# Managerial Labor Market Competition and Incentive Contracts

Job Market Talk at the University of Rome Tor Vergata

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- Principle-agent problem matters to explain incentive pay.
- Labor market competition gives total pay increases with firm size.

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Why is the fraction of incentives higher in larger firms?

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

## What I provide:

• An explanation based on the executive job ladder.

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# Introduction — firm size incentive premium

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## Key variables:

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

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## Size incentive premium:

• Controlling for total compensation, year × industry dummies, etc.

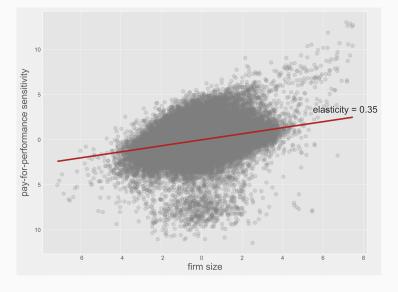


Figure 1: PPS increases in firm size (size incentive premium)

# Introduction — size incentive premium and labor market

	$\log(PPS)$				
	(1)	(2)	(3)	(4)	(5)
log(firm size)	0.585*** (0.0141)	0.347*** (0.0247)	0.529*** (0.00499)	0.561*** (0.00310)	0.571*** (0.0139)
log(firm size) × J-J rate			0.415** (0.101)		
log(firm size) × GAI				0.0648*** (0.00156)	
log(firm size) × inside CEO frac					-0.0458* (0.0202)
log(total pay)		0.609*** (0.0350)	-0.251*** (0.00173)	-0.304*** (0.00267)	-0.253*** (0.00173)
tenure, age, year	X	X	X	X	X
other controls	X	X	X	X	X
industry	X	X			
year × industry	X	X			
Observations adj. $R^2$	146,747 0.442	128,006 0.514	125,858 0.521	75,747 0.531	125,858 0.521

## Model:

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

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- labor market incentives decrease with firm size
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#### What are labor market incentives?

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

## Introduction — model intuition, cont'd

Key assumption (Gabaix and Landier, 2008):

- cash flow = firm size × executive productivity
- larger firms can always outbid smaller ones
- the job ladder towards larger firms

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Key assumption (Gabaix and Landier, 2008):

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- the job ladder towards larger firms

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)

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

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  - 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

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

ullet die with  $\eta \in (0,1)$ , the match breaks up, the job disappears

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#### Firms:

- ullet 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
- ullet with  $\lambda_1 \in (0,1)$  sample an outside firm s' from F(s')

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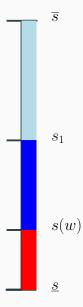
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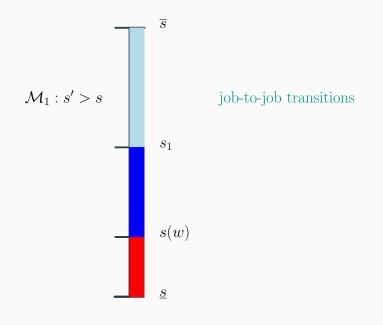
## Bertrand Competition:

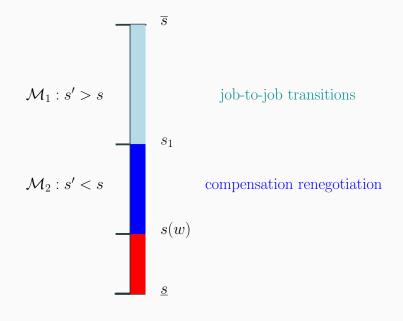
- current firm s versus outside firm s'
- each has a bidding frontier,  $\overline{W}(z,s)$ , defined by

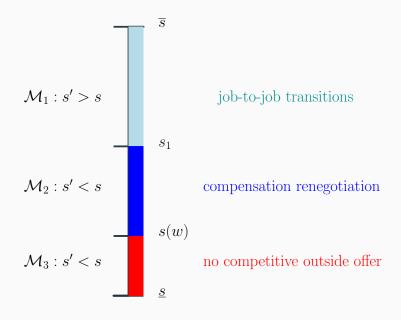
$$\Pi\Big(z,s,\overline{W}(z,s)\Big)=0$$

