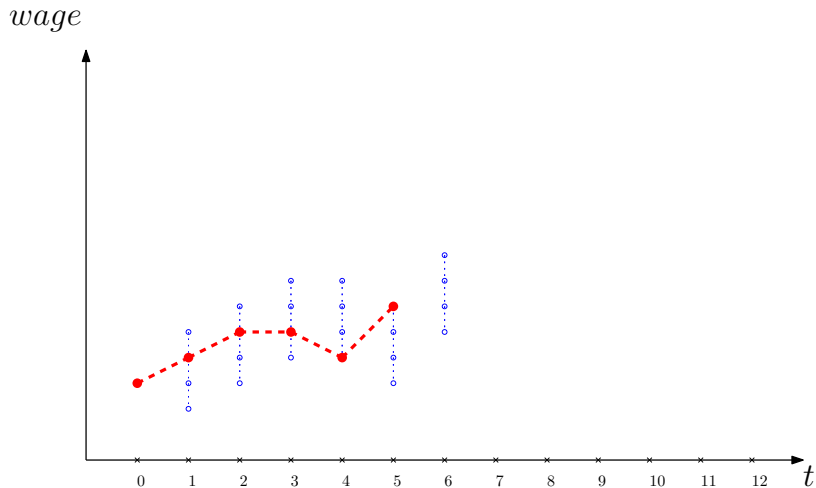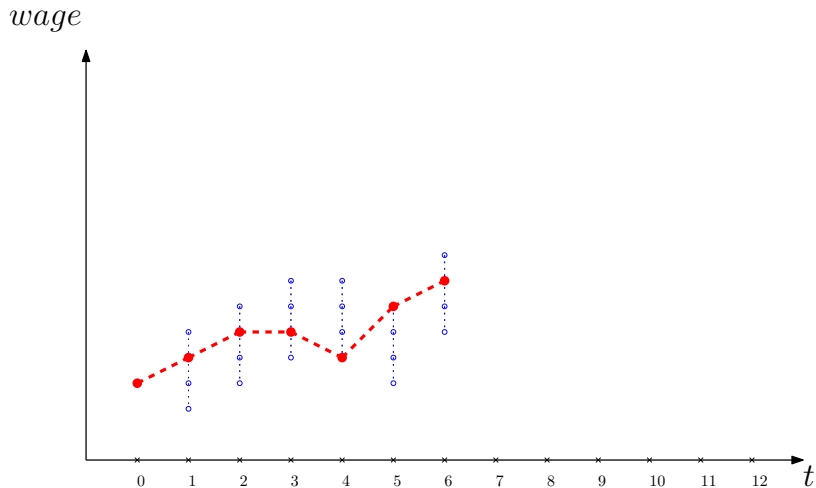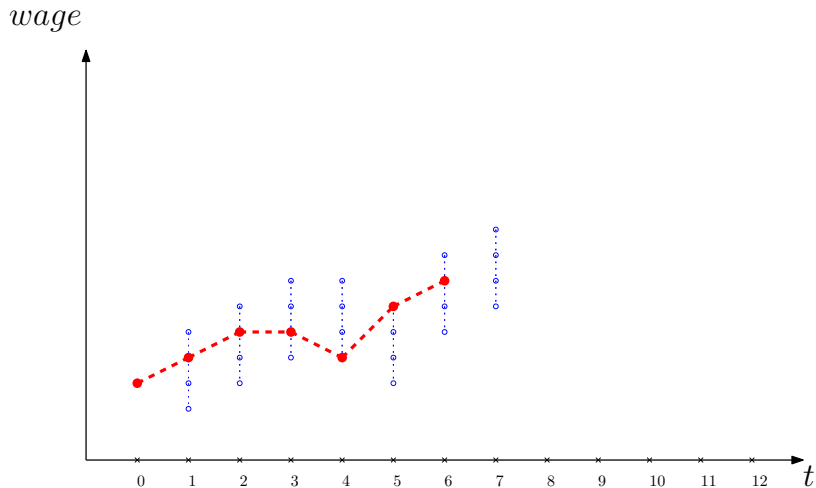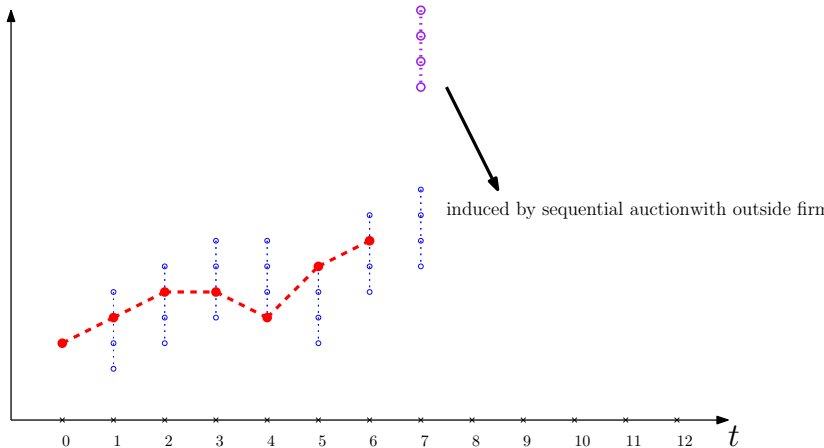
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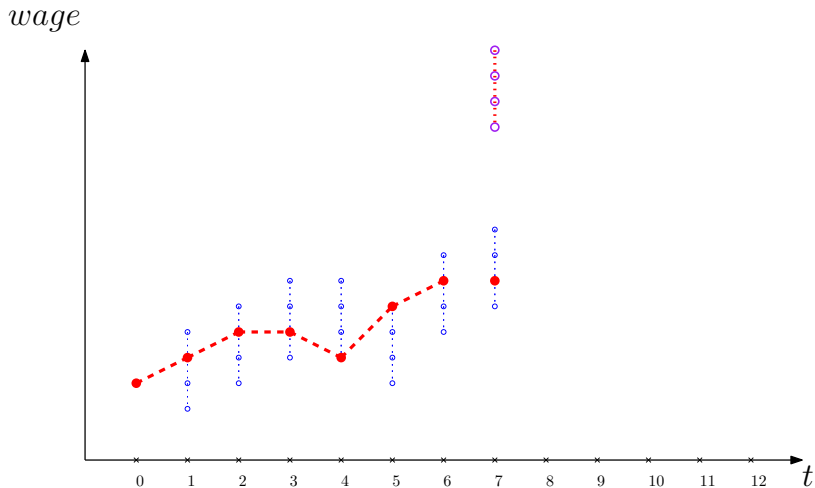
