Managerial Labor Market Competition and Incentive Contracts

Job Market Talk at HEC Paris

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Introduction

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- Labor market competition gives total pay increases with firm size.

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- Firm Size Incentive Premium and Managerial Labor Market:
  Incentive premium is higher in industries where the managerial labor market is more active.

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- Firm Size Incentive Premium and Managerial Labor Market:
  Incentive premium is higher in industries where the managerial labor market is more active.

What I provide:

- An explanation based on the executive job ladder.

Introduction — motivating facts

Data: U.S. S&P 1500 companies, 1992 - 2016

Key variables:

- `firm size` by market capitalization
- `performance-based incentives` by `PPS`, *pay-for-performance sensitivity*

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

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Size incentive premium:

- Controlling for total compensation, year $\times$ industry dummies, etc.

$$\texttt{Corr(PPS, firm size) > 0}.$$

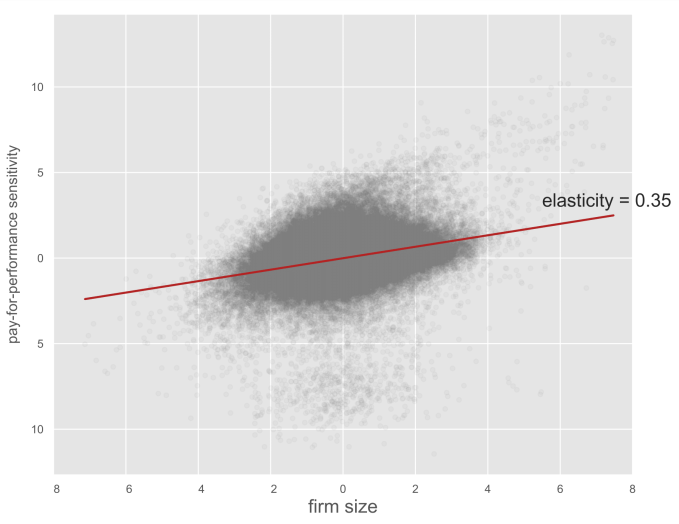

Figure 1: PPS increases in firm size (size incentive premium)

Scatter and linear fit of log(PPS) on log(Mktcap), based on S&P 1500 firms from 1992 to 2016.

	log(PPS)				
	(1)	(2)	(3)	(4)	(5)
log(firm size)	0.585*** (0.0141)	0.347*** (0.0247)	0.316*** (0.0029)	0.325*** (0.0036)	0.316*** (0.0029)
log(firm size) × J-J rate			0.716** (0.1054)		
log(firm size) × GAI				0.055*** (0.0112)	
log(firm size) × inside-CEO-%					-0.087*** (0.0196)
log(total pay)		0.609*** (0.0350)	0.692*** (0.0046)	0.0687*** (0.0056)	0.684*** (0.0046)
tenure, age, year	X	X	X	X	X
other controls	X	X	X	X	X
industry	X	X			
year × industry	X	X			
Obs.	146,747	128,006	128,006	79,476	128,006
adj. R^2	0.442	0.482	0.487	0.482	0.485

Introduction — model intuition

Model:

- dynamic moral hazard + job ladder

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Basic idea:

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What are labor market incentives?

- on-the-job executives can be poached by outside firms

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- on-the-job executives can be poached by outside firms
- labor market incentives: effort $\leftarrow$ productivity $\leftarrow$ poaching offer

Introduction — model intuition, cont'd

Key assumption (Gabaix and Landier, 2008):

- $\texttt{cash flow} = \texttt{firm size} \times \texttt{executive productivity}$
- larger firms can always outbid smaller ones
- the job ladder towards larger firms

Introduction — model intuition, cont'd

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- `cash flow` $=$ `firm size` $\times$ `executive productivity`
- larger firms can always outbid smaller ones
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Labor market incentives decrease in firm size

- job ladder effect — position on the ladder
- wealth effect — wealthier executives are harder to incentivize

Introduction — contributions

This paper

1. documents the firm size incentive premium

2. develops a dynamic equilibrium framework to explain the premium

3. explains the significant increase in executive compensation since the mid 1970s (Frydman and Saks 2010)

Related Literature

- Assignment models:
  - Tervio (2008), Gabaix and Landier (2008), Edmans et al. (2009), etc.
  - My paper adds dynamics and search frictions.
- Moral hazard models
  - Gayle and Miller (2009), Gayle et al. (2015)
  - My paper features a job ladder towards larger firms.

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- Dynamic contract literature
    - moral hazard: Spear and Srivastava (1987), etc.
    - limited commitment: Thomas Worrall (1988, 1990), etc.
- Labor search literature
    - sequential auction: Postel-Vinay and Robin (2002), etc.

Road Map

1. Model
2. Data & evidence
3. Structural estimation
4. Explain the pattern since the mid 1970s

The Model

Set Up: Moral Hazard

Discrete time and infinite periods

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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 discrete Markov Chain process

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

- die with $\eta \in (0, 1)$, 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 $F(s')$

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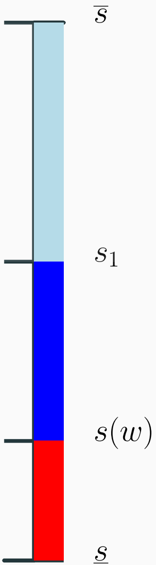
Bertrand Competition:

- current firm s versus outside firm s'
- each has a bidding frontier, $\overline{W}(z, s)$, defined by

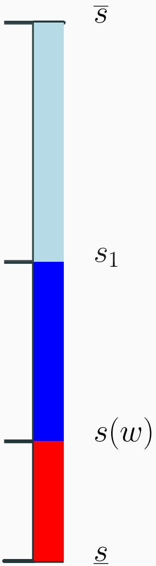
$$\Pi\Big(z, s, \overline{W}(z, s)\Big) = 0$$

- $\overline{W}(z, s)$ increases in z and s

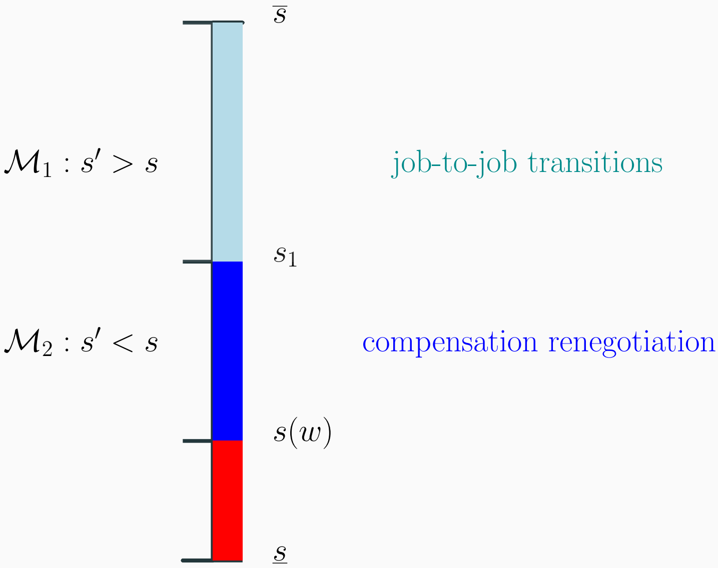


$\overline{s}$
s_1
$s(w)$
$\underline{s}$

$\mathcal{M}_1 : s' > s$



job-to-job transitions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s_1
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compensation renegotiation
$s(w)$
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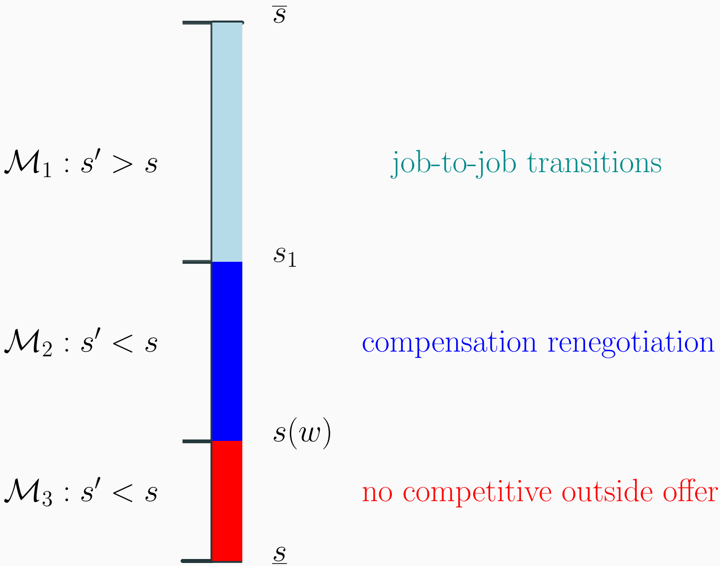
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compensation renegotiation
$s(w)$
$\mathcal{M}_3 : s' < s$
no competitive outside offer
$\underline{s}$