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









#### **Contracting Problem**

#### Firms maximize profits by choosing

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

#### subject to

Promise-keeping Constraint,	(PKC)
Incentive Compatibility Constraint,	(IC)
Participation Constraint of executive,	(PC-Executive)
Participation Constraint of firm,	(PC-Firm)

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$W(z',s') \geq \min\{\overline{W}(z',s'),\overline{W}(z',s)\},$	(PC-Executive)
Participation Constraint of firm,	(PC-Firm)

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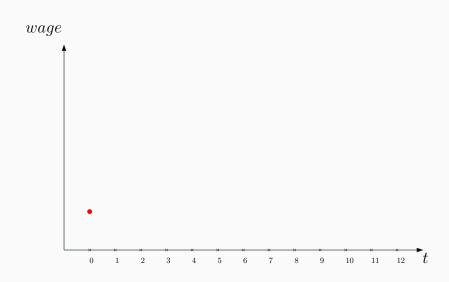
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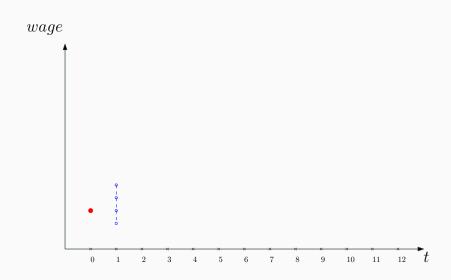
Details

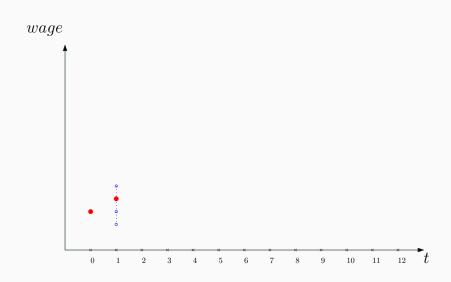
#### The Equilibrium

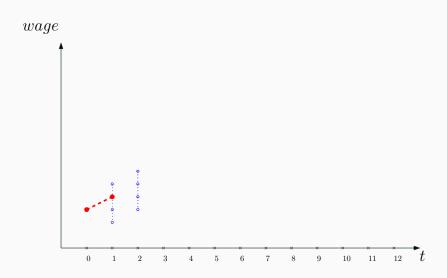
A stationary equilibrium is defined by

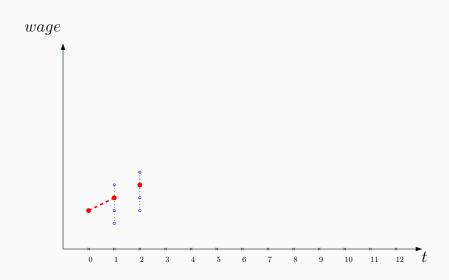
- value functions  $\{W^0, W, \Pi\}$ ;
- optimal contracts  $\sigma = \{w, W(z', s')\}$  for  $z' \in \mathbb{Z}$  and  $s' \in \mathbb{S}$ ;
- $\Gamma(z'|z)$  follows the optimal effort choice;
- a distribution of executives across employment states evolving according to flow equations.