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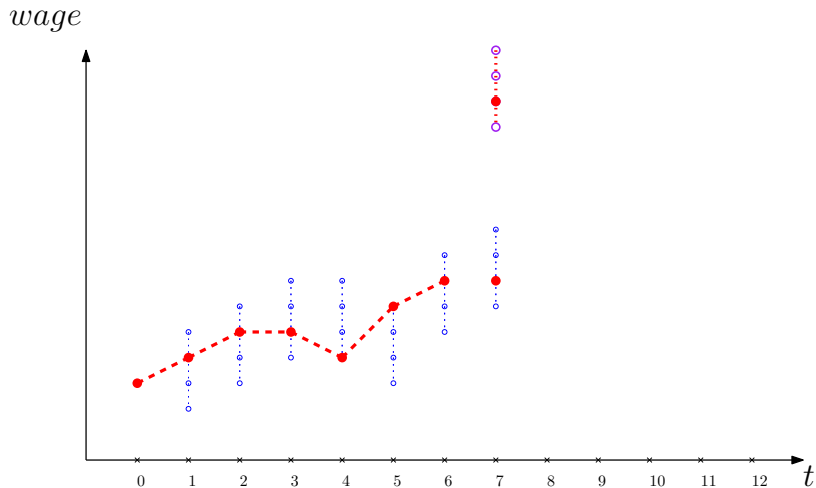
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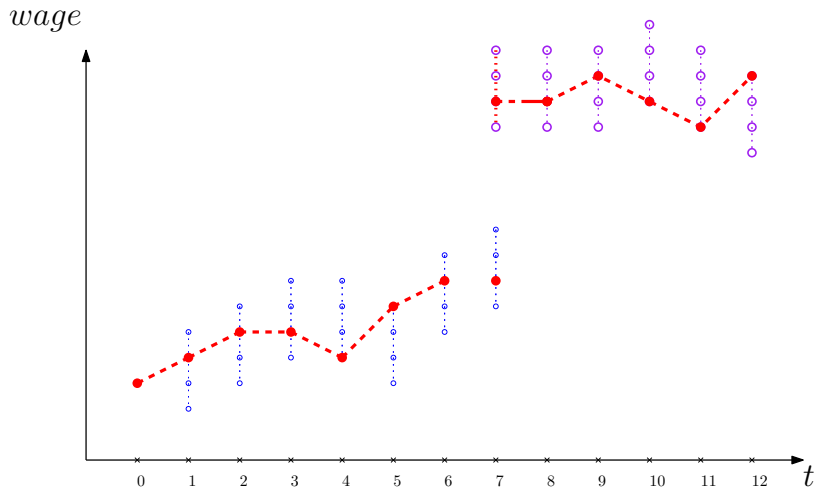
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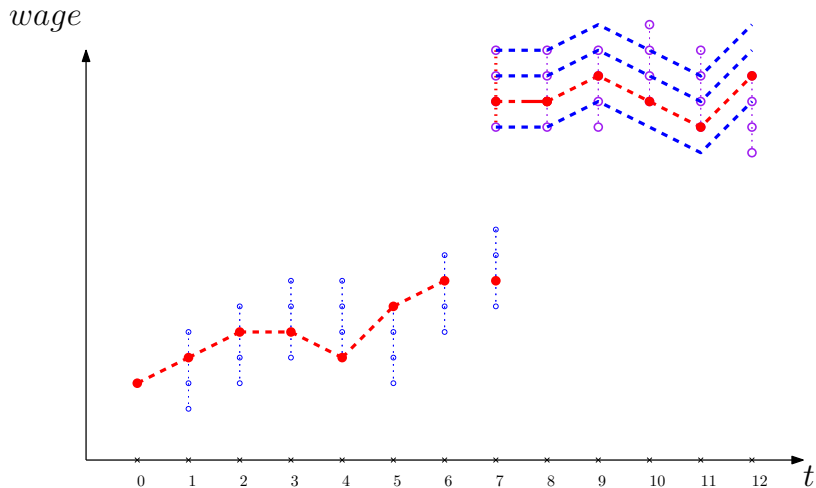
Why does compensation grow faster in larger firms?