Contracting Problem

Firms maximize profits by choosing

- current period compensation w
- state-contingent continuation value $W(z', s')$

subject to

$$\textit{Promise-keeping Constraint}, \tag{PKC}$$

$$\textit{Incentive Compatibility Constraint}, \tag{IC}$$

$$\textit{Participation Constraint of executive}, \tag{PC-Executive}$$

$$\textit{Participation Constraint of firm}, \tag{PC-Firm}$$

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&W(z', s') \leq \overline{W}(z', s), && \text{(PC-Firm)}
\end{aligned}
$$

Details

The Equilibrium

A 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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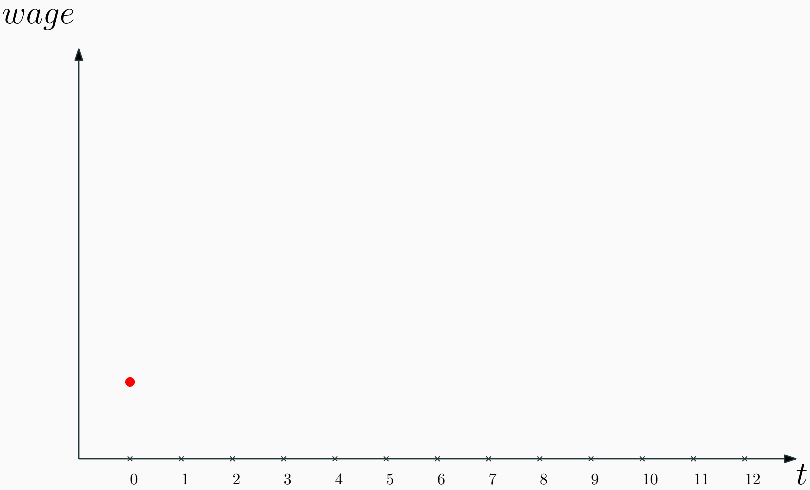

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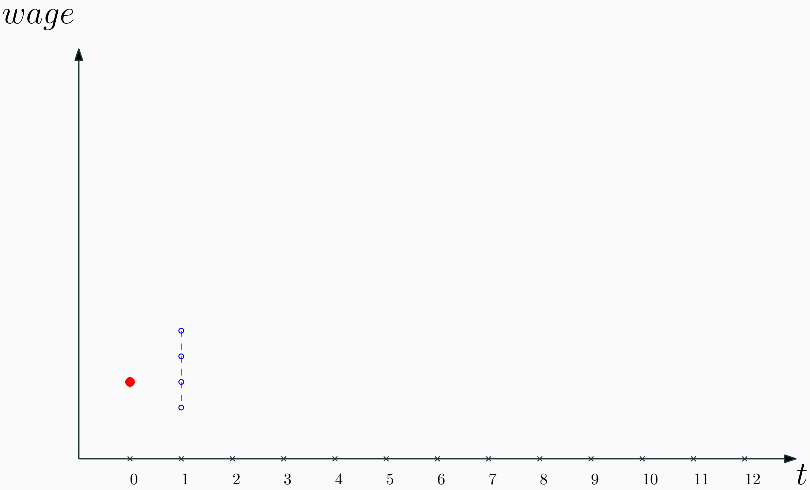

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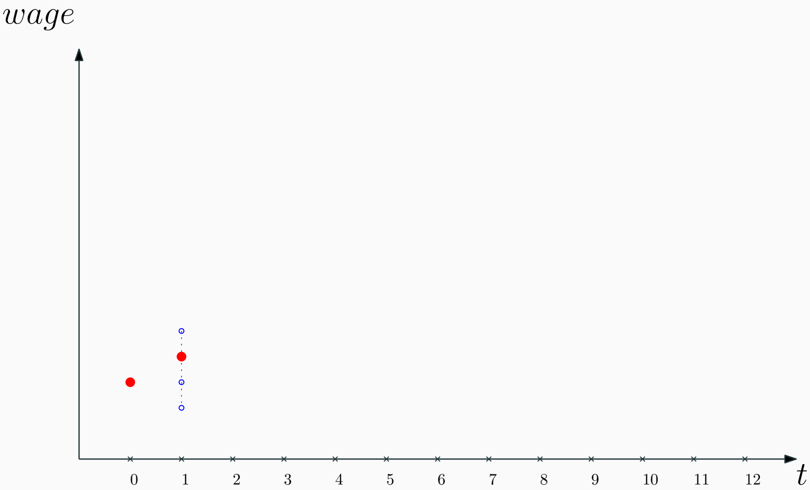

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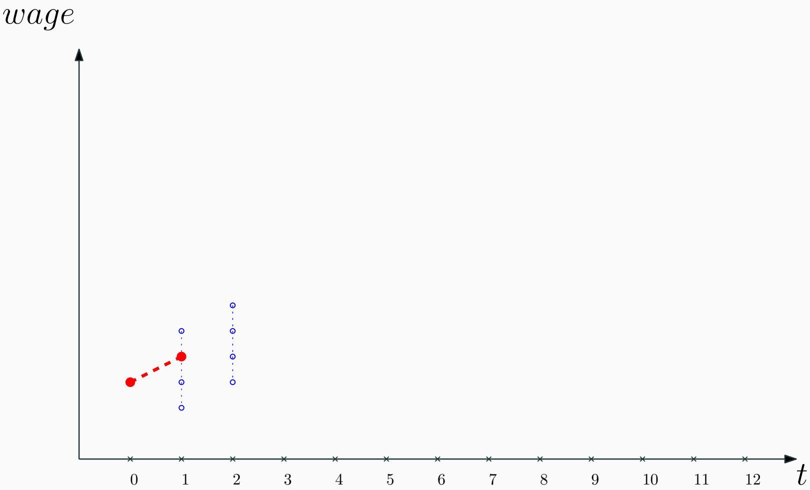

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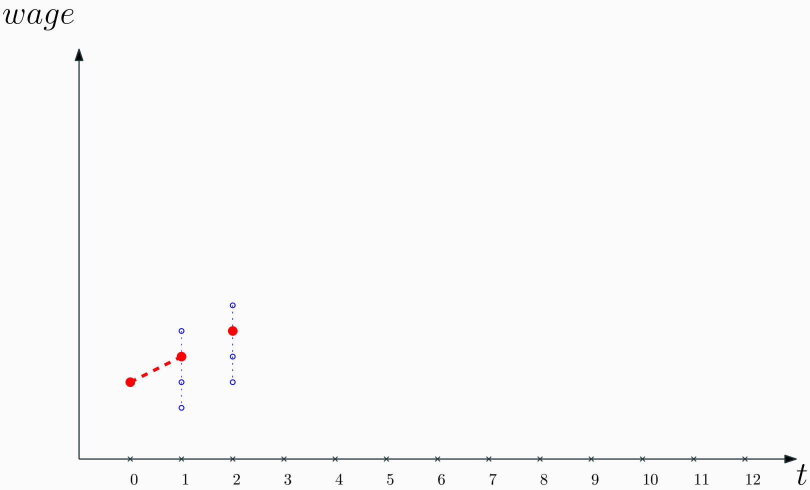

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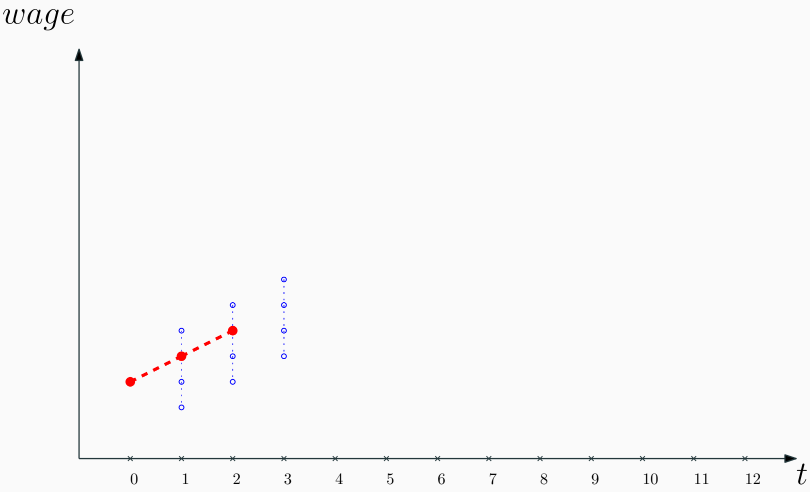