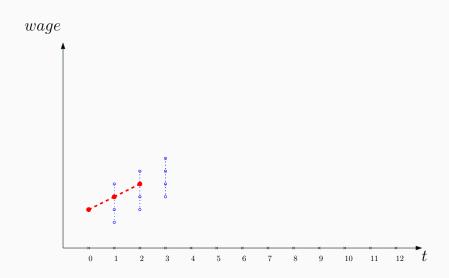


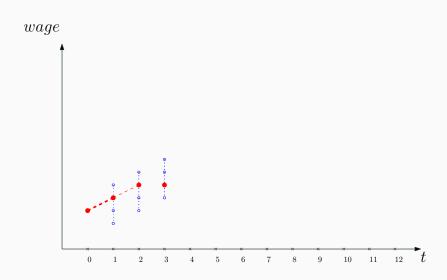


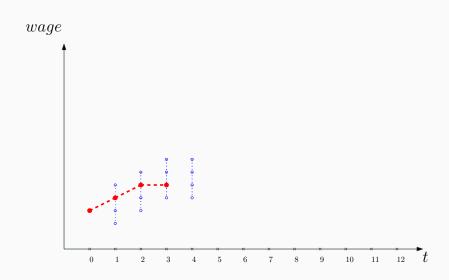


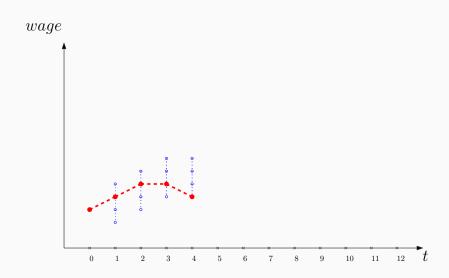


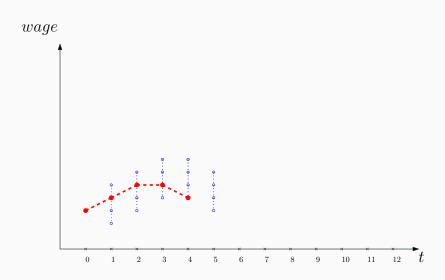


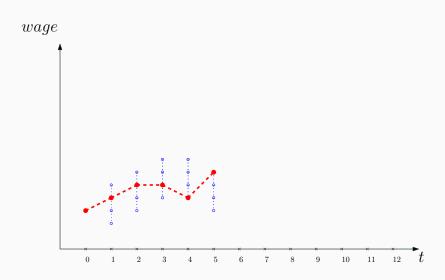


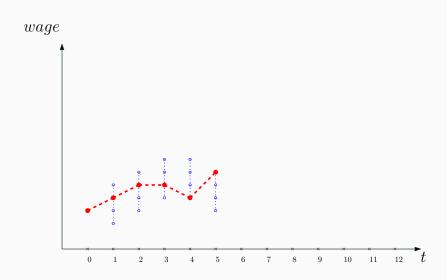


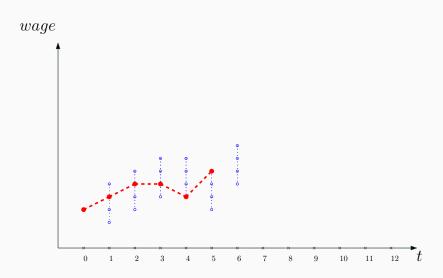


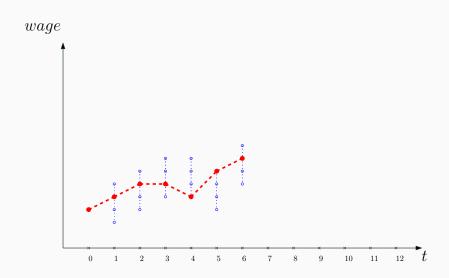


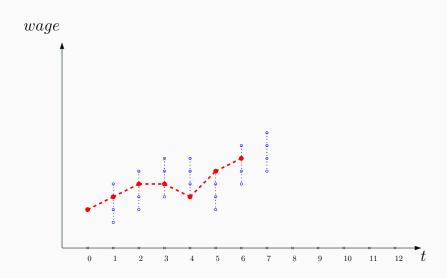


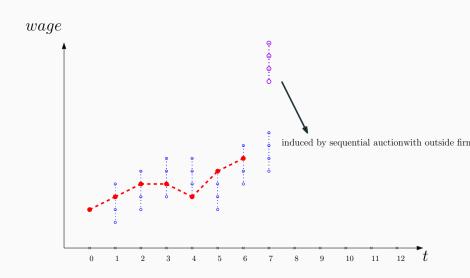


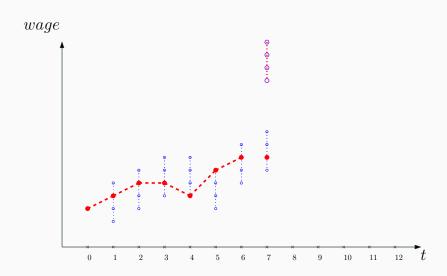


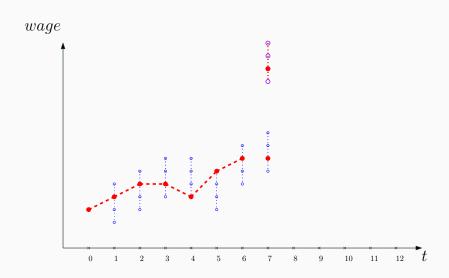


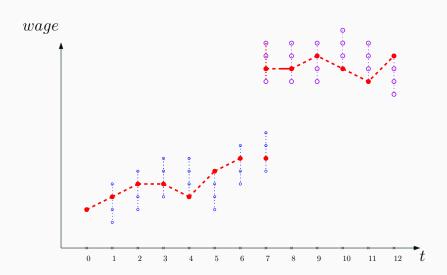


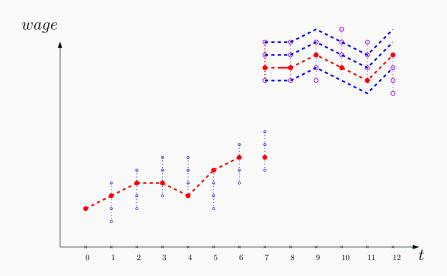












#### Labor market incentives

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