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

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

$s(w)$

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

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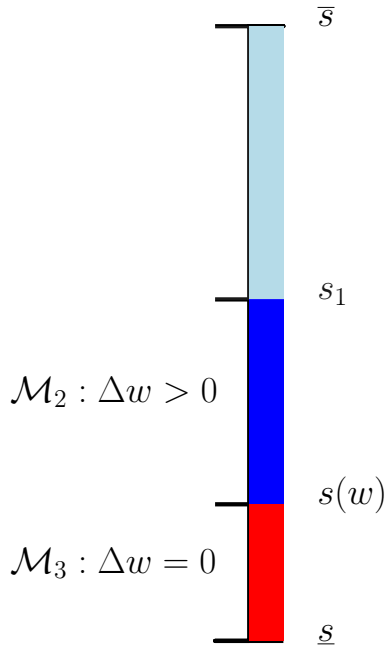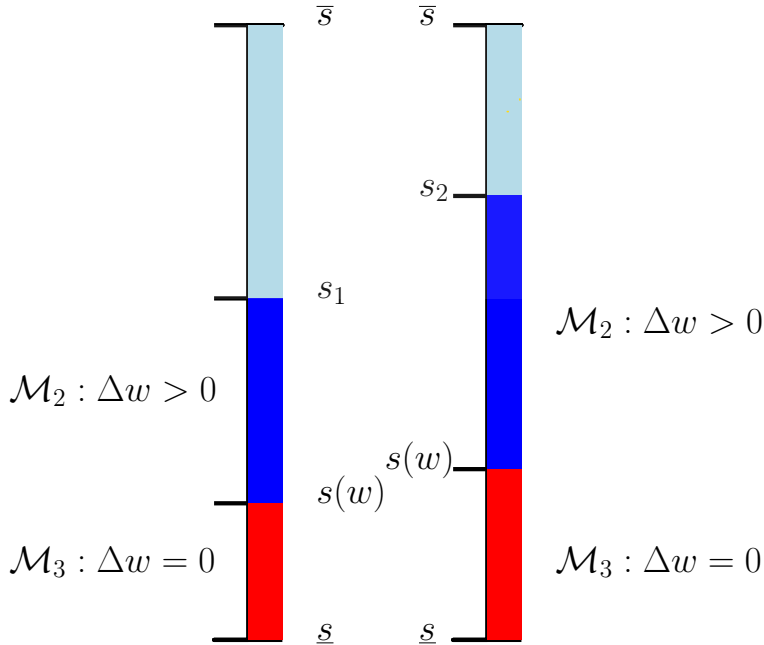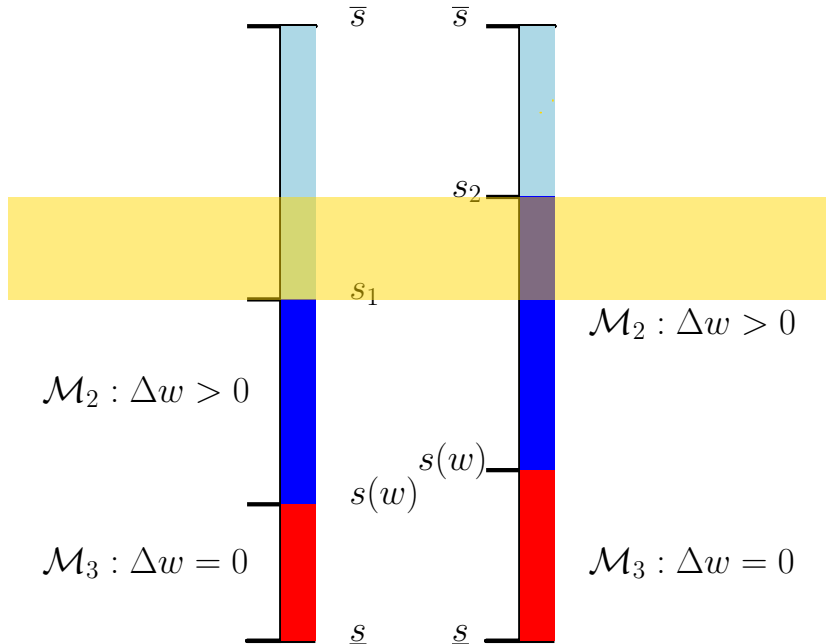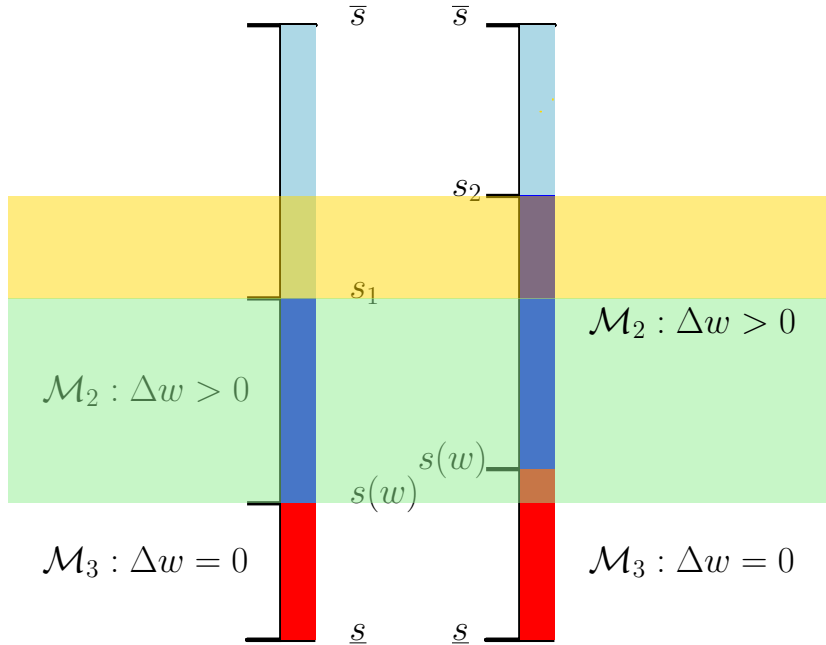
Why do performance-based incentives increase in firm size?

