Managerial Labor Market Competition and Incentive Contracts

Lunch Seminar, Department of Economics, VU

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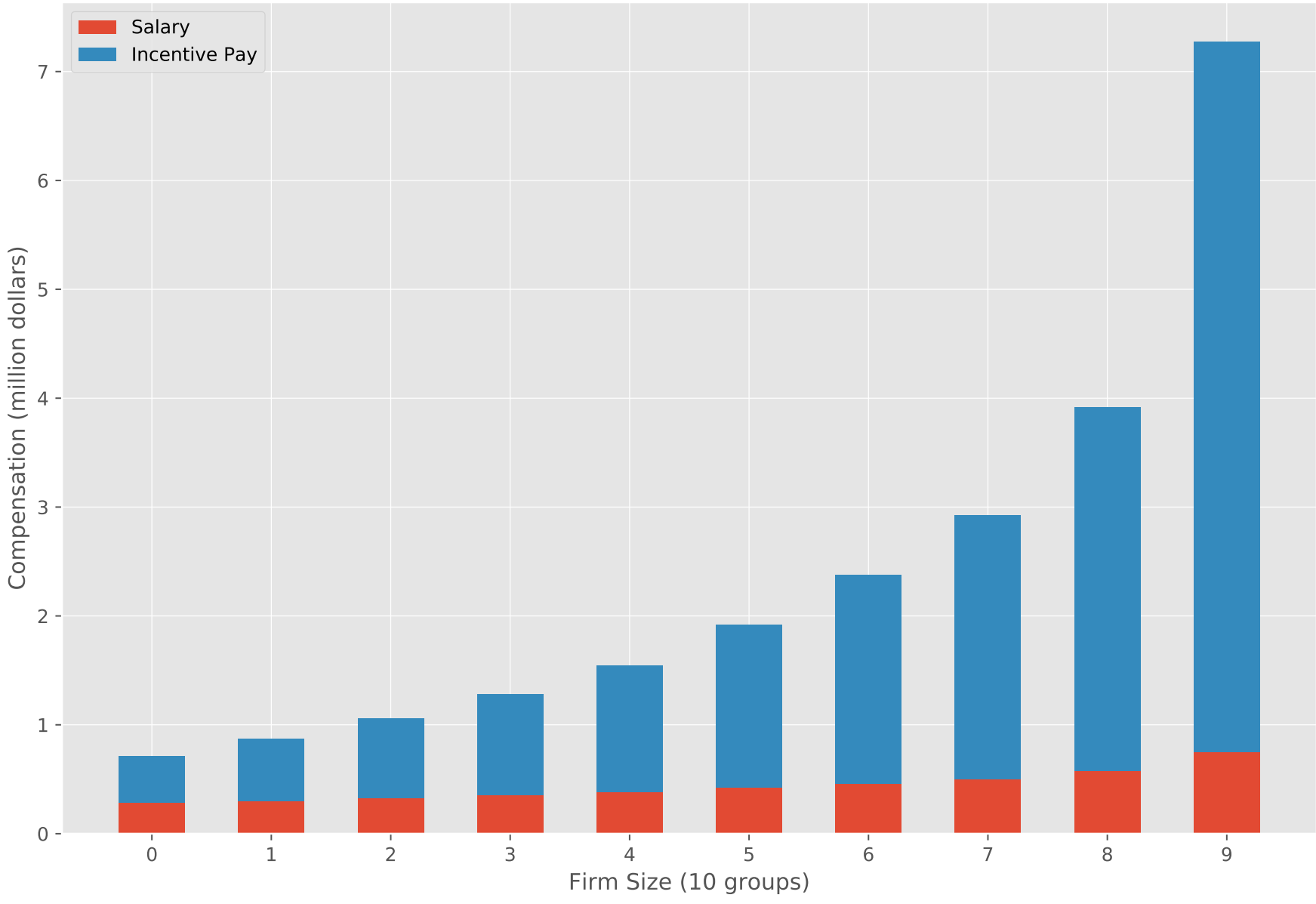
Introduction

Stylized Facts



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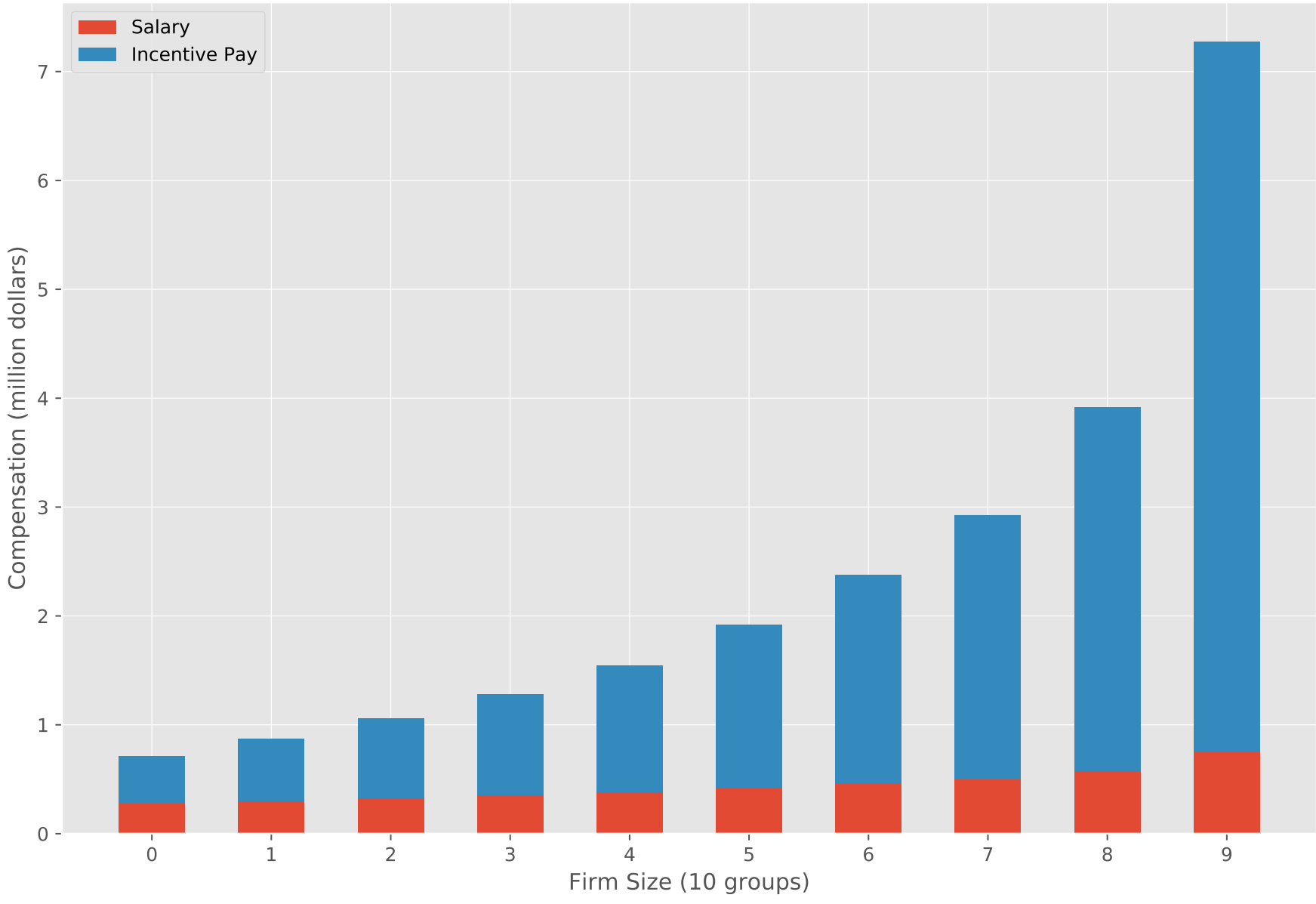

Stylized Facts

- A typical executive compensation package:

$$\underset{\text{(tdc1)}}{\text{total pay}} = \underset{30\%}{\text{salary}} + \underset{70\%}{\underset{\text{(bonus, stocks, options, etc.)}}{\text{performance-based pay}}}$$

- Performance-based incentives

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

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
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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