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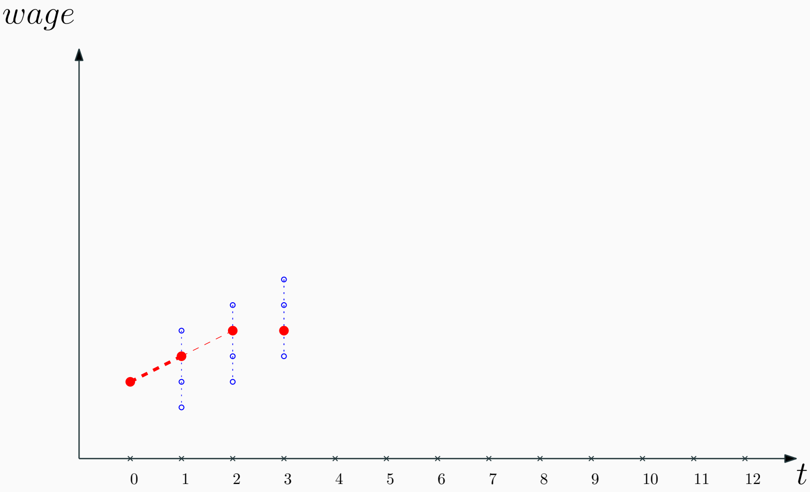

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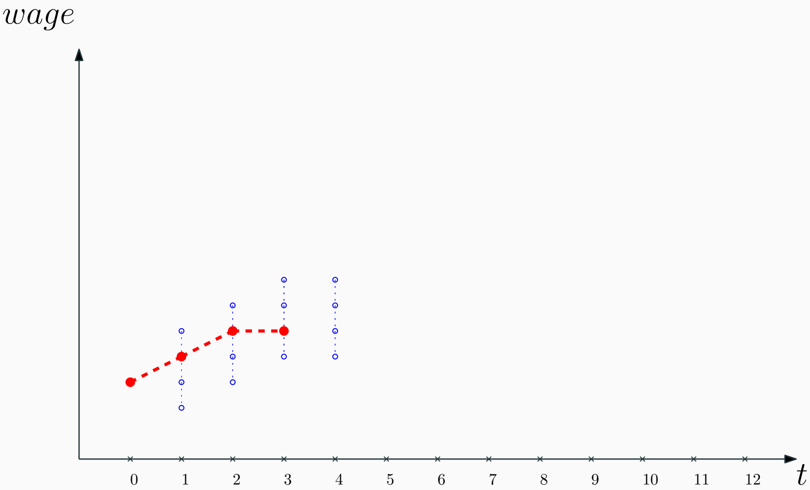

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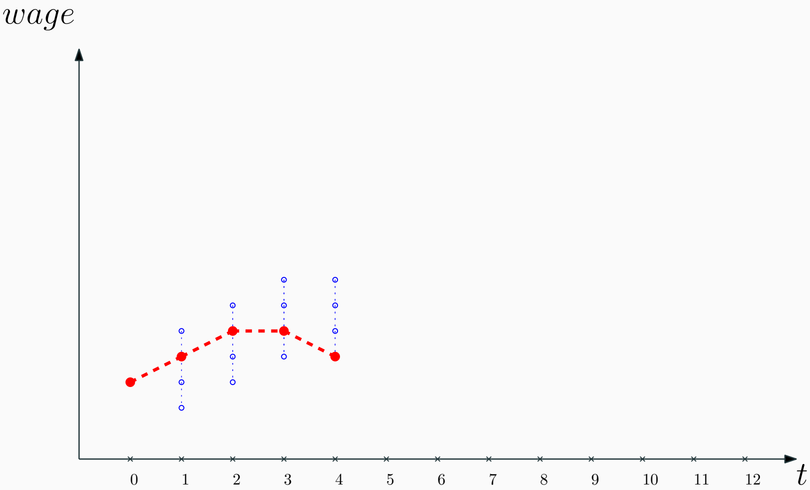

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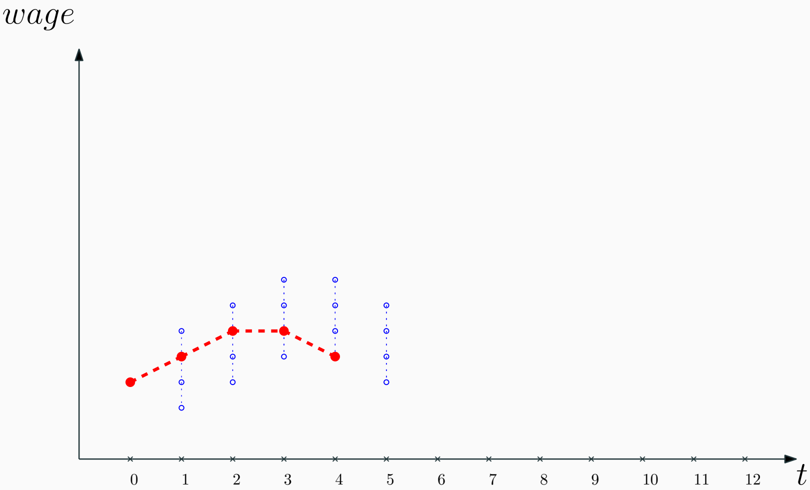

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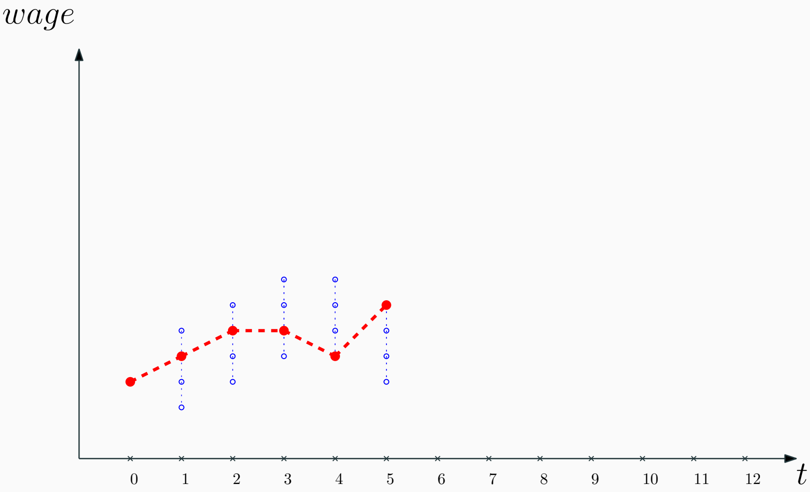

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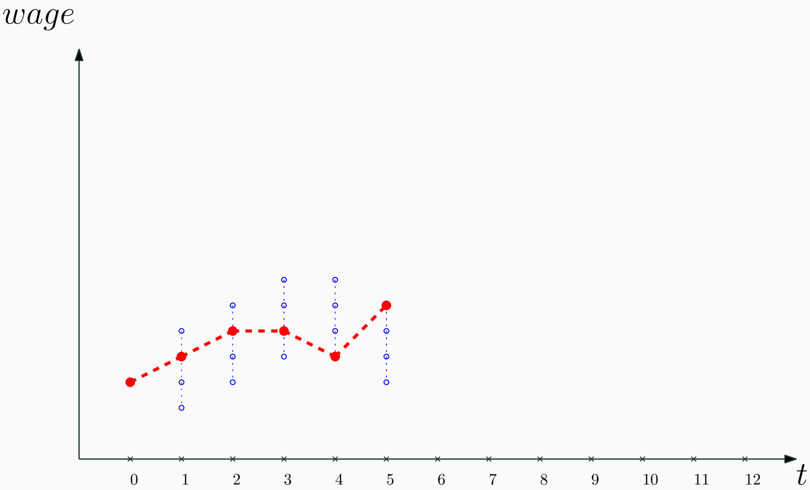

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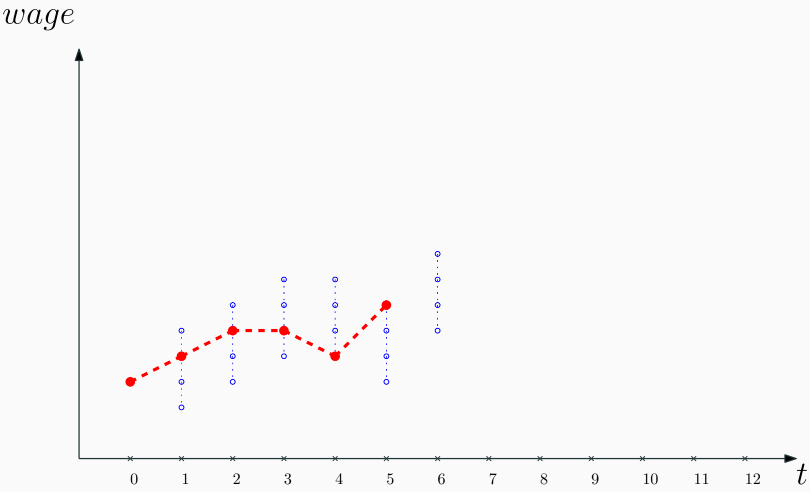