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

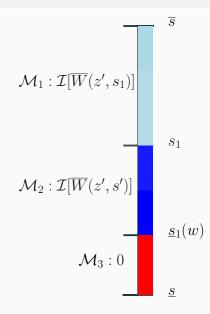
Performance-based Incentives

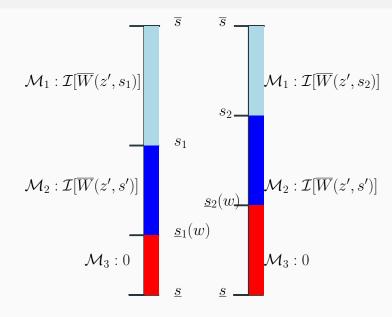
where

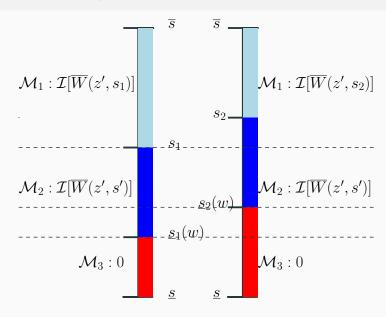
 $\mathcal{M}_1: s' \geq s$ , lead to job turnovers

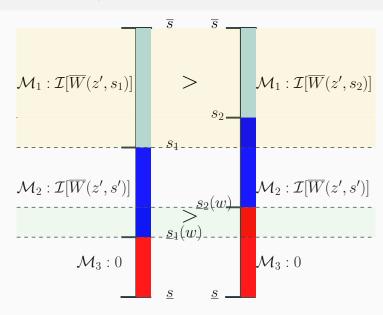
 $\mathcal{M}_2: s' < s, \text{ improve compensation, no job turnovers}$ 

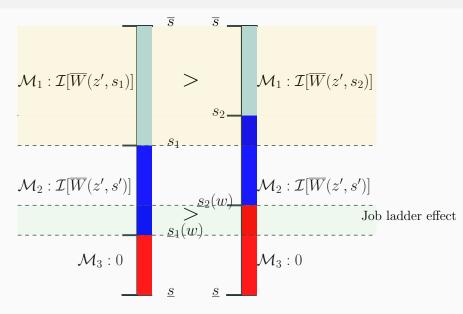
 $\mathcal{M}_3$ : other or no outside firms



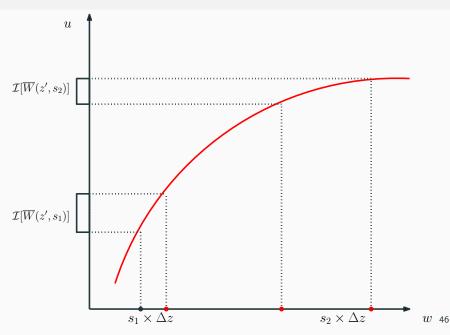


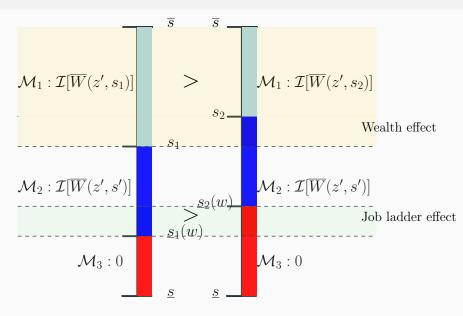






# Incentives from $\overline{W}(z',s)$ decrease in s





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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