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

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

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

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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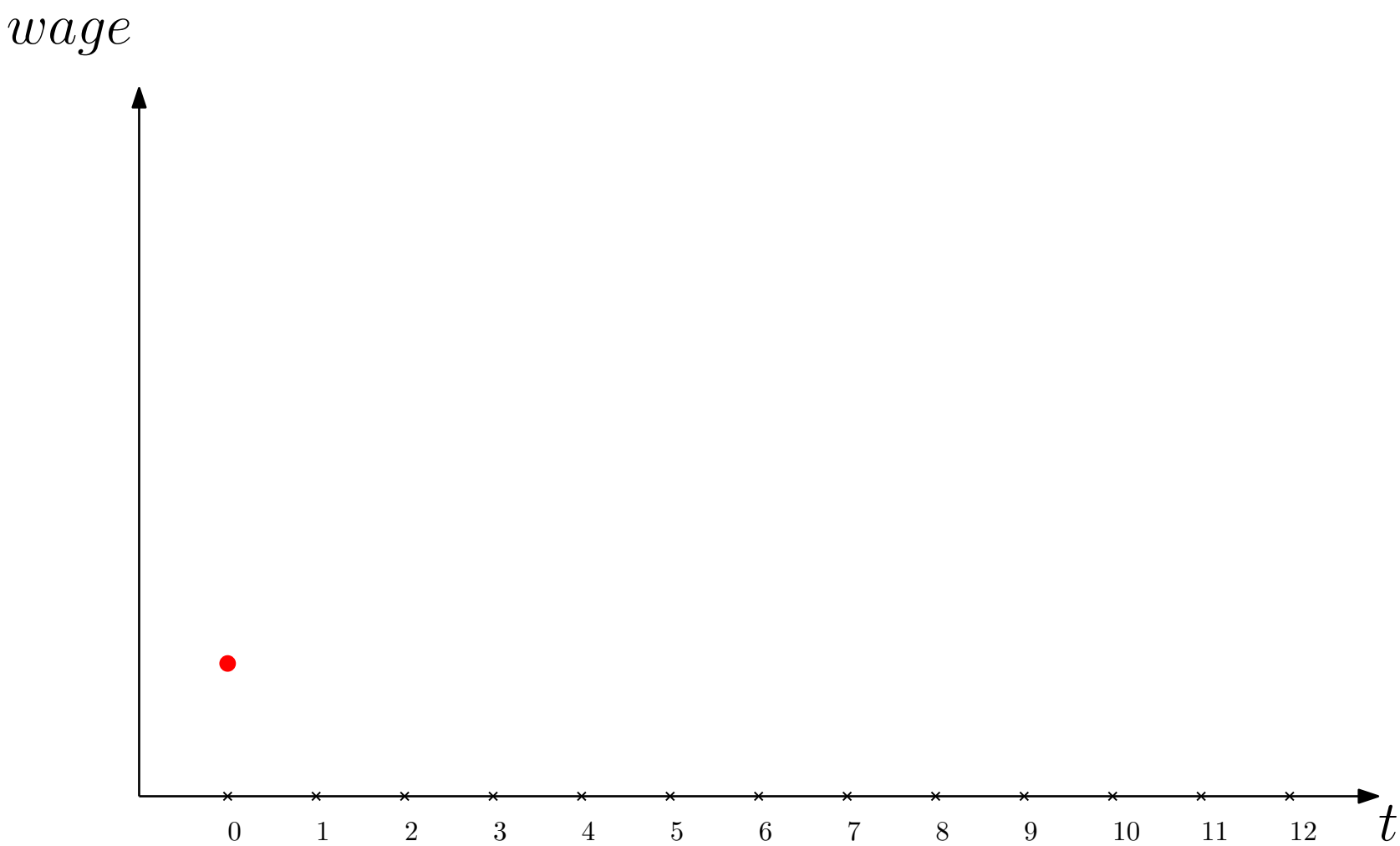

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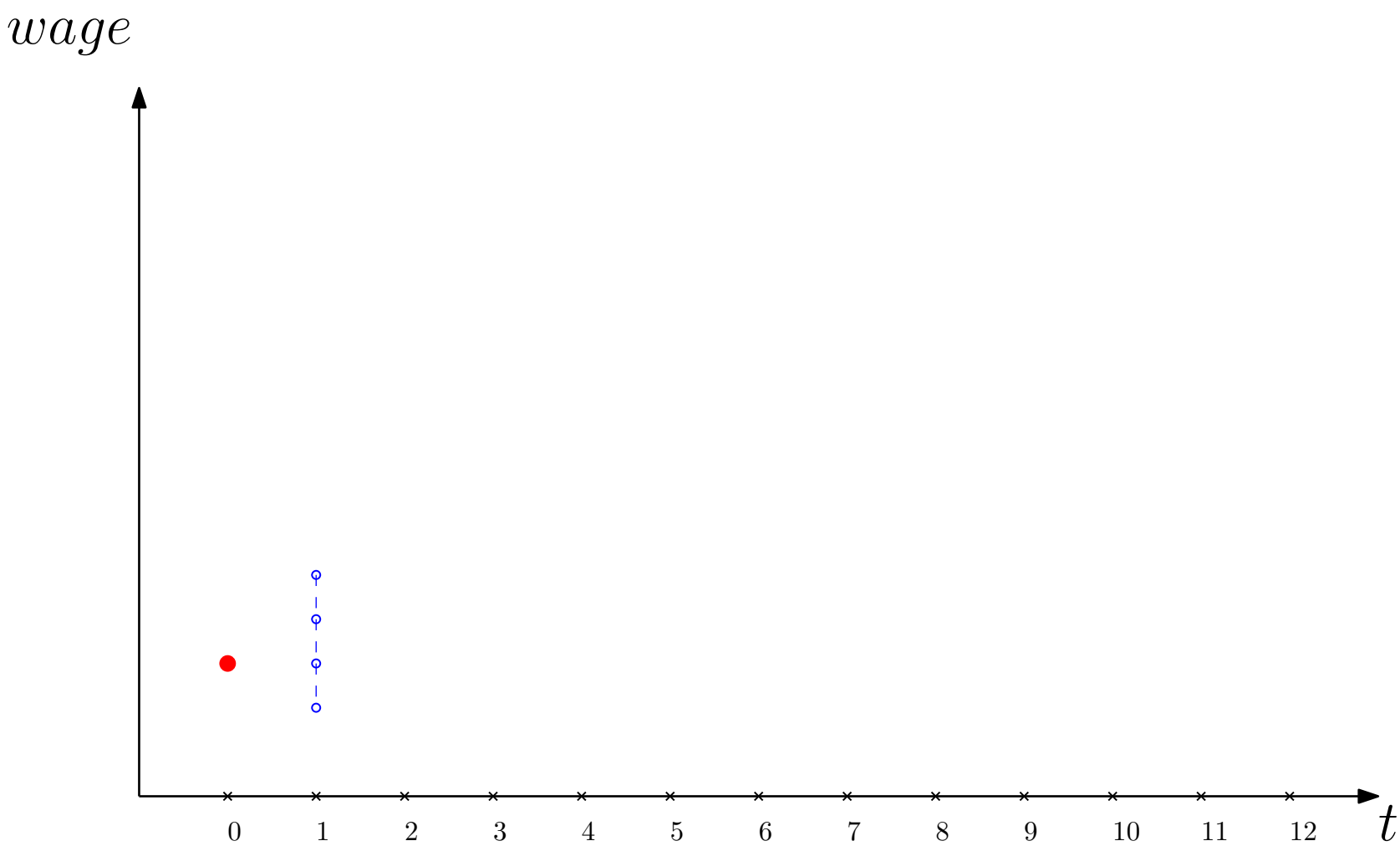

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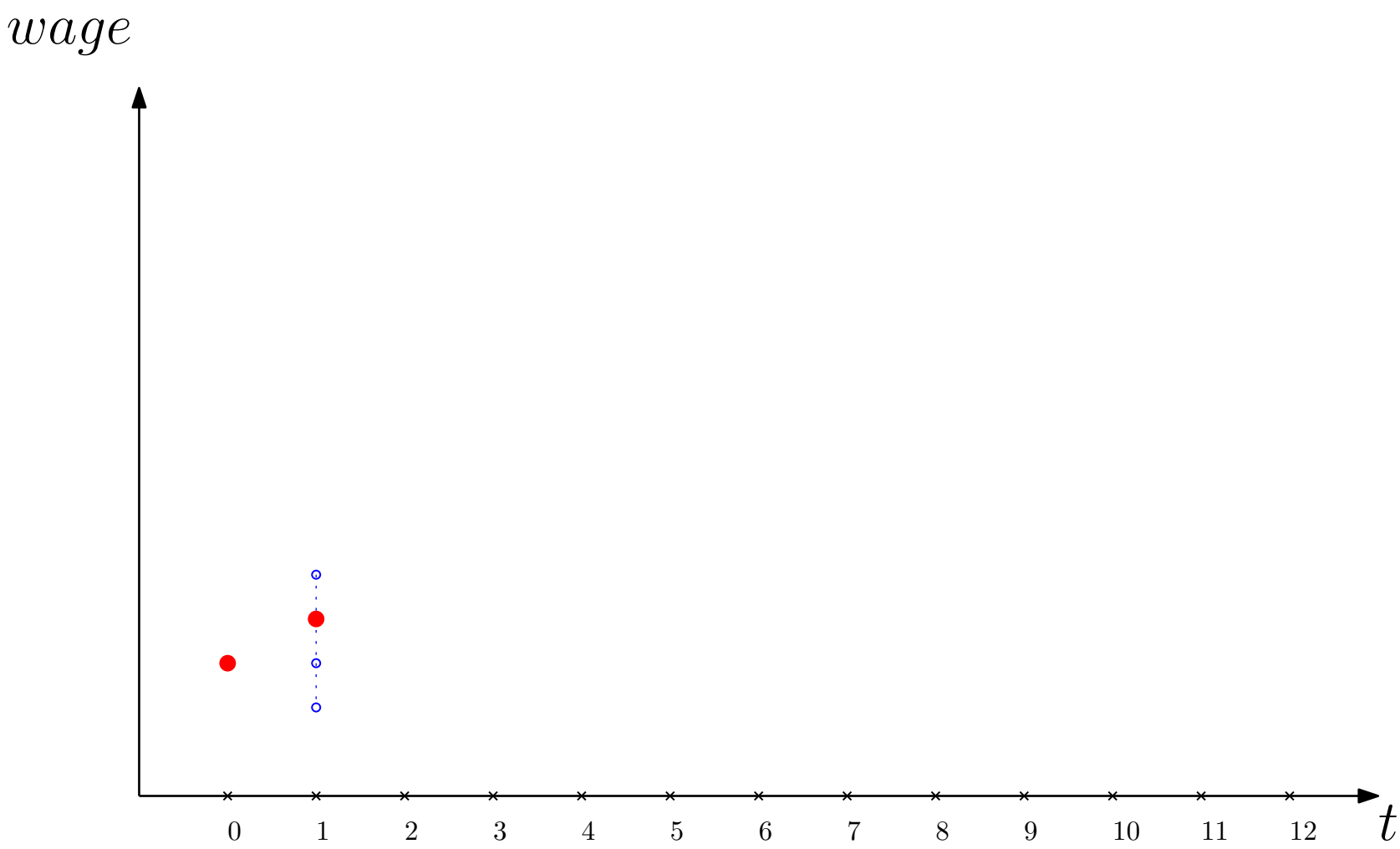