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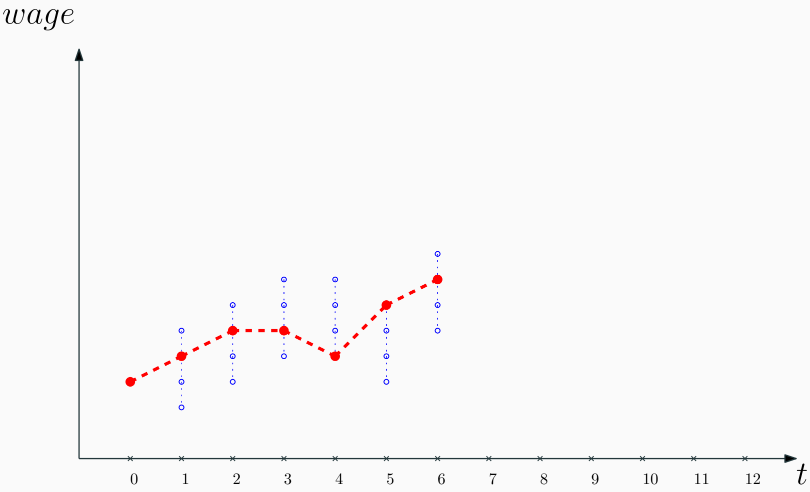

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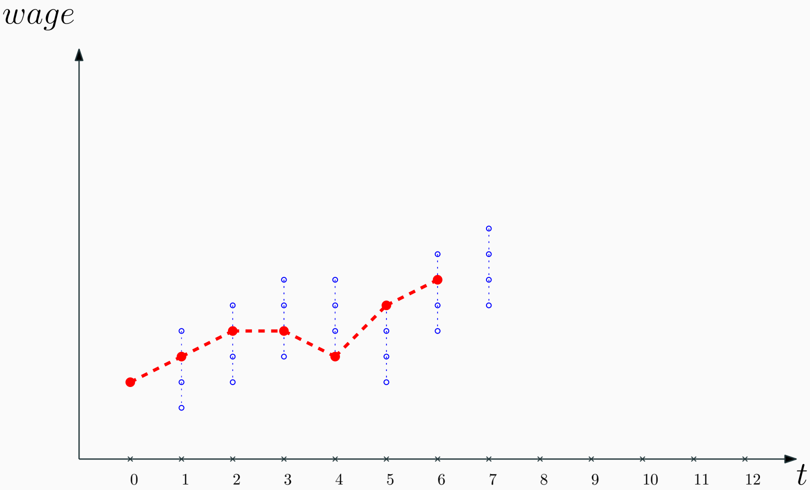

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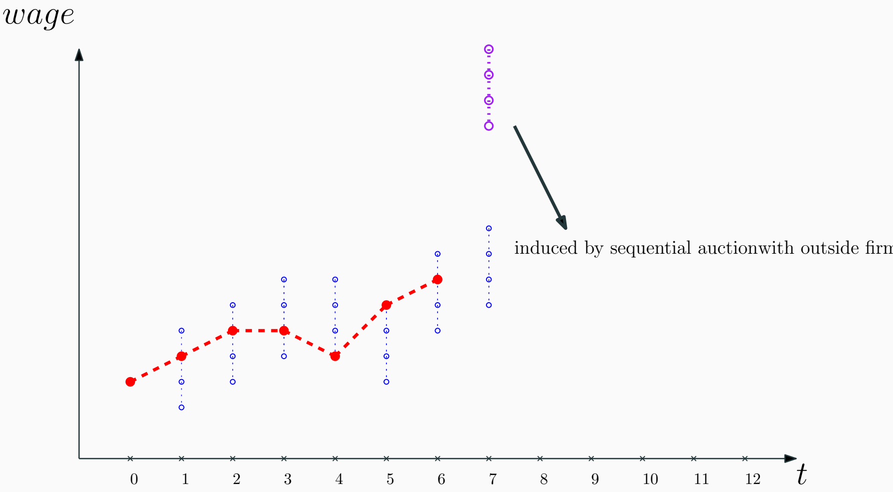

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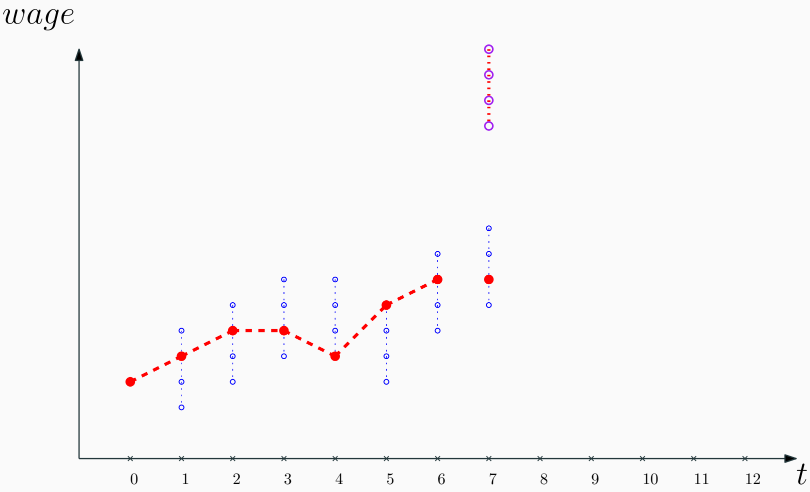

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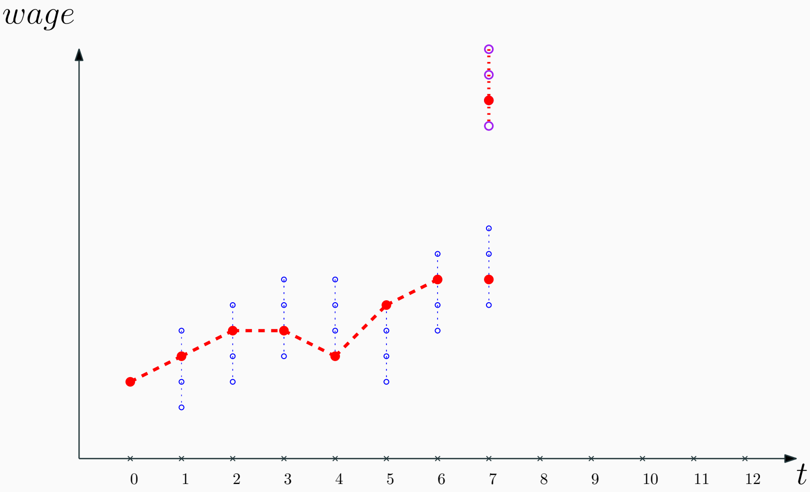

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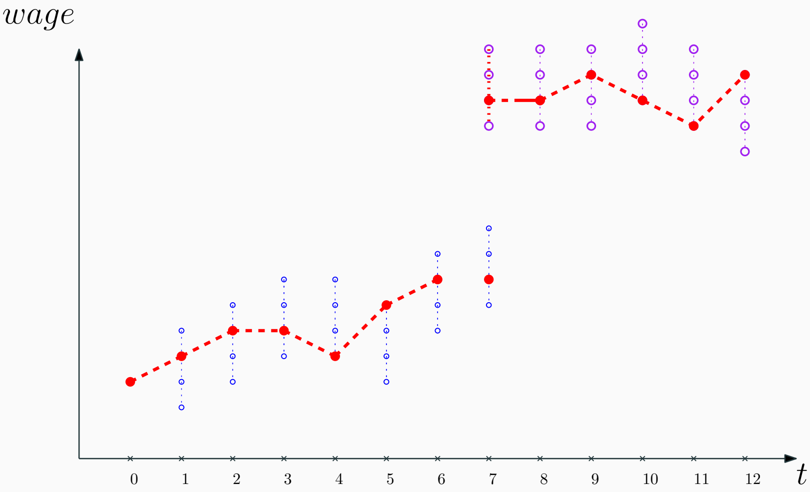

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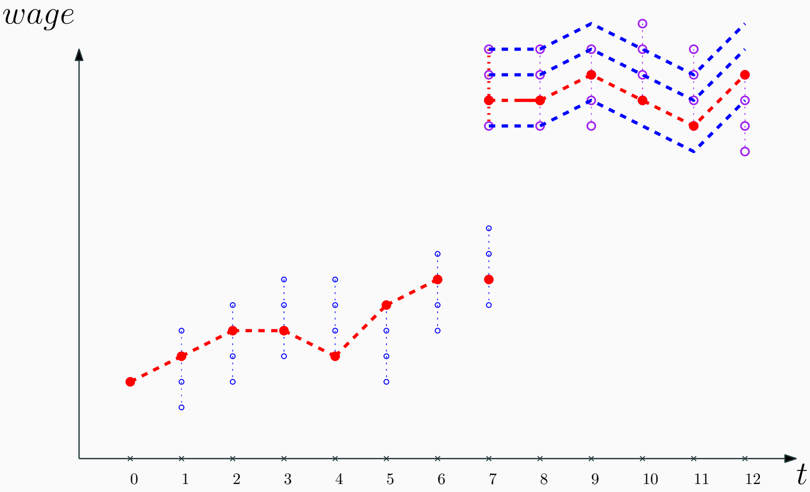