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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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

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

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$s(w)$

$s(w)$

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

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

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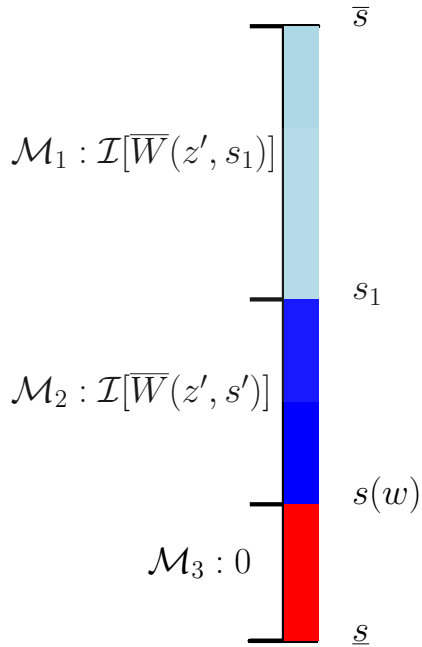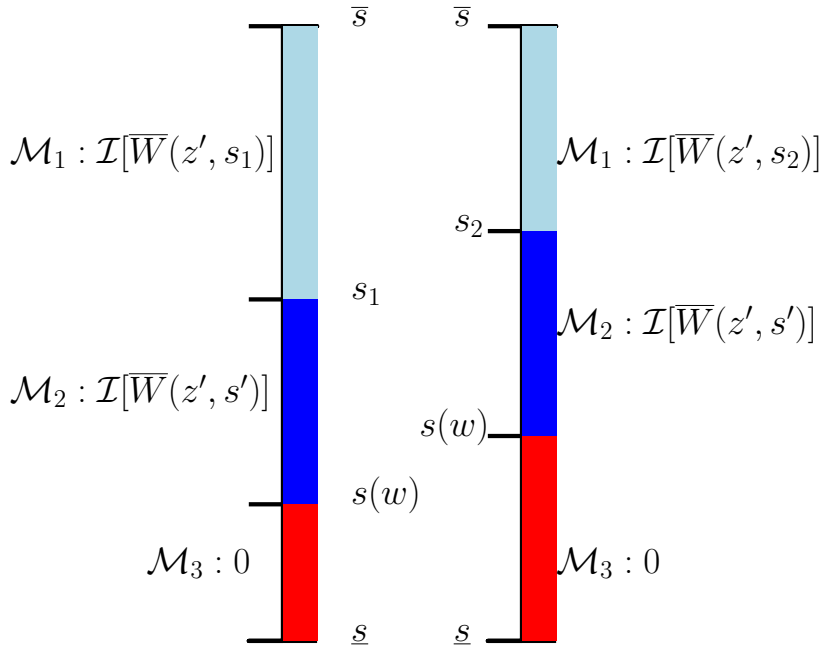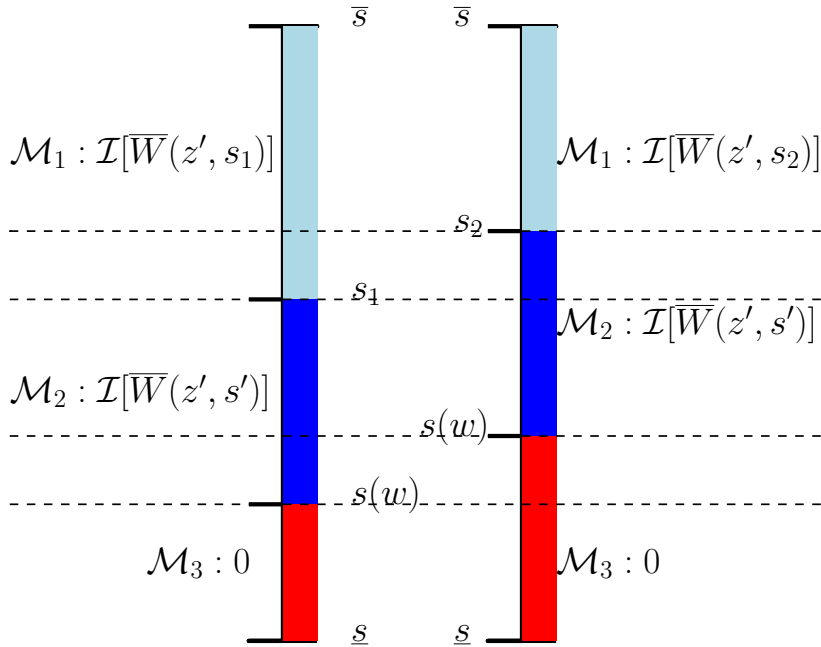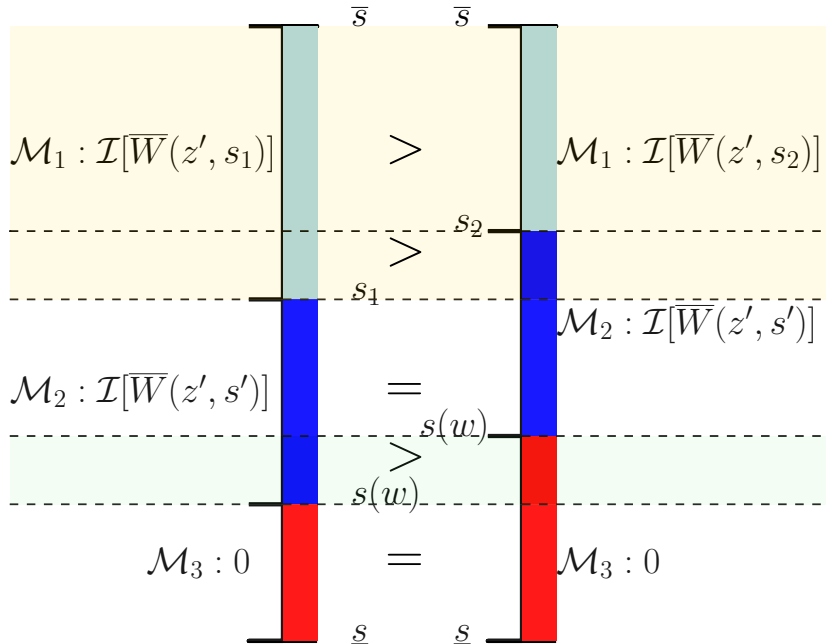
Incentives from $\overline{W}(z', s)$ decrease in s
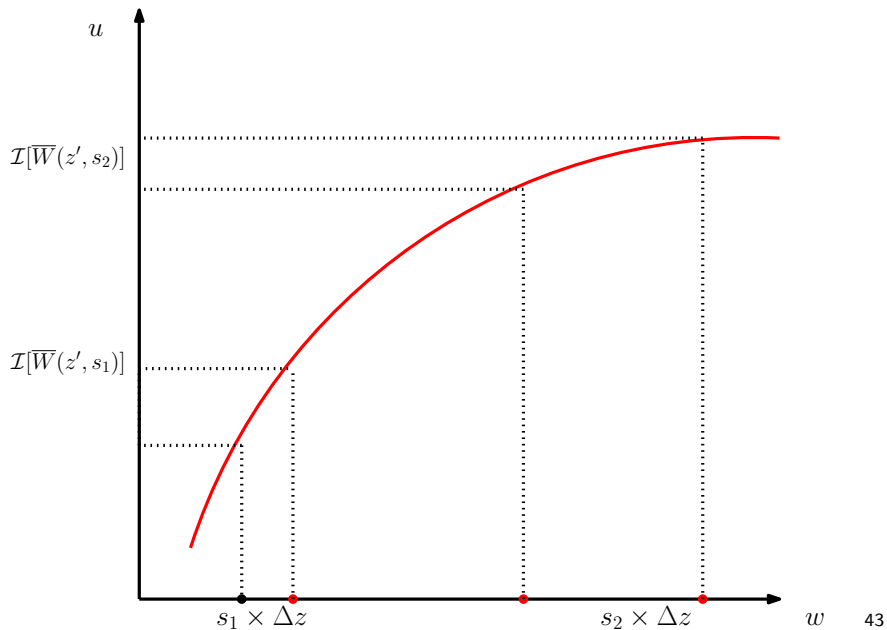
Incentives from $\overline{W}(z', s)$ decrease in s