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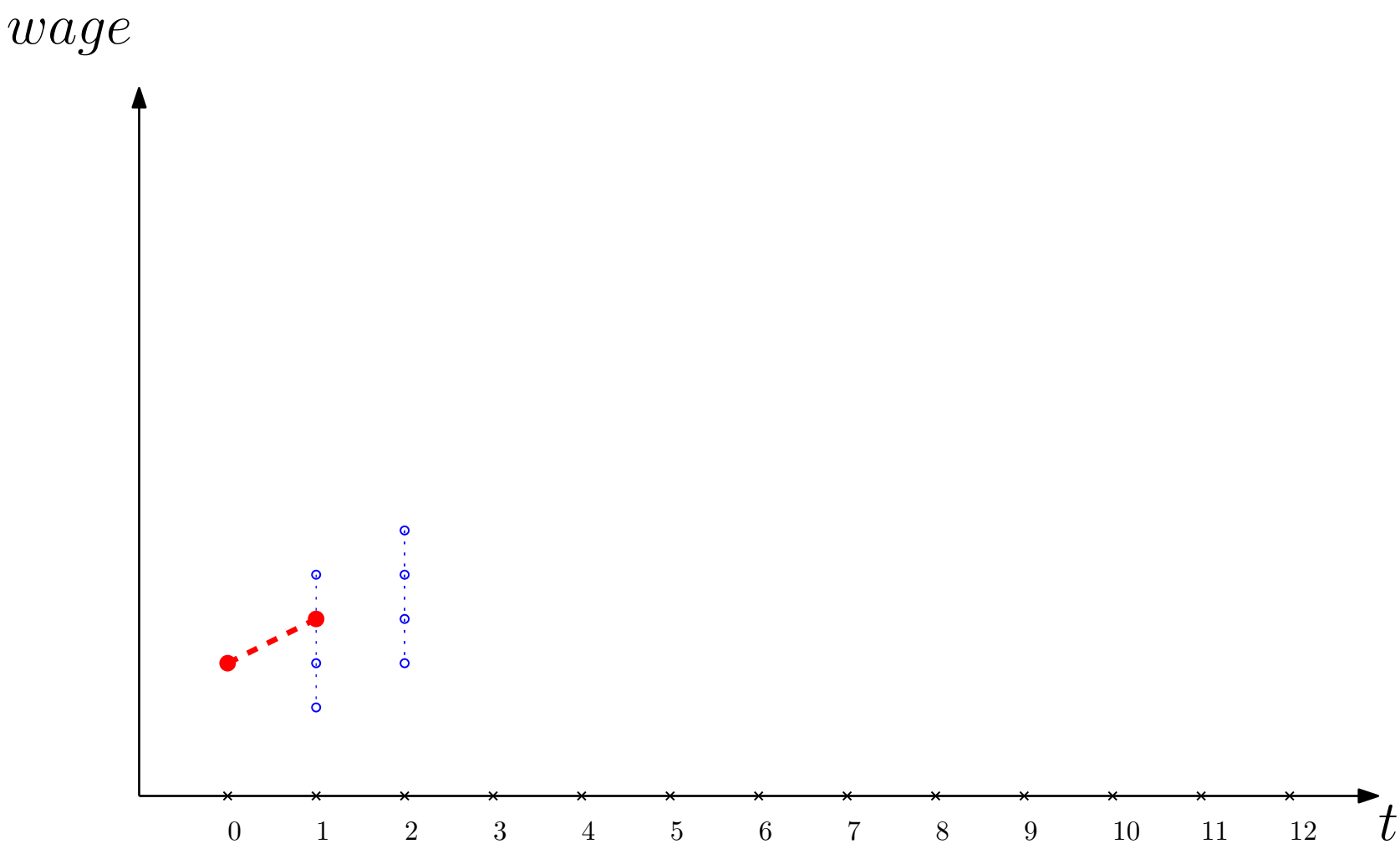

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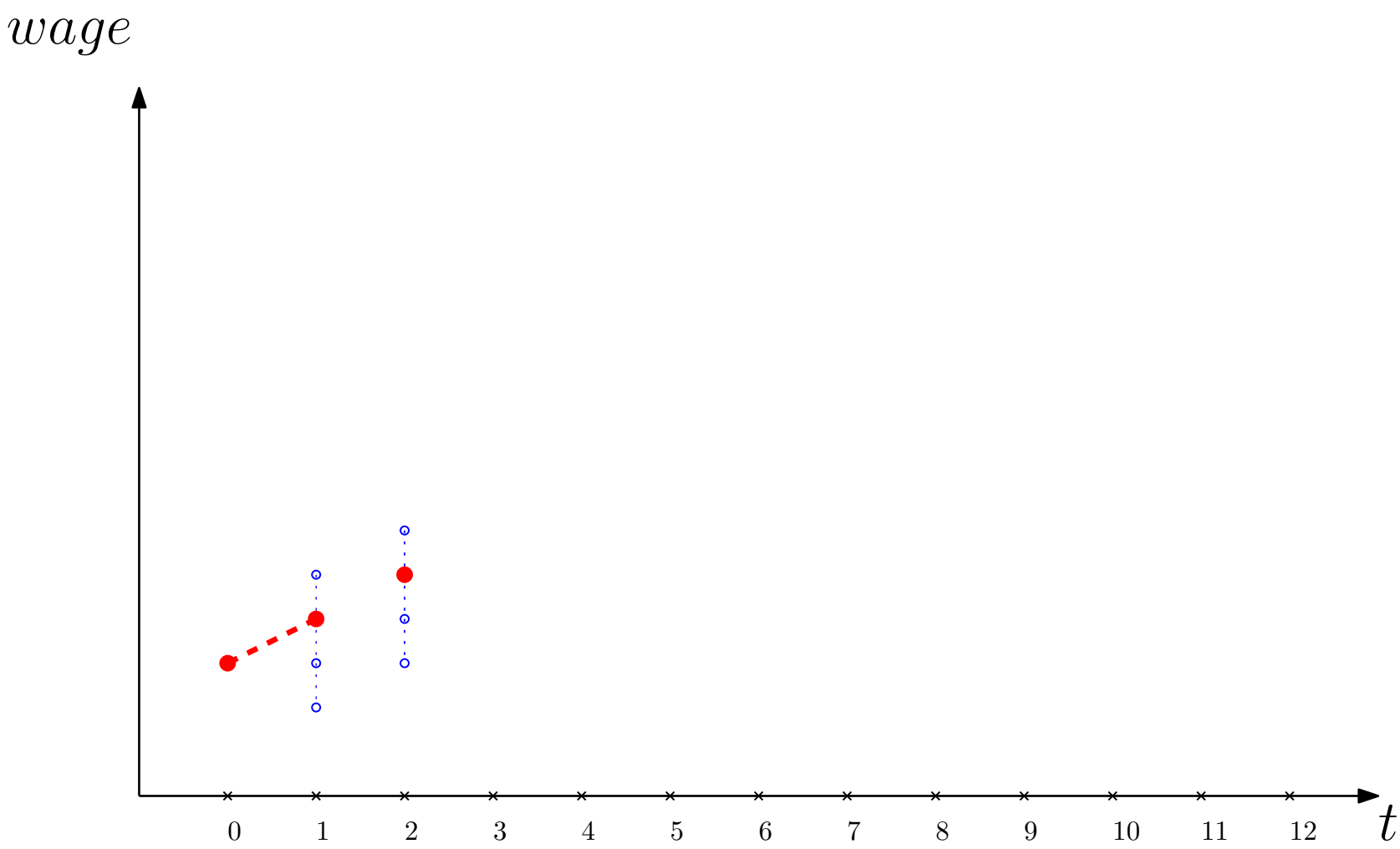