Size incentive premium

Labor market incentives

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

$$\mathcal{I}[W(z')] \equiv \mathbb{E}_{z'}\Big[W(z')|e=1\Big] - \mathbb{E}_{z'}\Big[W(z')|e=0\Big].$$

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The incentive compatibility constraint is

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

where

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

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

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

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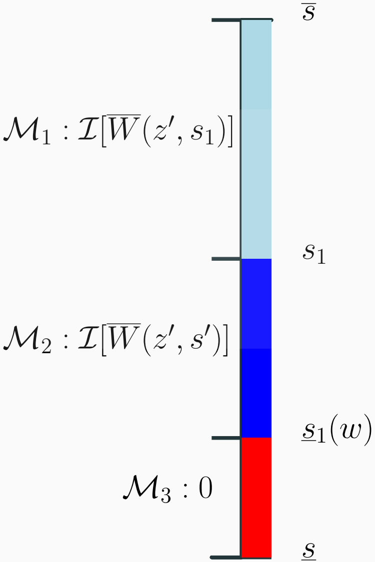

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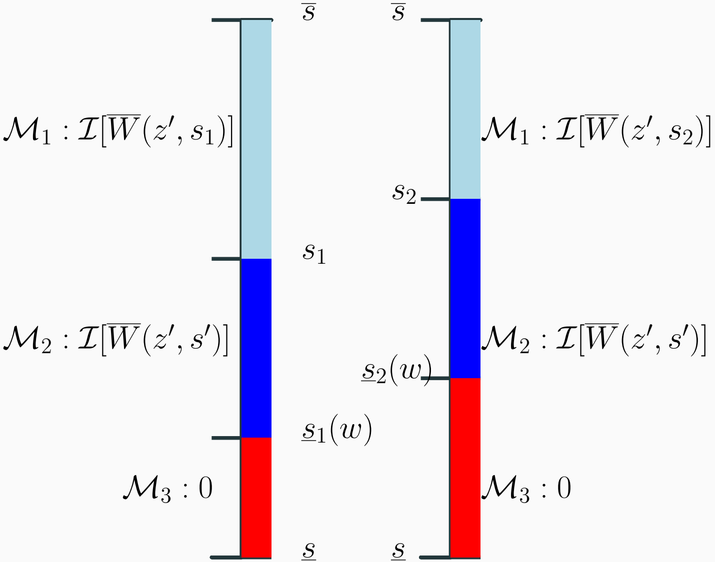

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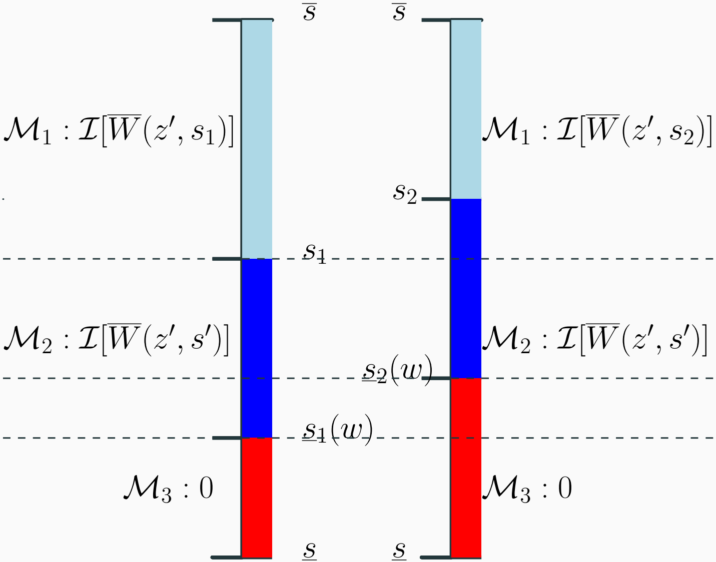

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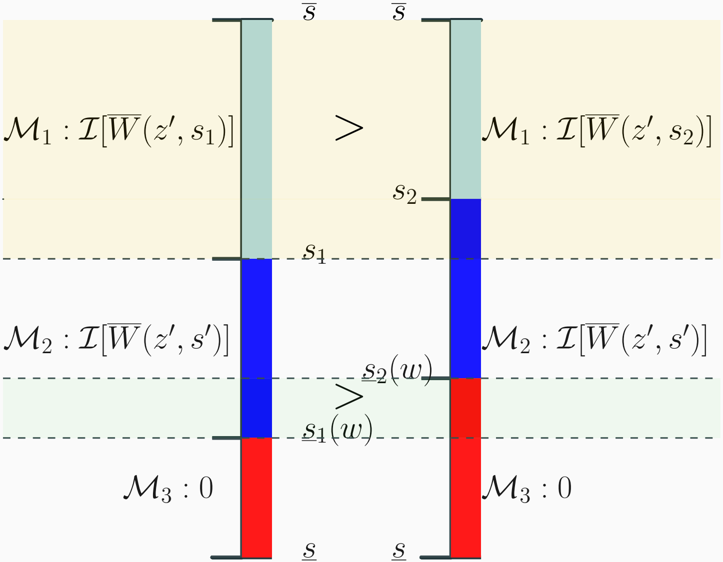

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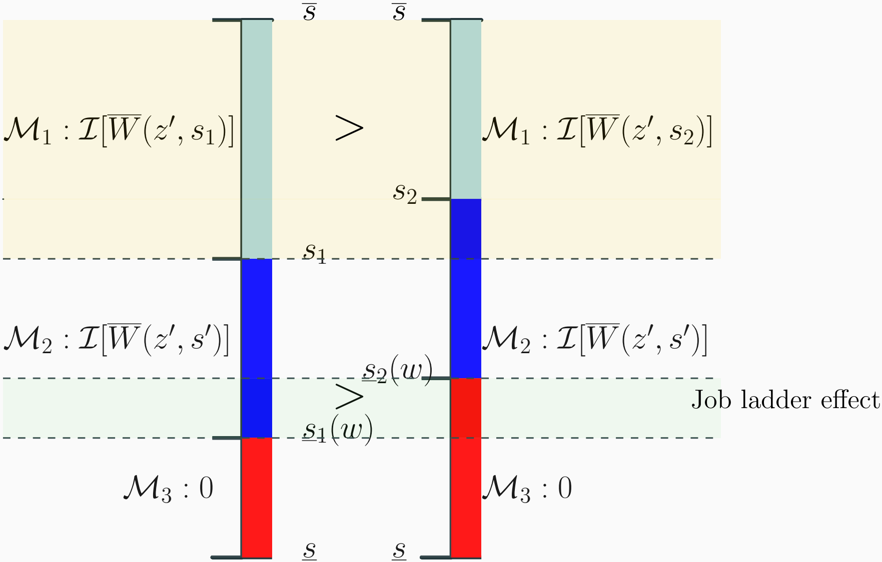
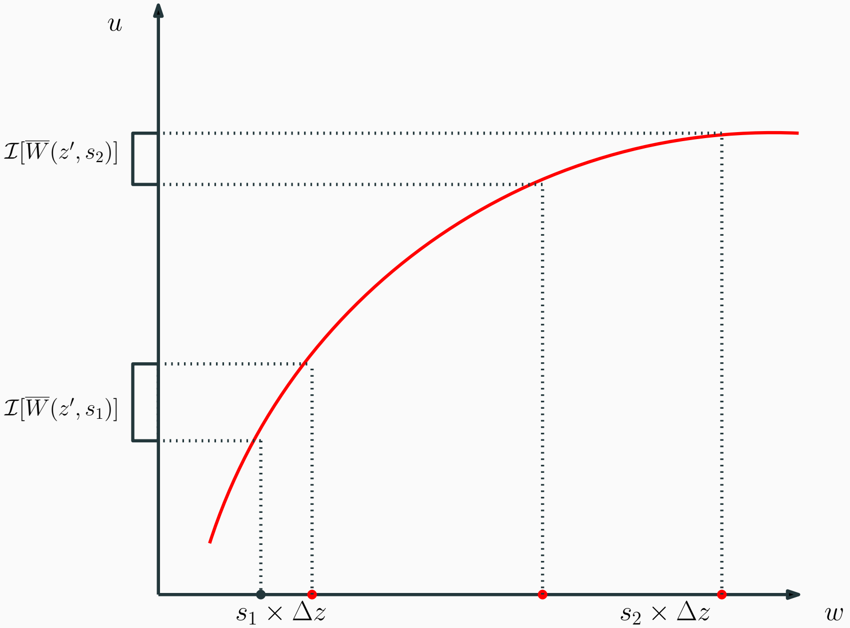