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 effect

- Spillover effect: more fierce bids 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
- instead of focusing on large firms
- more effective: lower the willingness to bid in small and medium firms
- possible ways (has been proposed or implemented)
  - more independent compensation committee
  - greater mandatory pay (or pay ratio) disclosure
  - say-on-pay legislation, etc.

Spillover effect
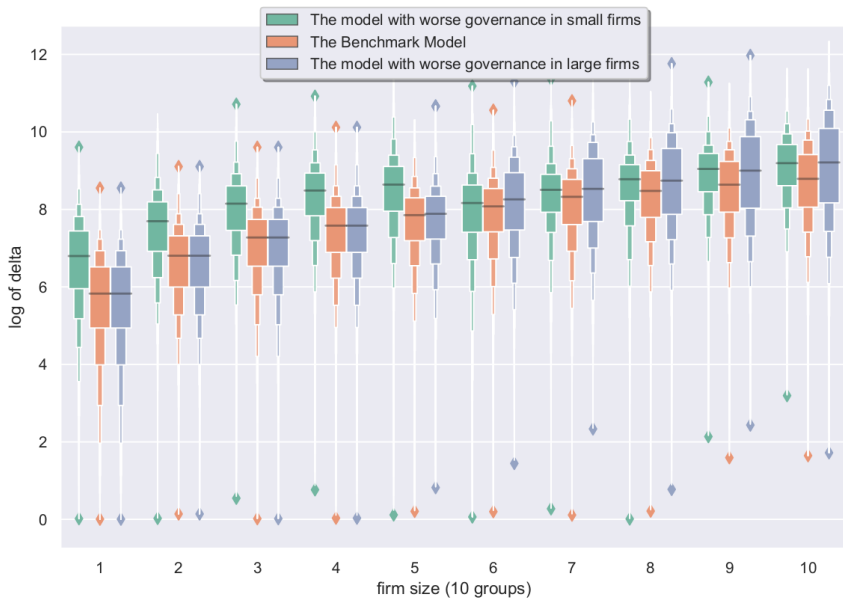
Spillover effect
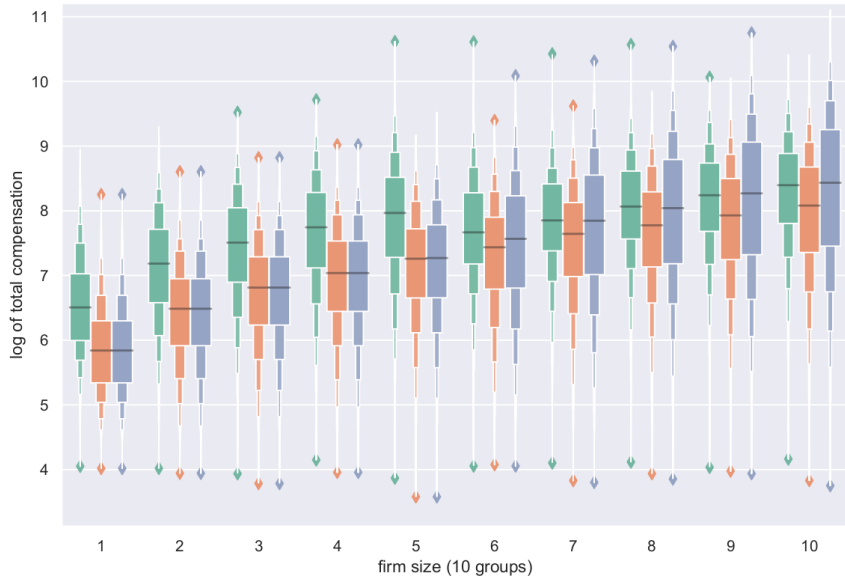
Conclusion