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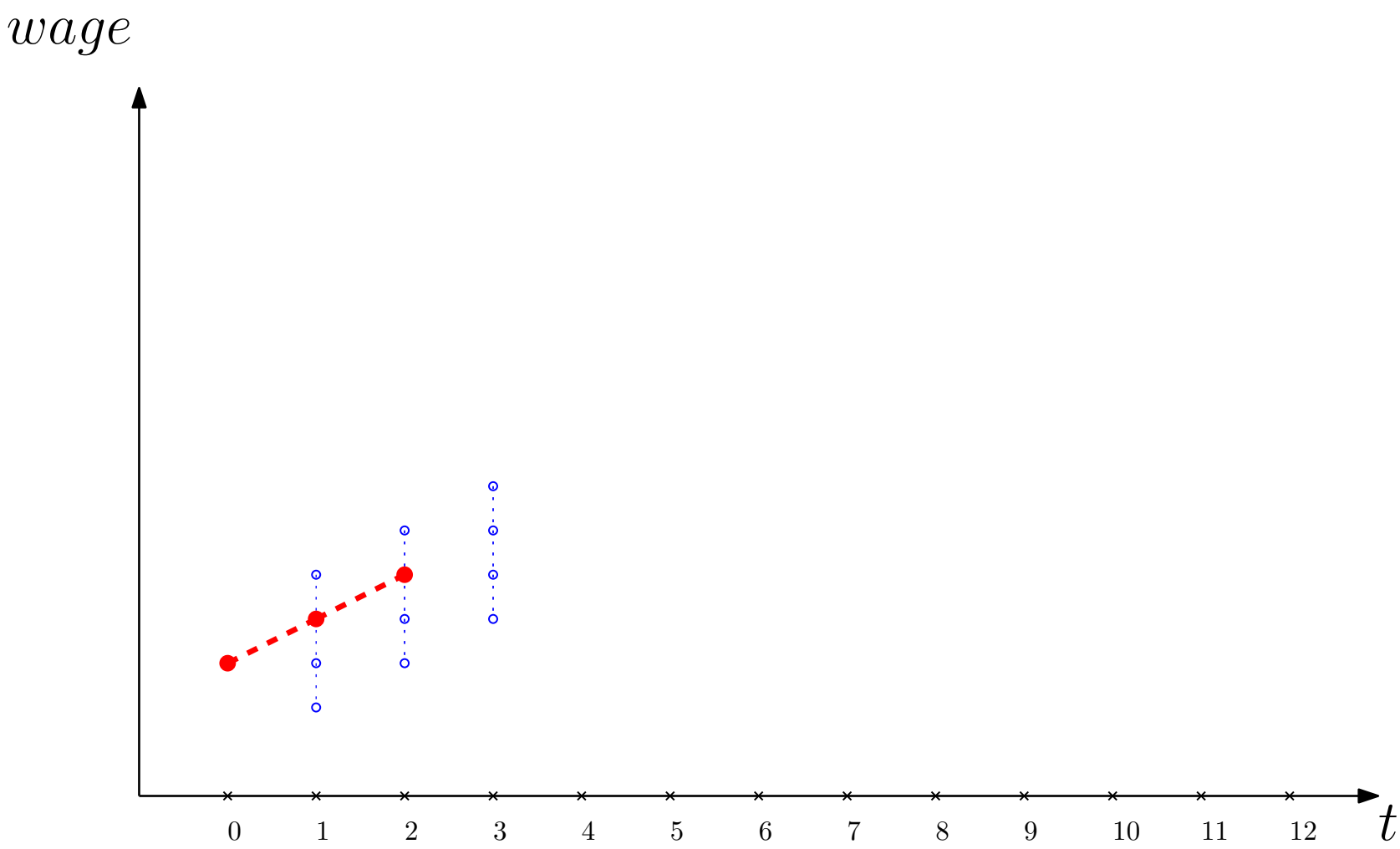

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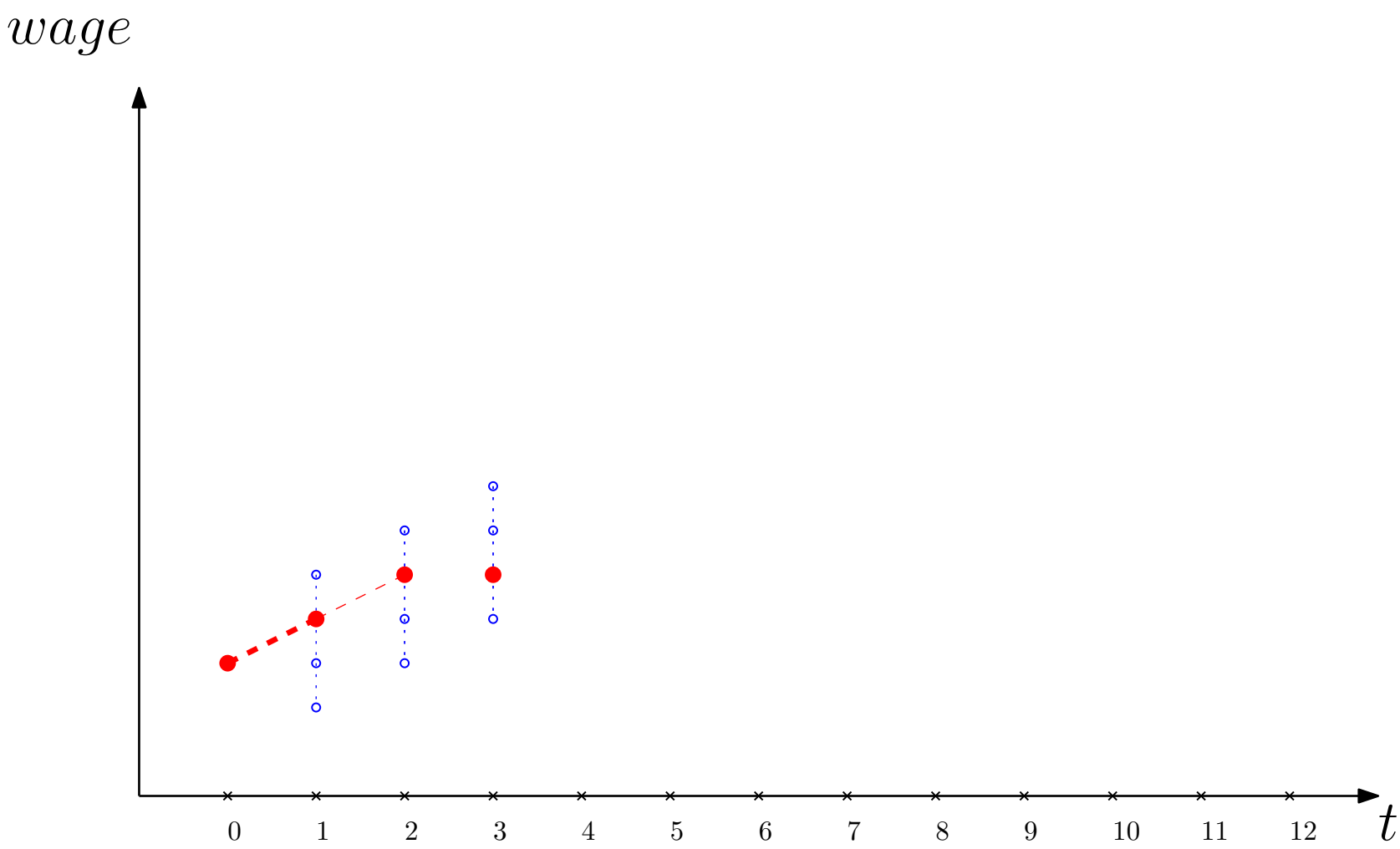

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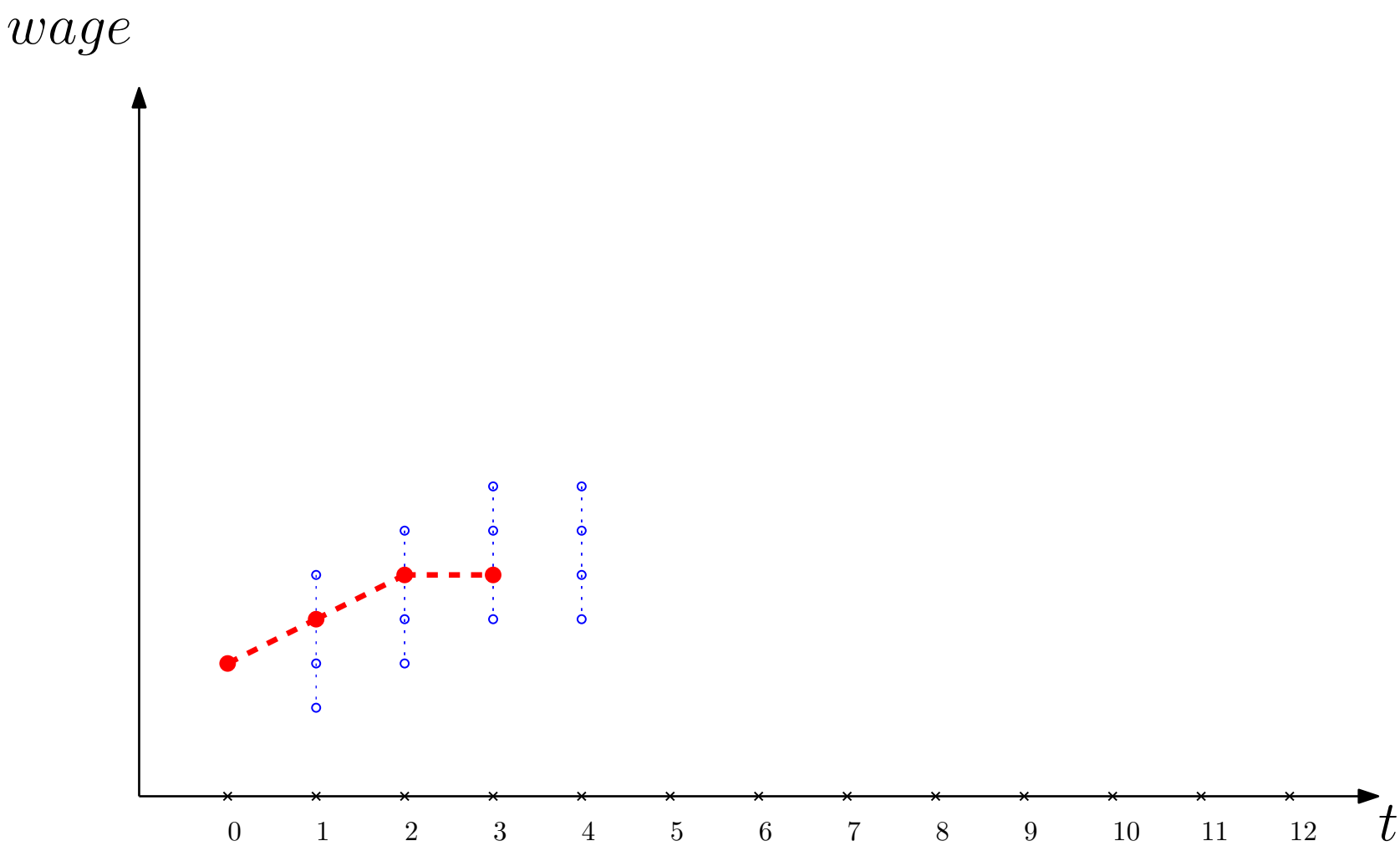