Incentives from $\overline{W}(z', s)$ decrease in s



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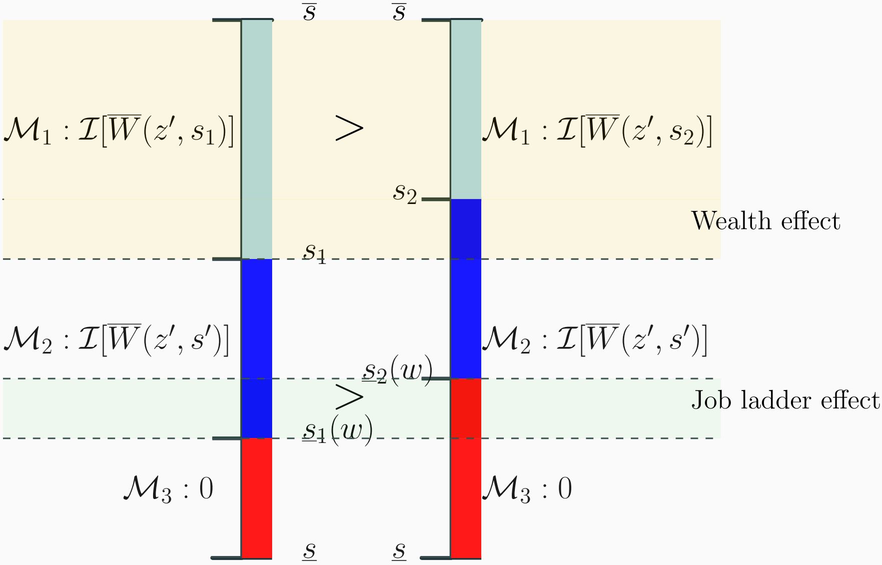

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Proposition

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

Summary

- Firms compete to retain/attract executives.
- Firm size matters.
- Labor market incentives decrease in firm size due to a job ladder effect and a wealth effect.

Data and Evidence

Data

Assemble a new dataset

- ExecuComp & BoardEX + hand-collected from LinkedIn/Bloomberg
- 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 n? days.
- Exit: otherwise.

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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
   - annual job-to-job transition rate 5%
   - relatively stable over years and across industries
2. Executives climb job ladders towards larger firms. Details
   - about 66% of job-to-job transitions are towards larger firms
   - for the rest, 20% of them are promotions from non-CEO to CEO

Reduced-form evidence

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

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

4. Starting from the same level of compensation, the pay-growth is higher in larger firms. Details

   - 1% increase in firm size leads to 10% increase in pay-growth rate

Estimation

Model Specifications

- utility function of CRRA form

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

- production function of multiplicative form

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

- 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 $F(s)$

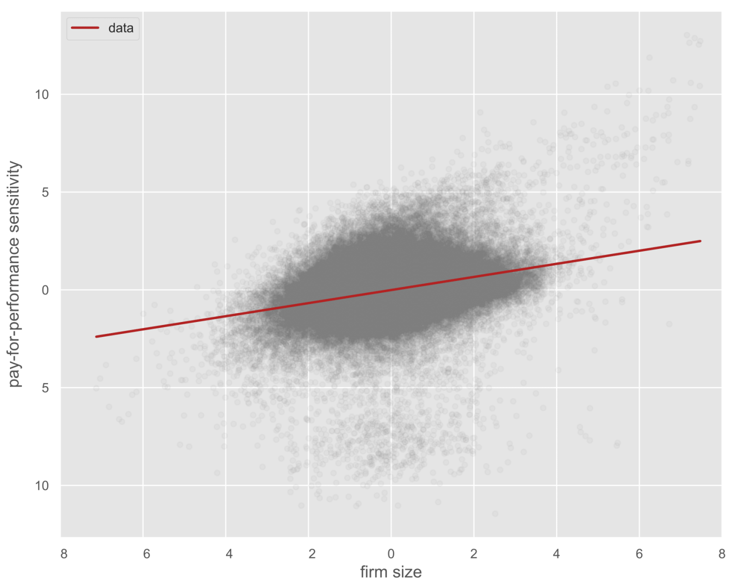
Parameters

Parameters	Description
η	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 Estimates

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

Data


data
pay-for-performance sensitivity
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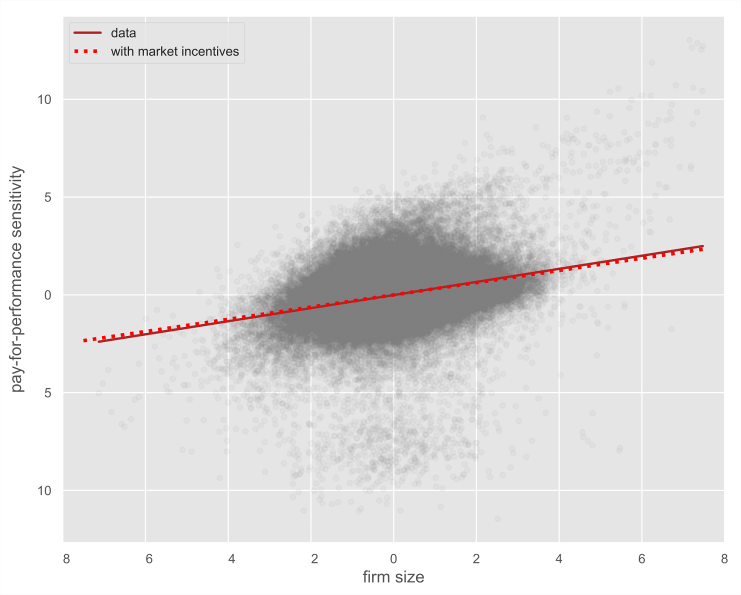
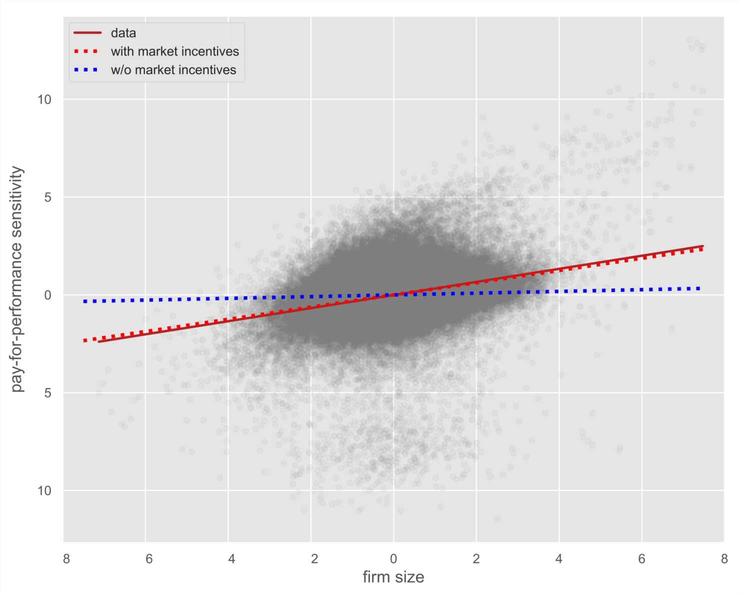
firm size