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
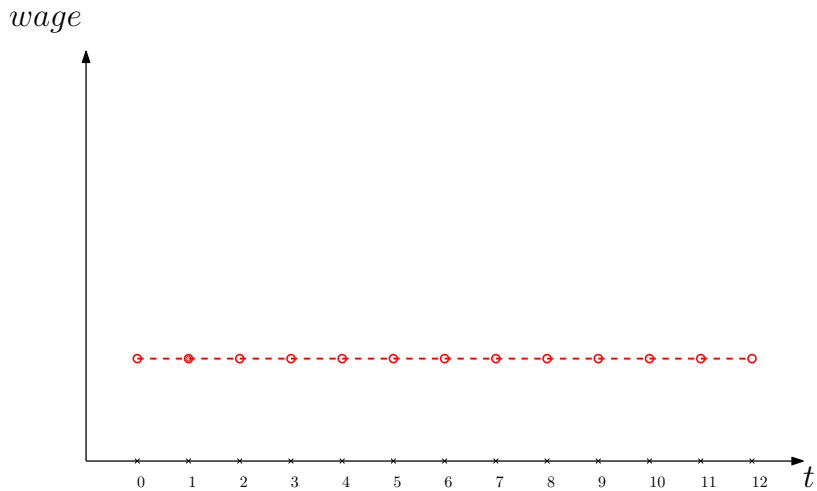
Only Moral Hazard
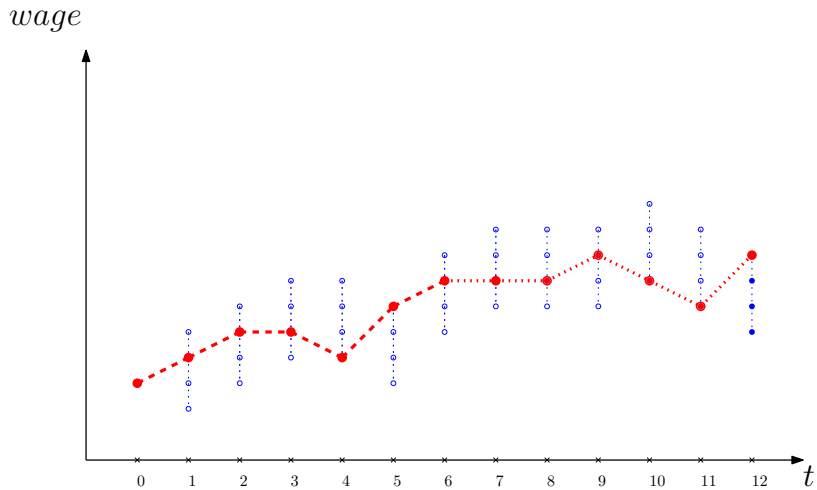
Only Limited Commitment
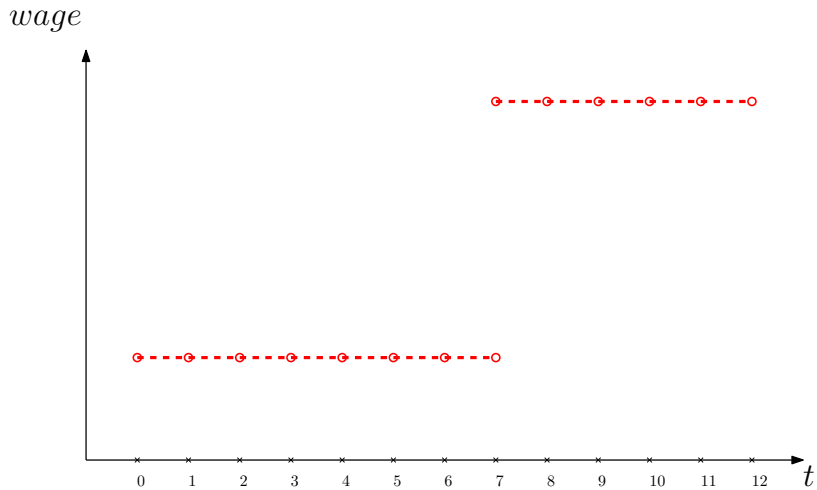
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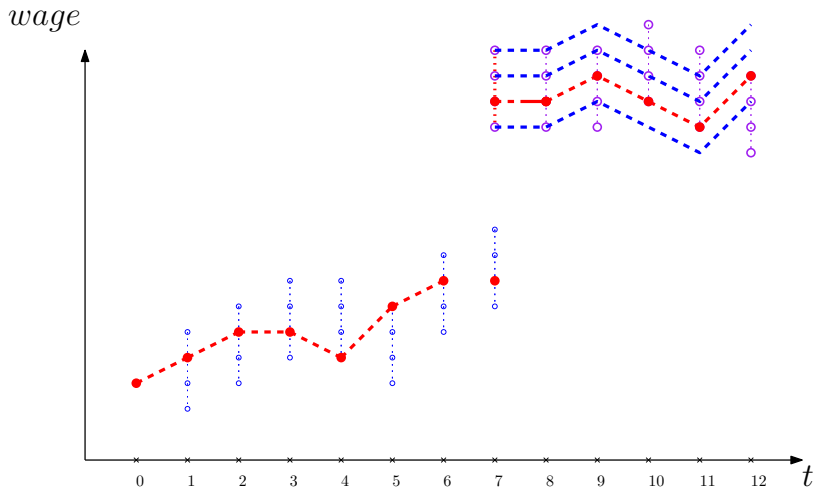
Job-to-job transition rate over age
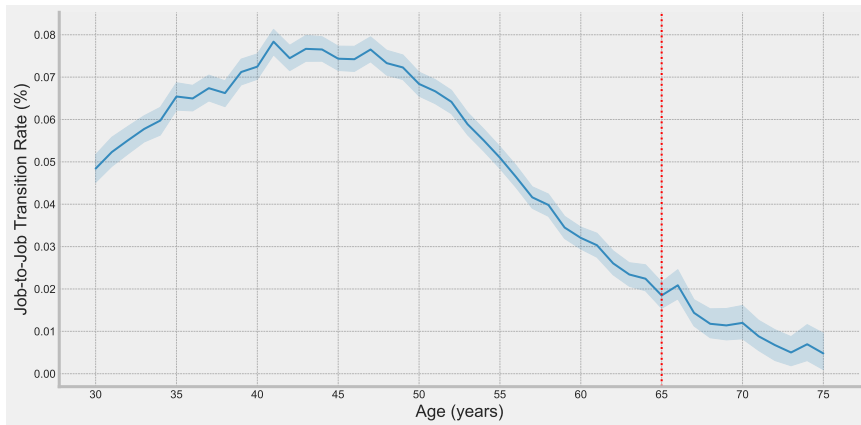
Exit rate over age
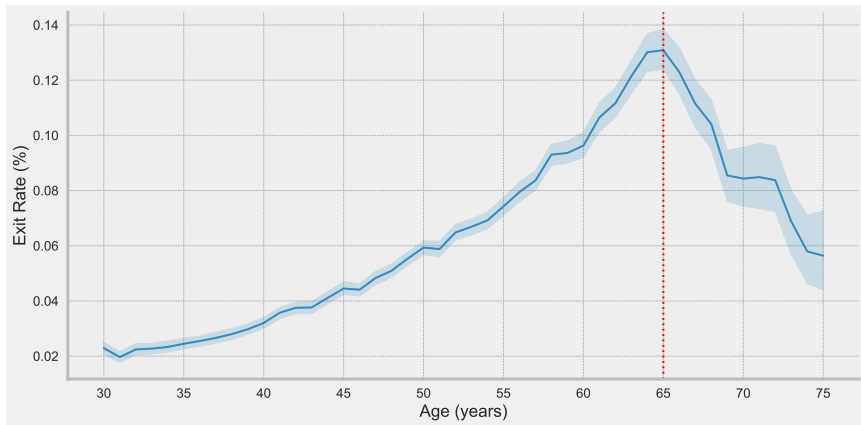
Climb the Job Ladder