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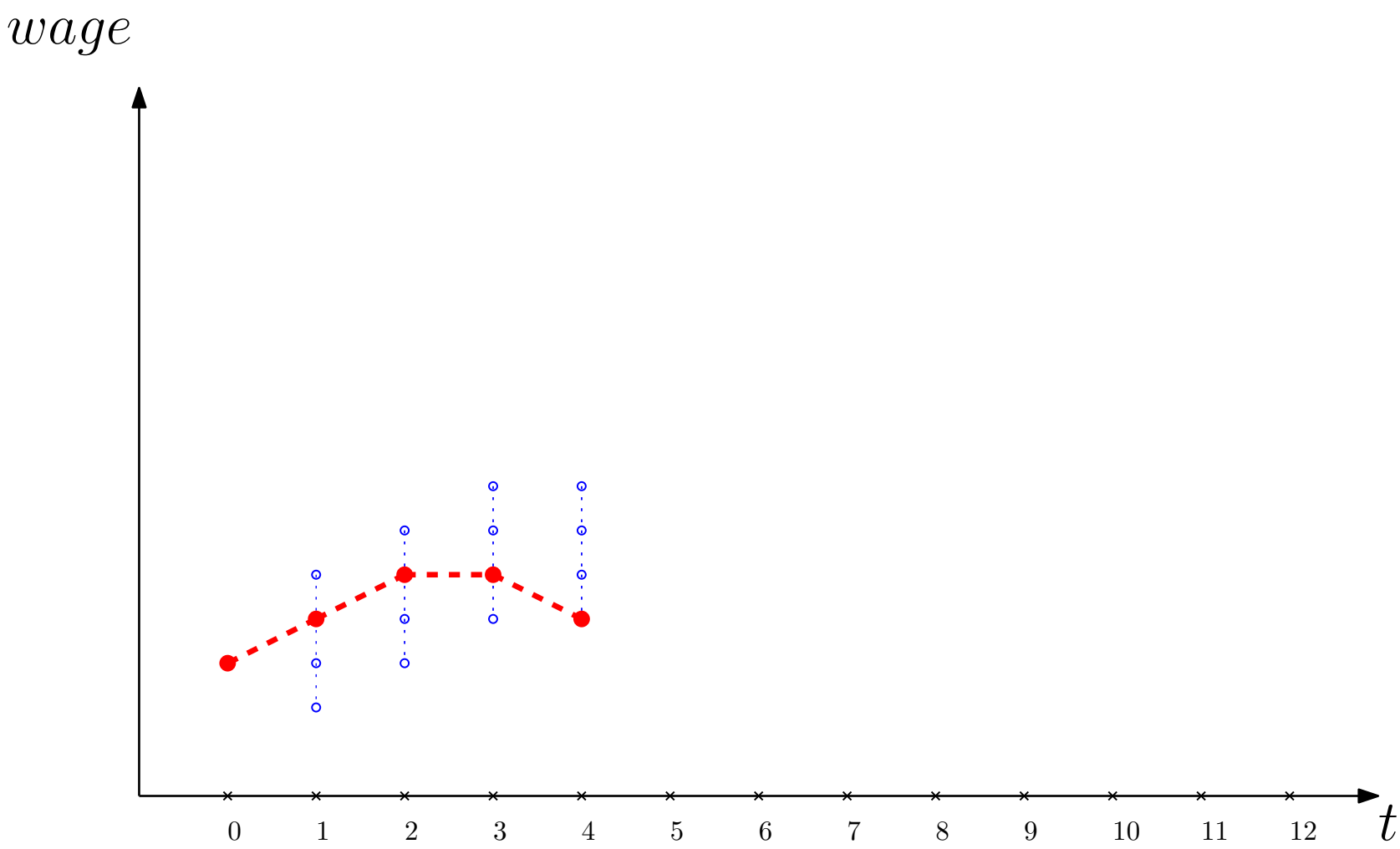

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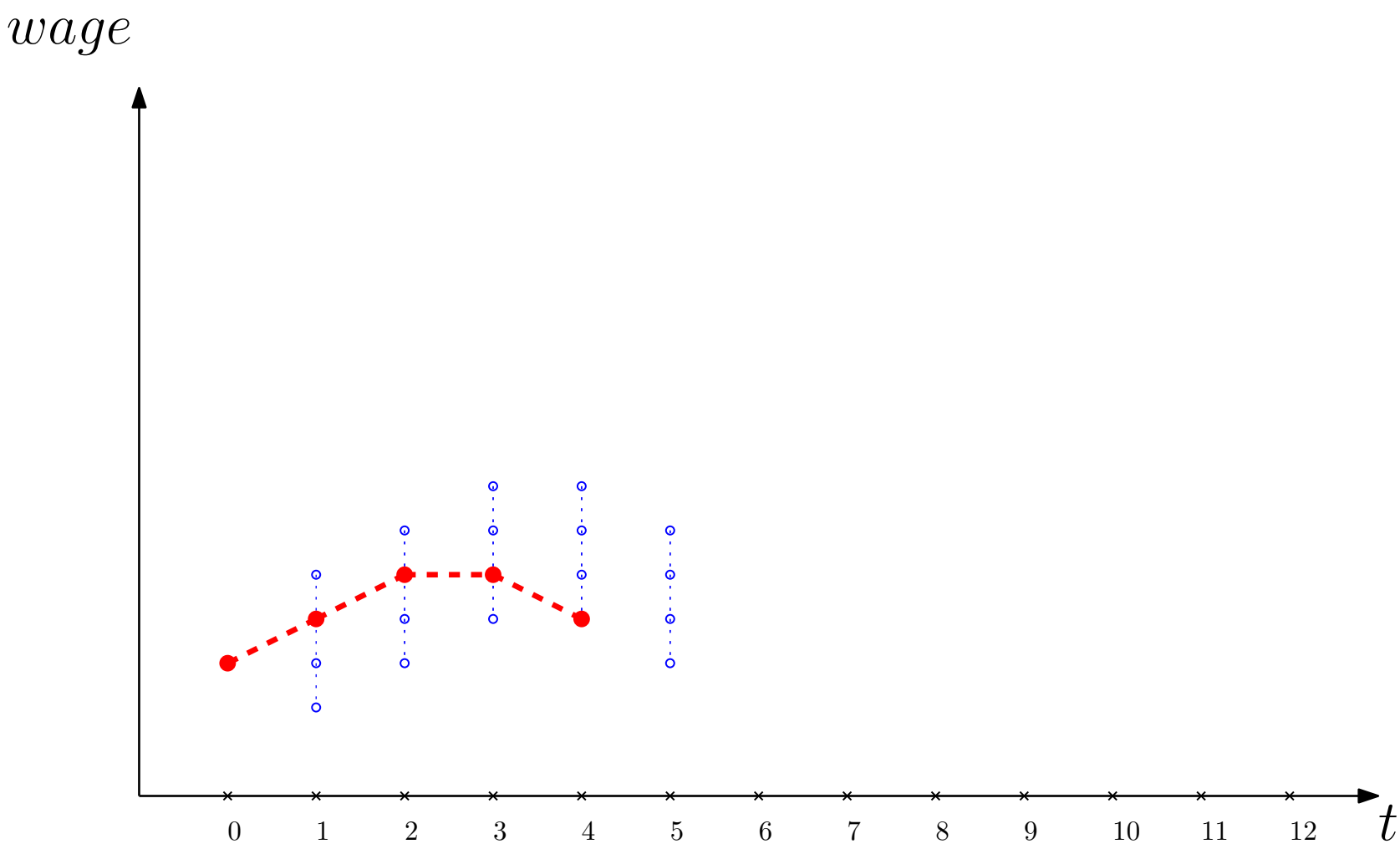