### Reduced-form evidence

- 5. Firm-size incentive premium is higher in industries where managerial labor market is more active. [Incentive Premium]
  - job-to-job transition rate (industry-year level)
  - general ability index (Custódio et al. 2013)
  - fraction of outsider CEO (Martijn Cremers and Grinstein 2013)

# **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)

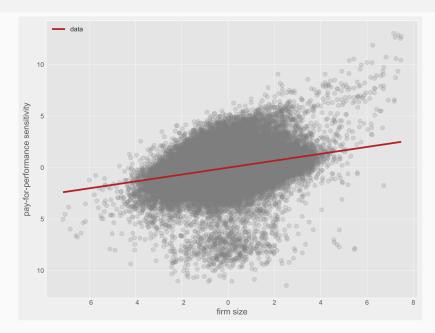
### **Parameters**

Parameters	Description
$\overline{\eta}$	the death probability
$\lambda_1$	the offer arrival probability
$\rho_z$	the $AR(1)$ coefficient of productivity shocks
$\mu_z$	the mean of productivity shocks for $\emph{e}=1$
$\sigma_z$	the standard deviation of productivity shocks
$\mu_s$	the mean of $F(s)$
$\sigma_{s}$	the standard deviation of $F(s)$
<i>c</i>	cost of efforts
$\sigma$	relative risk aversion
$\alpha_0, \alpha_1$	production function parameters

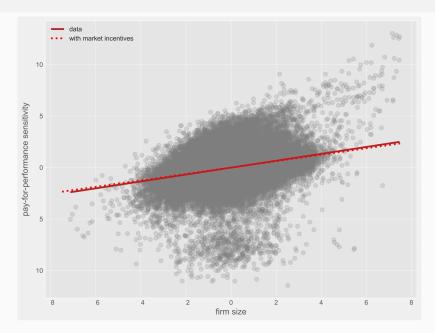
### **Moments and Estimates**

Data	Model	Estimates	Standard Error
0.0691	0.0691	$\eta = 0.0695$	0.0127
0.0498	0.0473	$\lambda_1 = 0.3164$	0.0325
0.7683	0.6299	$\rho_z = 0.8004$	0.0366
0.1260	0.1144	$\mu_z=0.0279$	0.0014
0.0144	0.0160	$\sigma_z^2 = 0.1198$	0.0044
7.4515	7.4806	$\mu_s = 1.2356$	0.0365
2.3060	2.1610	$\sigma_s = 2.5795$	0.1211
7.2408	7.2665	$\alpha_0 = -1.5534$	0.0147
1.1846	0.8960	$\alpha_1 = 0.5270$	0.0217
0.3830	0.2822		
1.1063	1.1997	$\sigma = 1.1038$	0.0030
8.4994	8.478	c = 0.0814	0.0259
3.4438	3.35872		
	0.0691 0.0498 0.7683 0.1260 0.0144  7.4515 2.3060  7.2408 1.1846 0.3830  1.1063 8.4994	0.0691 0.0691 0.0498 0.0473 0.7683 0.6299 0.1260 0.1144 0.0144 0.0160 	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

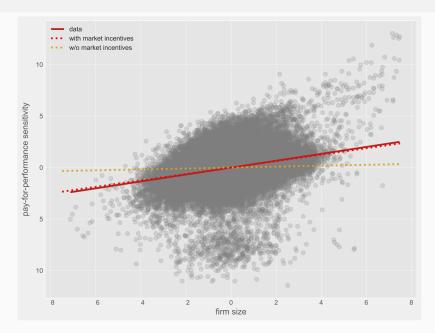
## Data



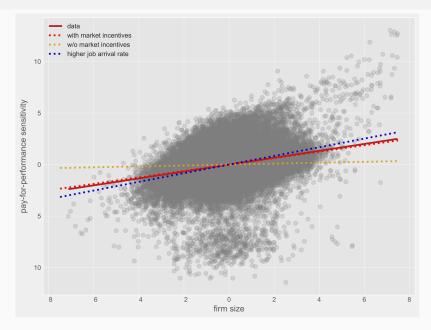
### Predictions — model



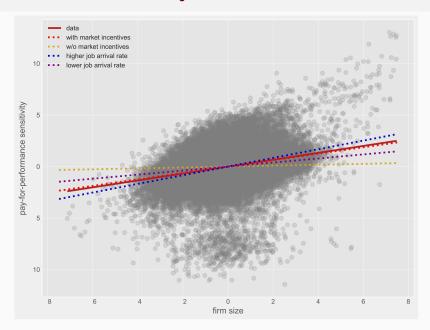
### Predictions — without labor market incentives