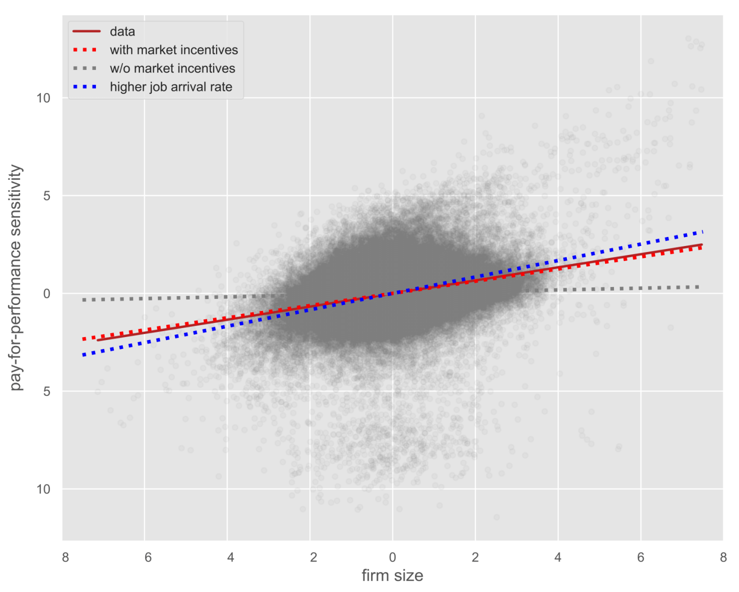
Predictions — model



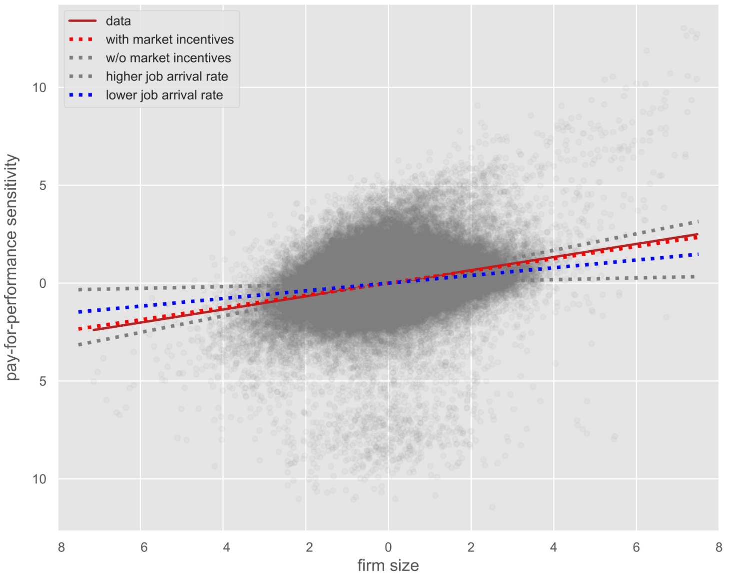
Predictions — without labor market incentives



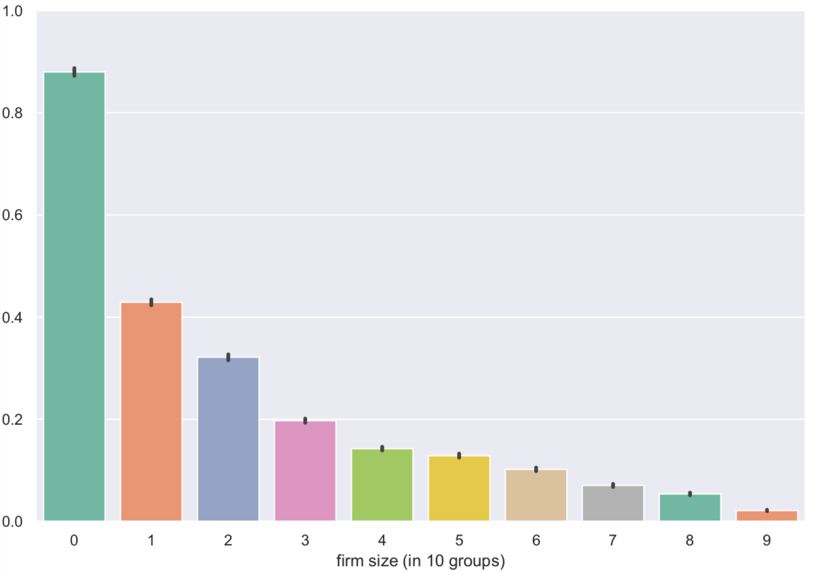
Predictions — with higher job arrival rate



Predictions — with lower job arrival rate



Fraction of labor market incentives



The pre-1970 puzzle

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Frydman and Saks (2010) document that since the mid-1970s:

1. sharp increase in total and incentive pay.
2. more inequality among executives
3. higher correlation between compensation and firm size

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Frydman and Saks (2010) document that since the mid-1970s:

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These facts can be quantitatively explained by an exogenous increase in higher job arrival rate λ_1.

- Huson et al. (2001), Murphy and Zabojnik (2007): An increasing number of CEO openings have been filled through external hires.
- Frydman (2005): Executive jobs have increasingly placed greater emphasis on general rather than firm-specific skills.

Calibration for moments in the 1970s and 1990s

Moments	Data		Model	
(dollar value in year 2000)	1970s	1990s	$\lambda_1 = 0.05$	$\lambda_1 = 0.4$
Mean total pay (thousand)	1090	4350	985	4296
Mean size (million)	-	-	2426	5710
Mean PPS (thousand)	21.743	120.342	24.972	125.310
$\beta_{totalpay-size}$	0.199	0.264	0.175	0.240
Percentiles of total pay (thousand)				
25th percentile	640	1350	109	1217
50th percentile	930	2360	478	2957
75th percentile	1310	4430	1596	5860

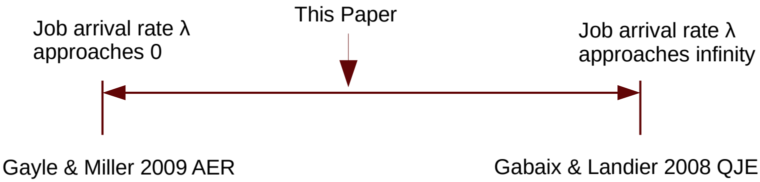
A conjecture by Gabaix and Landier (2008)

Another possibility is that the U.S. CEO market before 1970 was more like the contemporary Japanese CEO market. Companies would groom their CEOs in-house and not poach them from other firms. Hence, this labor market would just not be described well by our model. We conclude that our frictionless benchmark model does not apply unamended to the pre-1970 sample and leave the search for a fuller model to future research.

— Gabaix and Landier (2008)

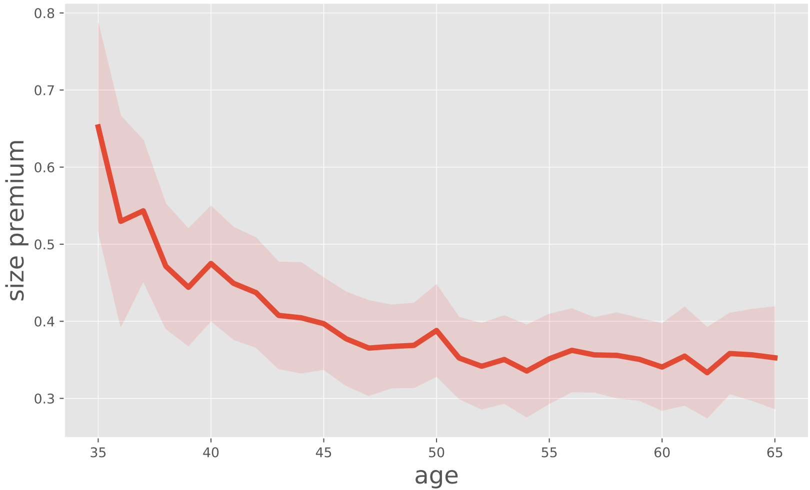
Conclusion

A model links GM and GL



- In terms of compensation level, a "weighted sum" of GM and GL
- In terms of incentives, the interaction gives labor market incentives

Firm size incentive premium over age



Takeaways

- Moral hazard problem is not necessarily more severe in larger firms.
- Small and medium firms take advantage of the labor market incentives.
- Managerial labor market competition explains firm size incentive premium.

Thanks you for your attention.

http://bohuecon.github.io

Contracting Problem

Firms choose $\{w, W(z', s')\}$ to 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