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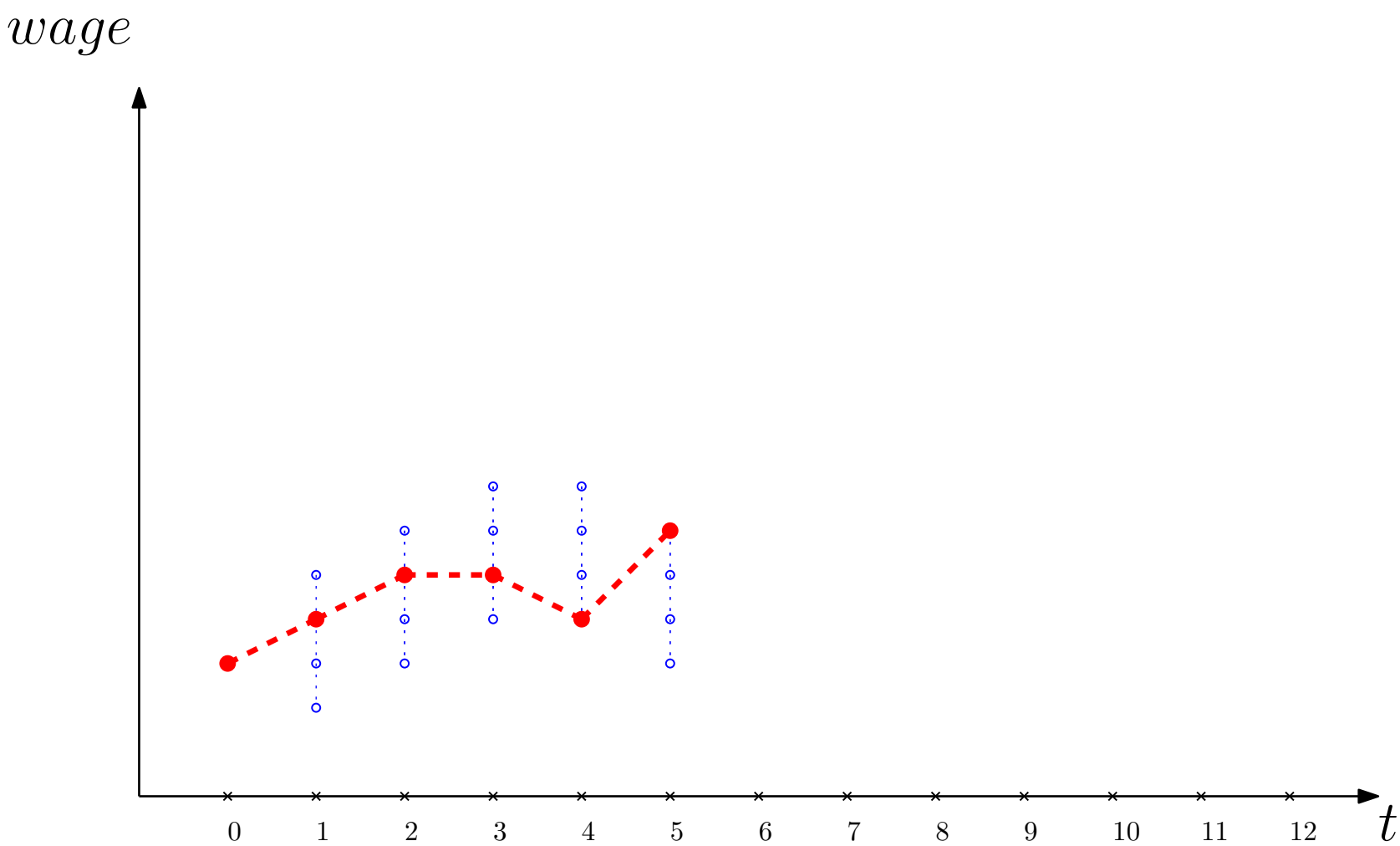

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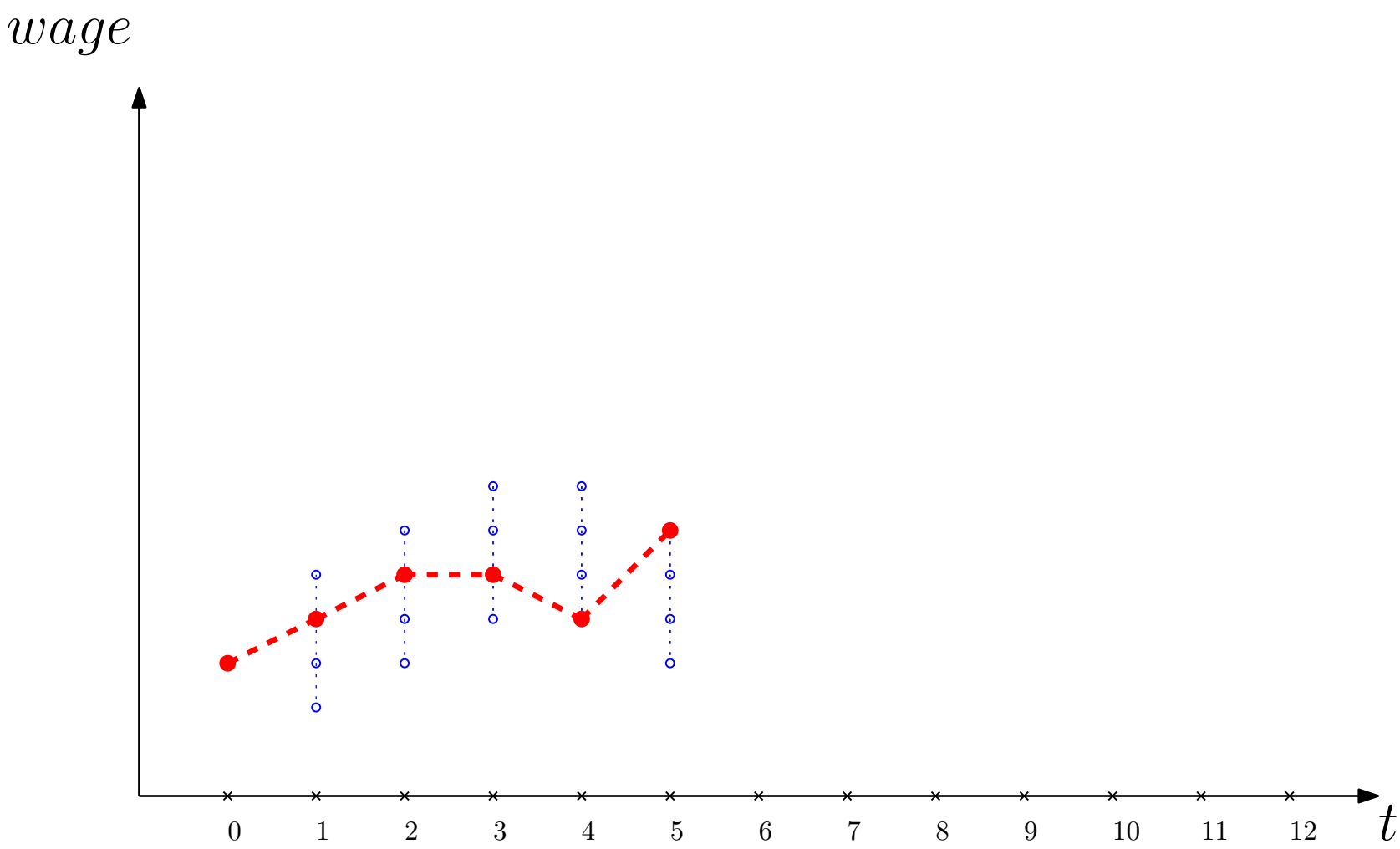

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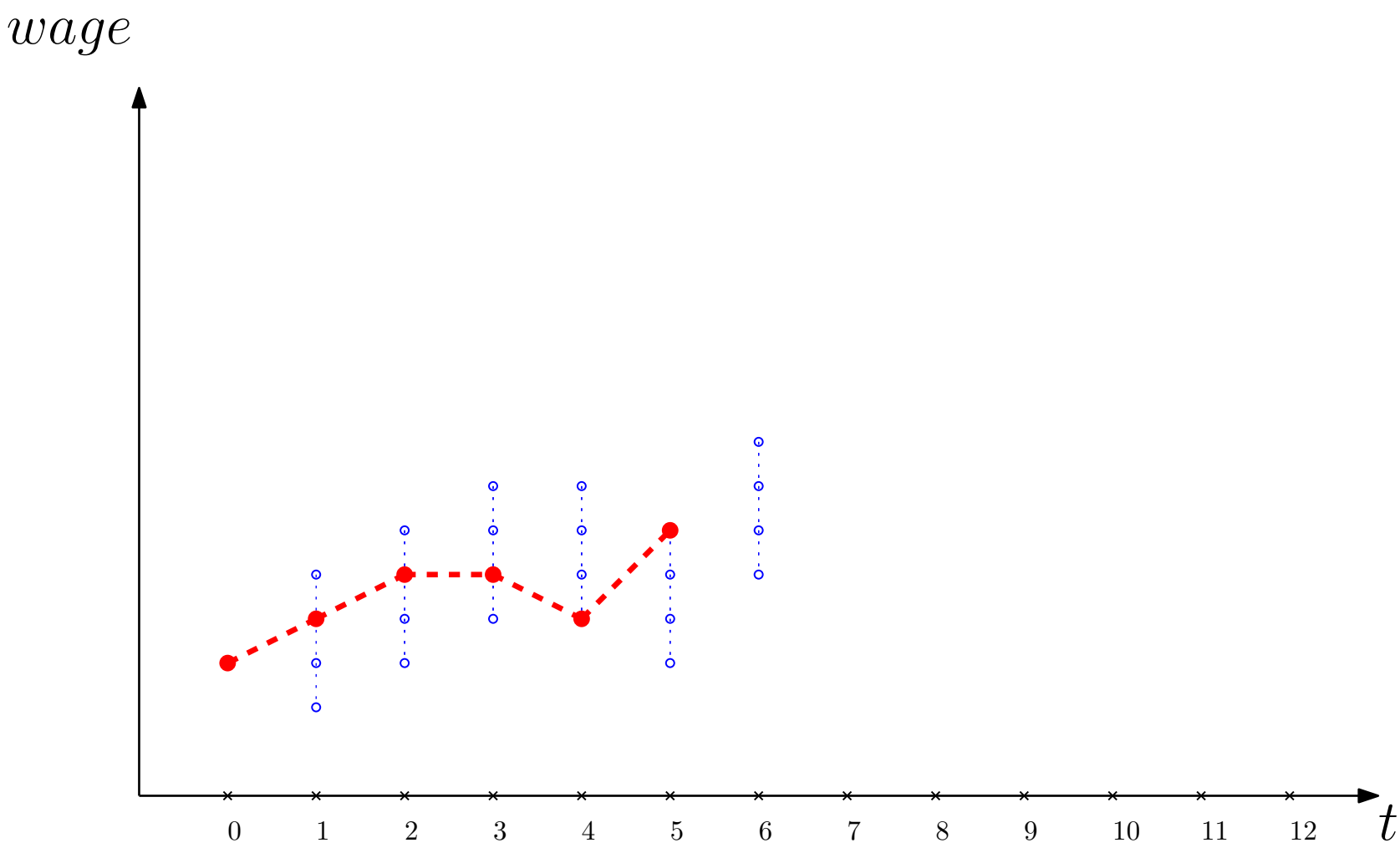