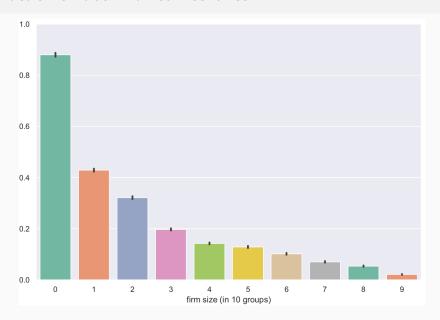
## Predictions — with higher job arrival rate



## Predictions — with lower job arrival rate



### Fraction of labor market incentives



# Long-run trends

## Long-run trends in executive compensation

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:

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

These facts can be quantitatively explained by an exogenous increase in higher job arrival rate  $\lambda_1$ .

- 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.

# Long-run trends in executive compensation

Moments	Da	ata	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
$eta_{totalpay-size}$	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

# **Conclusion**

### **Takeaways**

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

# 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

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

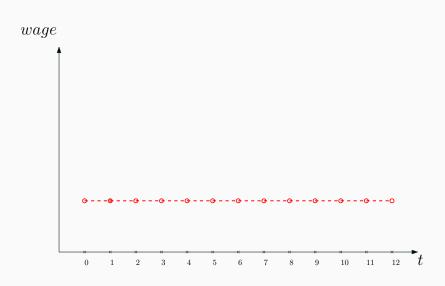
$$\tilde{\beta} \sum_{z' \in \mathbb{Z}} \sum_{s' \in \mathbb{S}} W(z', s') \tilde{F}(s') \Big( \Gamma(z'|z) - \Gamma^{s}(z'|z) \Big) \ge c, \tag{IC}$$

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

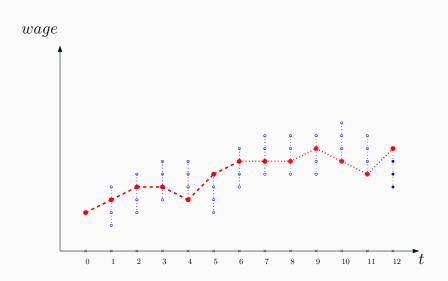
$$W(z',s') \leq \overline{W}(z',s).$$
 (PC-Firm)

Back

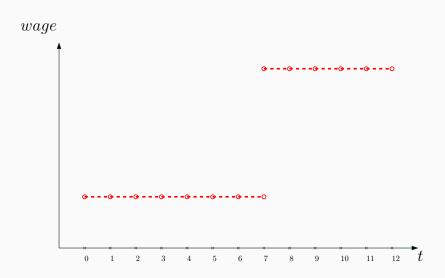
## No Moral Hazard, Full Commitment



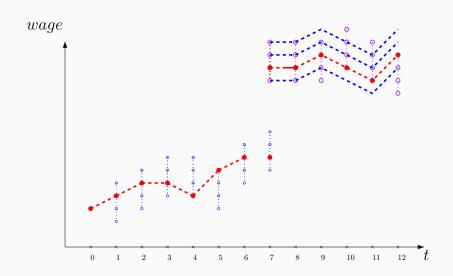
# **Only Moral Hazard**



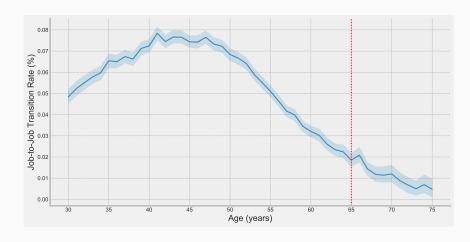
# **Only Limited Commitment**



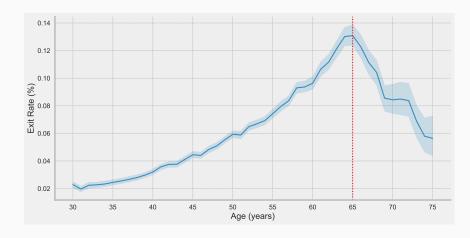
# **Optimal Contract**



# 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					
Total obs.	Firm size decrease obs. (%)	Firm size increase obs. (%)			
2567	985 (39%)	1582 (61%)			
2617	1051 (40%)	1566 (60%)			
2616	1038 (40%)	1578 (60%)			
	Total obs. 2567 2617	Total obs. Firm size decrease obs. (%) 2567 985 (39%) 2617 1051 (40%)			