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

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

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

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

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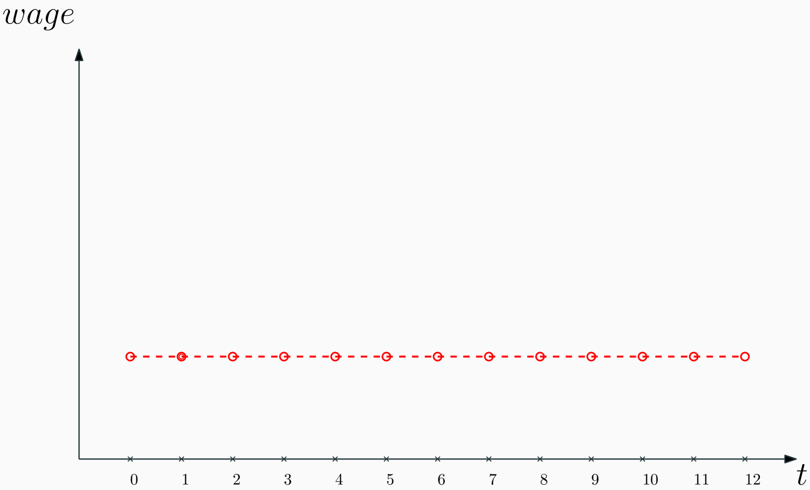
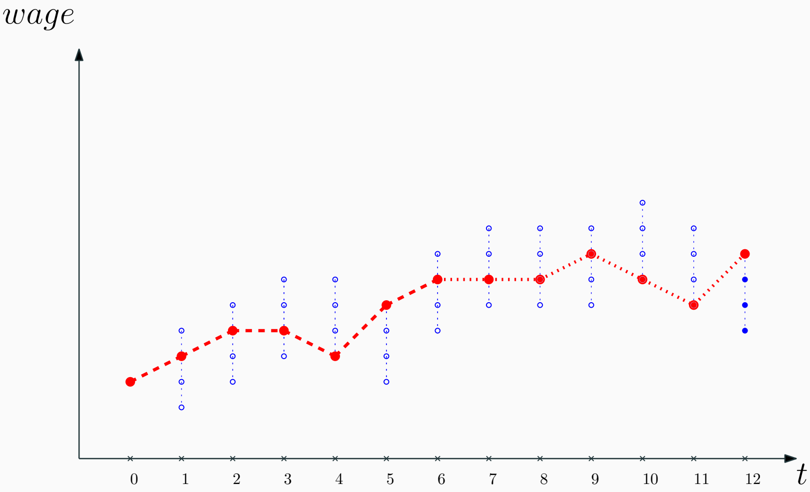
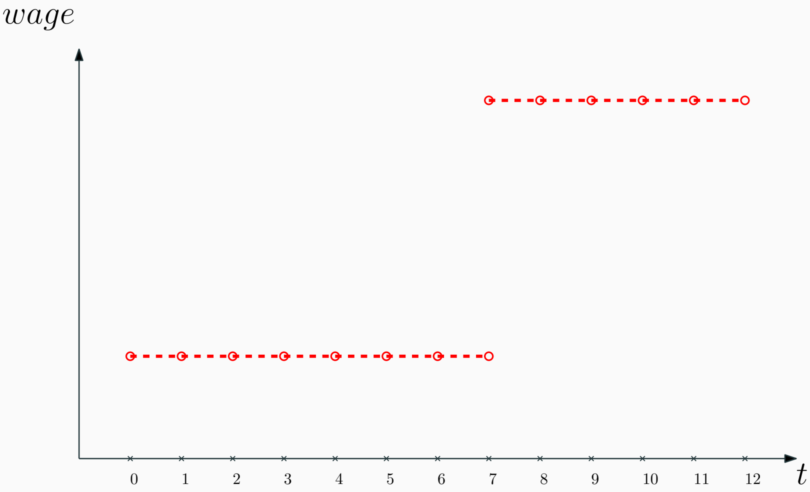
No Moral Hazard, Full Commitment



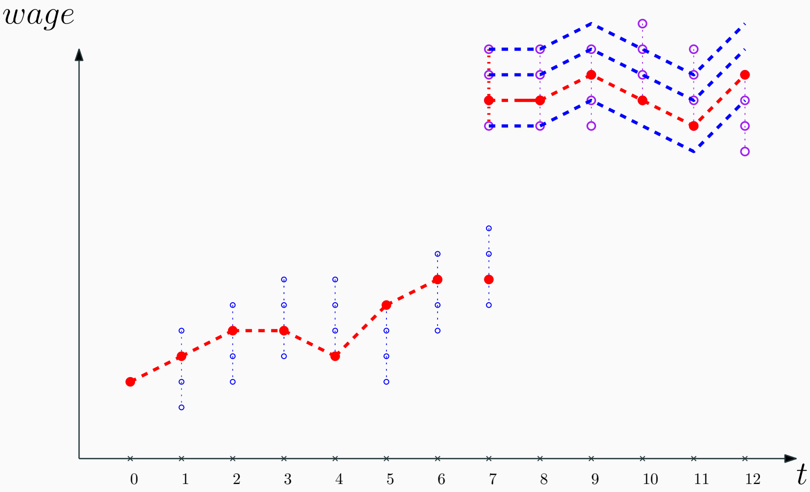
Only Moral Hazard



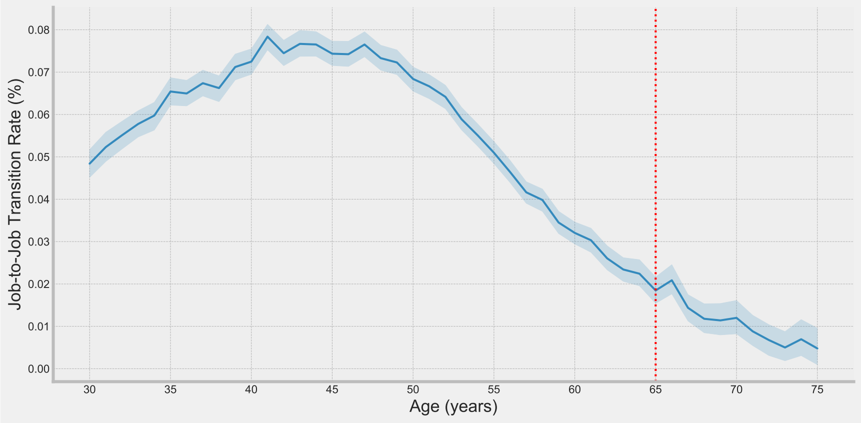
Only Limited Commitment



Optimal Contract



Job-to-job transition rate over age



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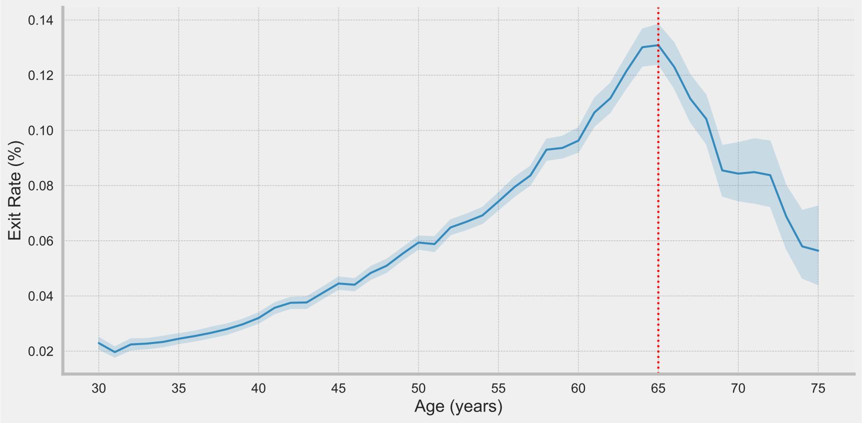
Exit rate over age



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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

	$\Delta\log(tdc1)$					
	(1)	(2)	(3)	(4)	(5)	(6)
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)$_{-1}$ × *EE90*			0.0711*			
			(0.0403)			
log(firm size)$_{-1}$ × *EE190*				0.0759**		
				(0.0353)		
log(firm size)$_{-1}$ × *gai*					0.0233***	
					(0.00546)	
log(firm size)$_{-1}$ × *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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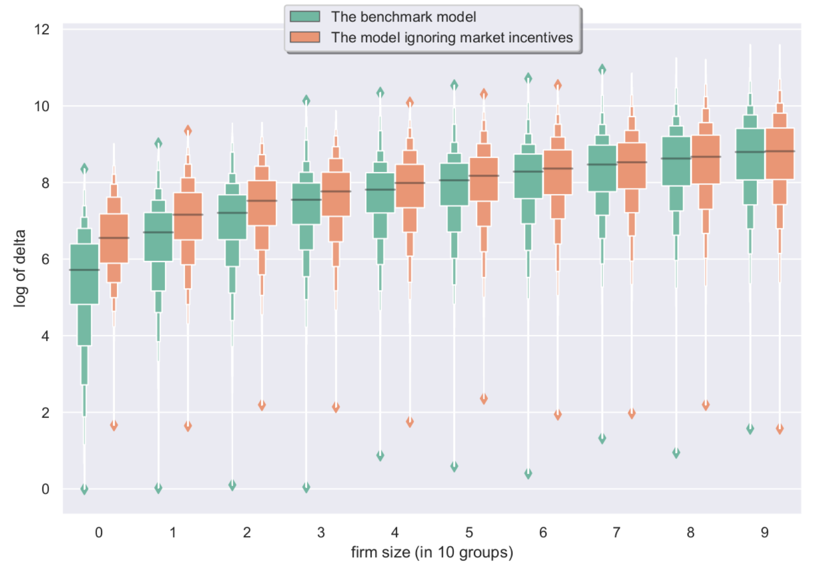
If labor market incentives are ignored ...



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CEO's of "Small Firms" in S&P 500

tdc1: total compensation
delta: dollar-percentage incentive

Company	Market Cap millions	tdc1 000's	delta 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

CEO's of "Large Firms" in S&P 500

tdc1: total compensation
delta: dollar-percentage incentives

Company	Market Cap millions	tdc1 000's	delta 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	1106.8351
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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