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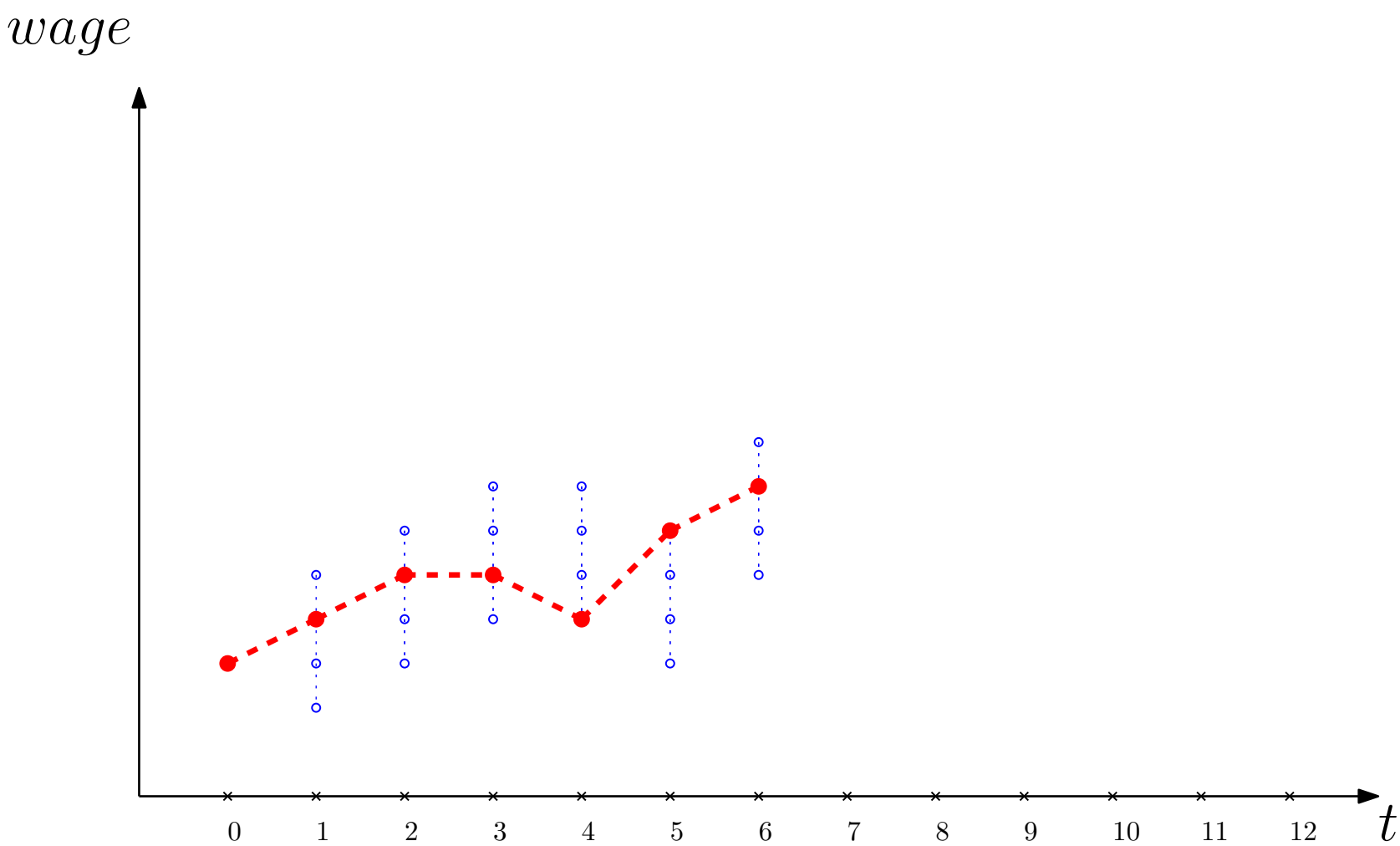

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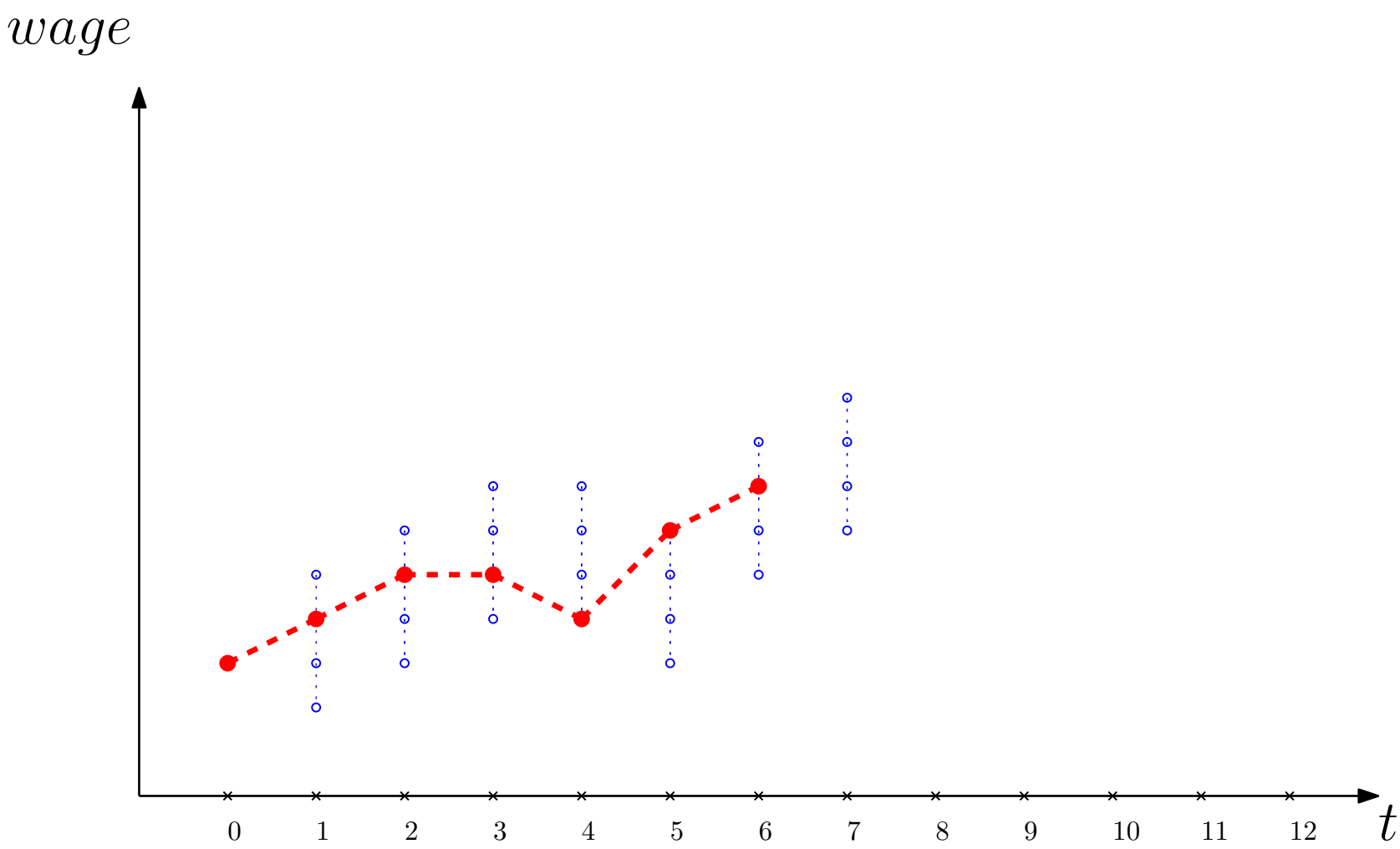