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%)

Back

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***	0.347***	0.525***	0.529***	0.561***	0.571***
	(0.0141)	(0.0247)	(0.00512)	(0.00499)	(0.00310)	(0.0139)
$\log(firm\ size)$ $\times\ EE90$			0.359*			
			(0.118)			
$\log(firm\ size)$ $\times\ EE190$				0.415**		
				(0.101)		
$\log(firm\ size)$ $\times\ gai$					0.0648***	
					(0.00156)	
$\log(firm\ size)$ $\times\ inside\ CEO$						-0.000458*
						(0.000202)
$\log(tdc1)$		0.609***	-0.251***	-0.251***	-0.304***	-0.253***
		(0.0350)	(0.00173)	(0.00173)	(0.00267)	(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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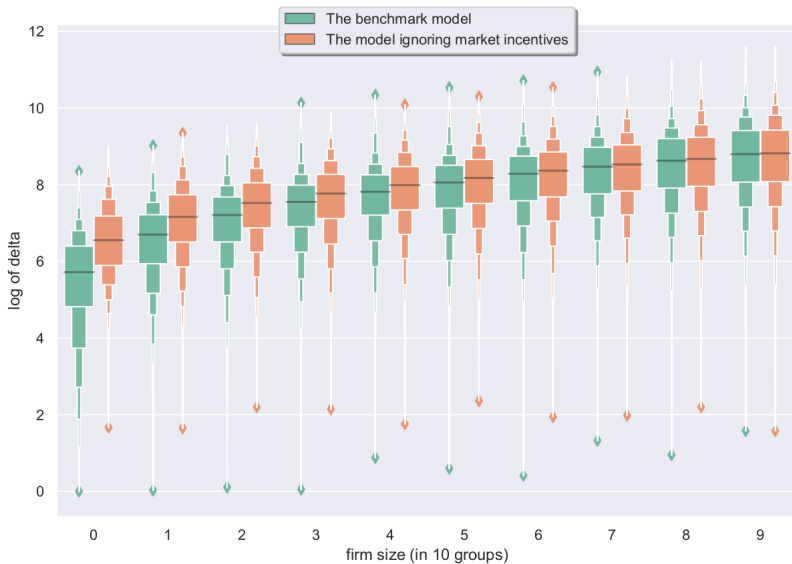
CEO's of "Small Firms" in S&P 500

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+----------------------------------------------------------------+
 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
+----------------------------------------------------------------+
  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   121238.6   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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