Panel B: Across age groups

Age groups	Total obs.	Firm size decrease obs. (%)	Firm size increase obs. (%)
≤ <b>4</b> 0	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%)

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

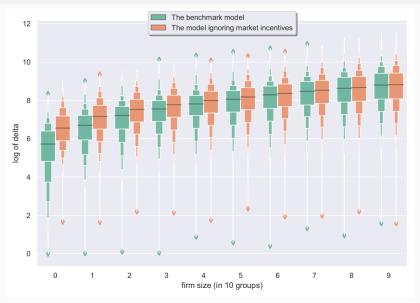
Job	-to-Job Transition	
•	(1)	(2)
log(Firm Size)	0.917**** (0.0109)	0.972* (0.0139)
Age	0.985**** (0.00273)	0.967*** (0.0112)
log(tdc1)		0.830**** (0.0150)
Market-Book Ratio	0.942**** (0.0150)	0.939**** (0.0157)
Market Value Leverage	1.033** (0.0139)	1.035** (0.0142)
Profitability	0.913**** (0.0197)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

Table 1: Compensation growth increases with firm size

	$\Delta \log(tdc1)$					
	(1)	(2)	(3)	(4)	(5)	(6)
log(firm size)_1	0.112*** (0.00903)	0.154*** (0.0129)	0.108*** (0.00183)	0.107*** (0.00189)	0.141*** (0.00177)	0.127*** (0.00489)
$\begin{array}{l} log(firm\ size)_{-1} \\ \times\ EE90 \end{array}$			0.0711* (0.0403)			
$\begin{array}{l} log(firm\ size)_{-1} \\ \times\ EE190 \end{array}$				0.0759** (0.0353)		
$\begin{array}{l} log(firm\ size)_{-1} \\ \times\ gai \end{array}$					0.0233*** (0.00546)	
$log(firm\ size)_{-1} \times inside\ CEO$						-0.000232*** (0.0000696)
$log(tdc1)_{-1}$	-0.290*** (0.0200)	-0.390*** (0.0262)	-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 adj. R <sup>2</sup>	129068 0.157	106819 0.216	106820 0.260	106820 0.260	58188 0.233	106820 0.262

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 adj. $R^2$	146747 0.442	128006 0.514	125858 0.521	125858 0.521	75747 0.531	125858 0.521

## 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/%|

1113.547

1130.155

1194.977

1328.171

1368.129

1474.909

1276.448

60.939838 I

165.73476 I

473.70974 I

566.14187

128.10688 |

344.02299 I

99.525198 I

428.10996

133.42285 |

431.01562 |

158.65569

1775.531

2602.093

3094.134

2638.243

4584.605

2709.708

1102.528

3738.803

8945.338

950.098

INCYTE CORP 446.408 2432.9734 WESTROCK CD 547.828 2800.668 130.96215 | ENVISION HEALTHCARE CORP 678.6906 1777.991 217.729 | PRICELINE GROUP INC 886.0817 LKQ CORP 889.9763 REGENERON PHARMACEUTICALS 897.3801

SKYWORKS SOLUTIONS INC

ALASKA AIR GROUP INC

ACUITTY BRANDS INC.

CENTENE CORP

HOLOGIC INC

ANSYS INC

GARTNER INC

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

COCA-COLA CO

PEPSICO INC

CHEVRON CORP

INTEL CORP

CISCO SYSTEMS INC

WAL-MART STORES INC

EXXON MOBIL CORP

INTL BUSINESS MACHINES CORP

AT&T INC

95494.39

97836.48

121238.6

126749.6

129381.2

86128.2 35750.103

94944.89 17283.529

147738.2 6101.835

192048.2 16652.894

12781.61

15268.415

16269.85

21693.615

13125.882

344490.6 48922.808 3843.027

2014.3633

1666.3201 I

425.62199 I

2919.7995 I

5981.3853 I

1106.8351 I

1298.8777 I

1874.5755 I

1465.7708 I

**+----**

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