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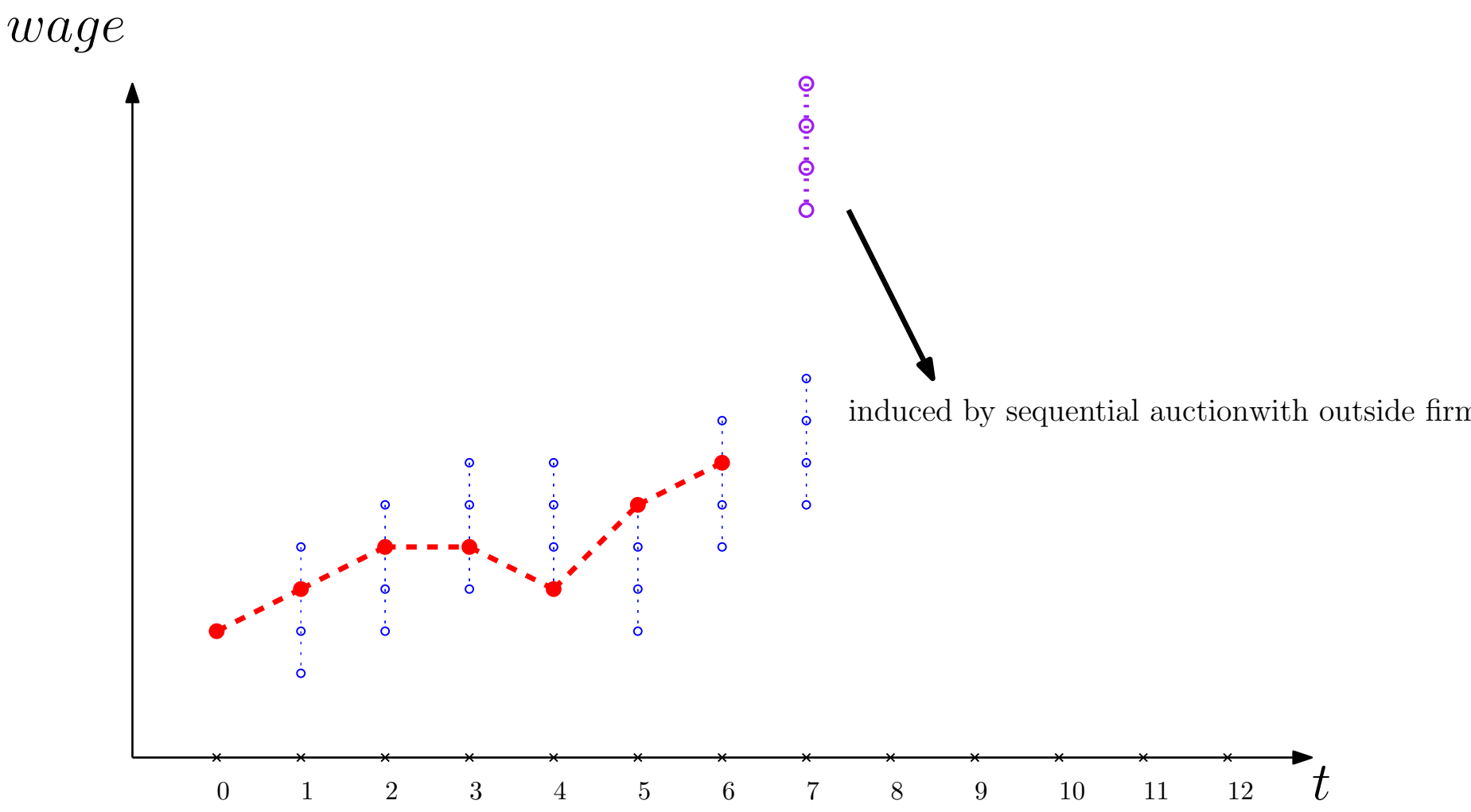

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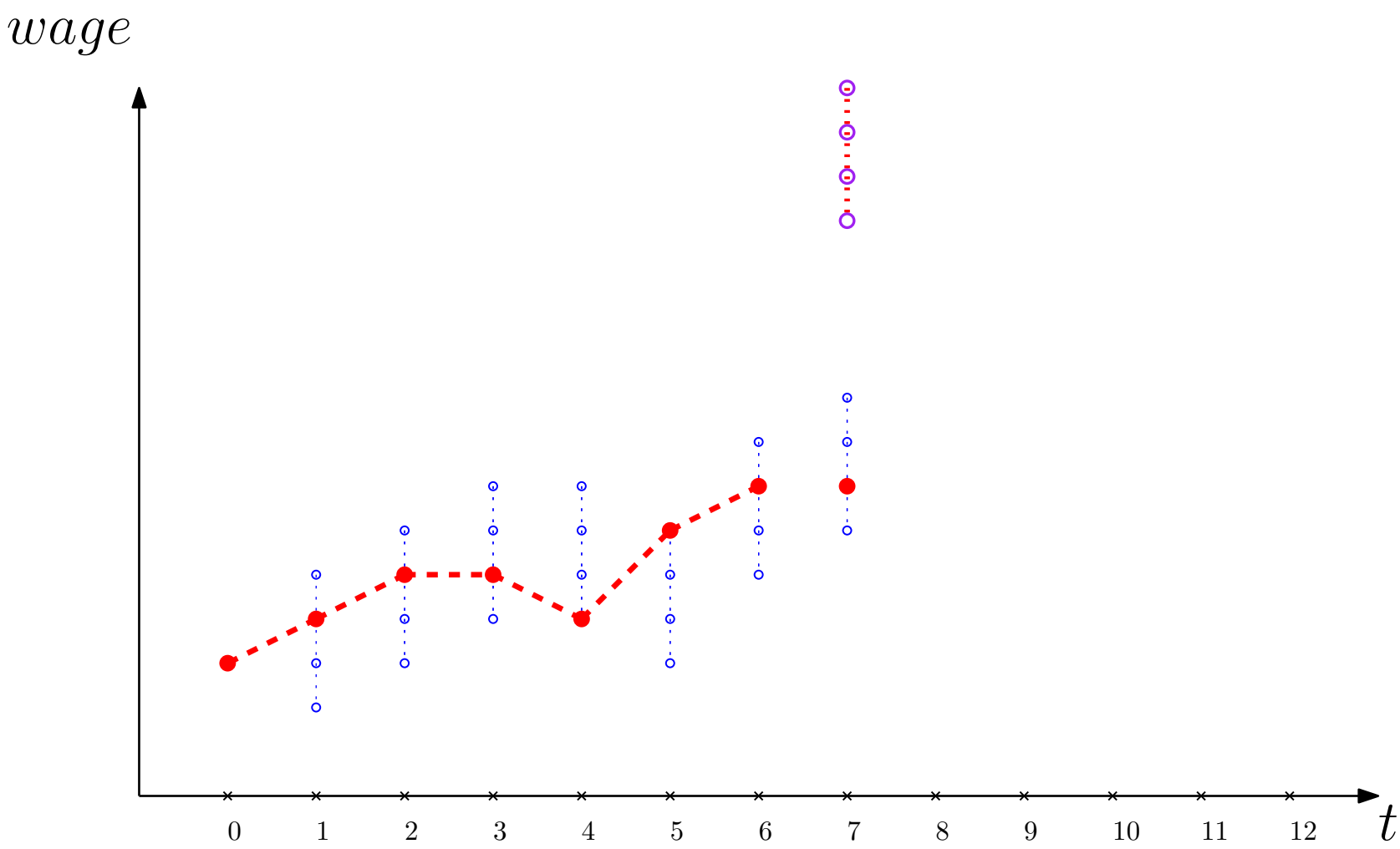

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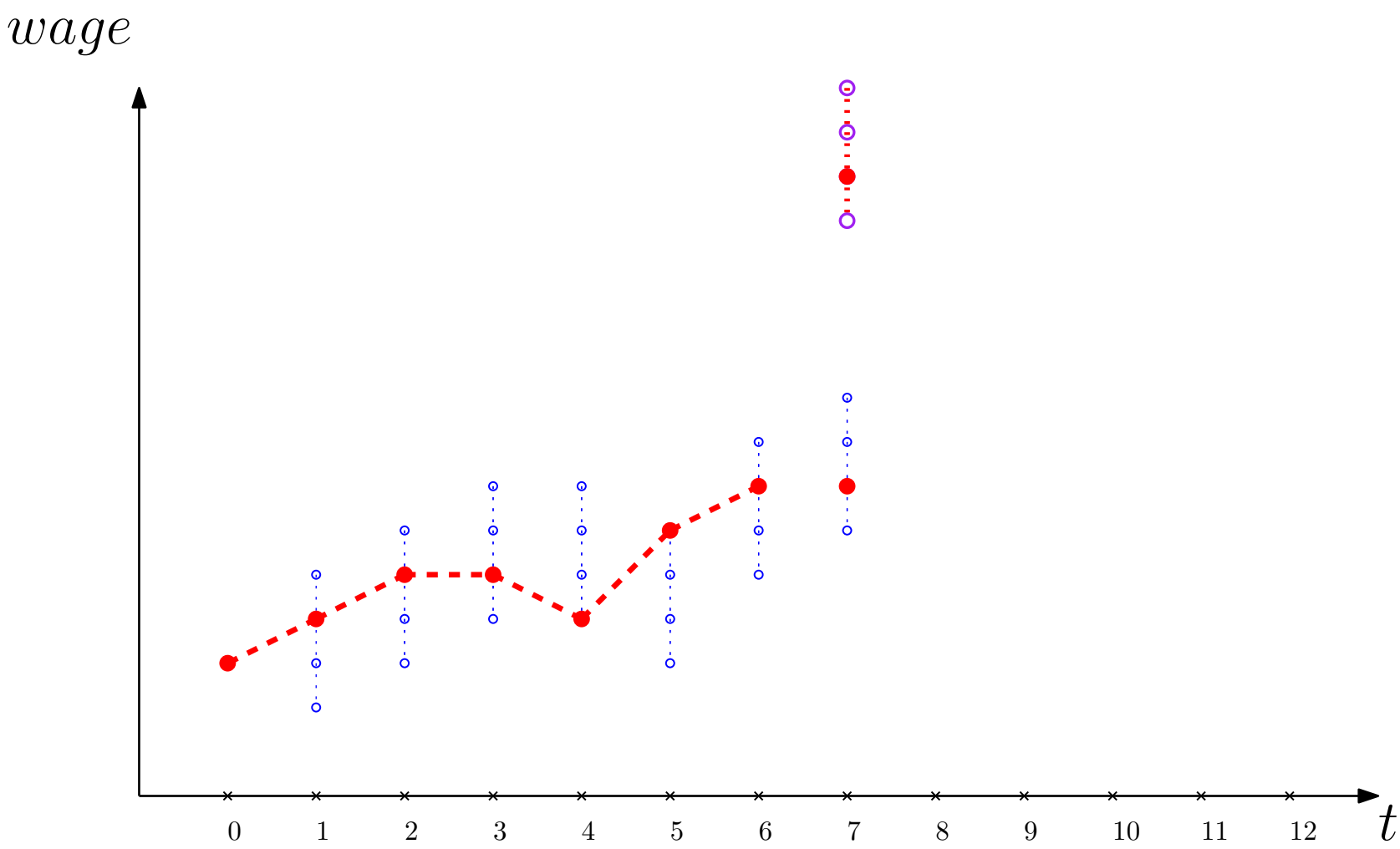

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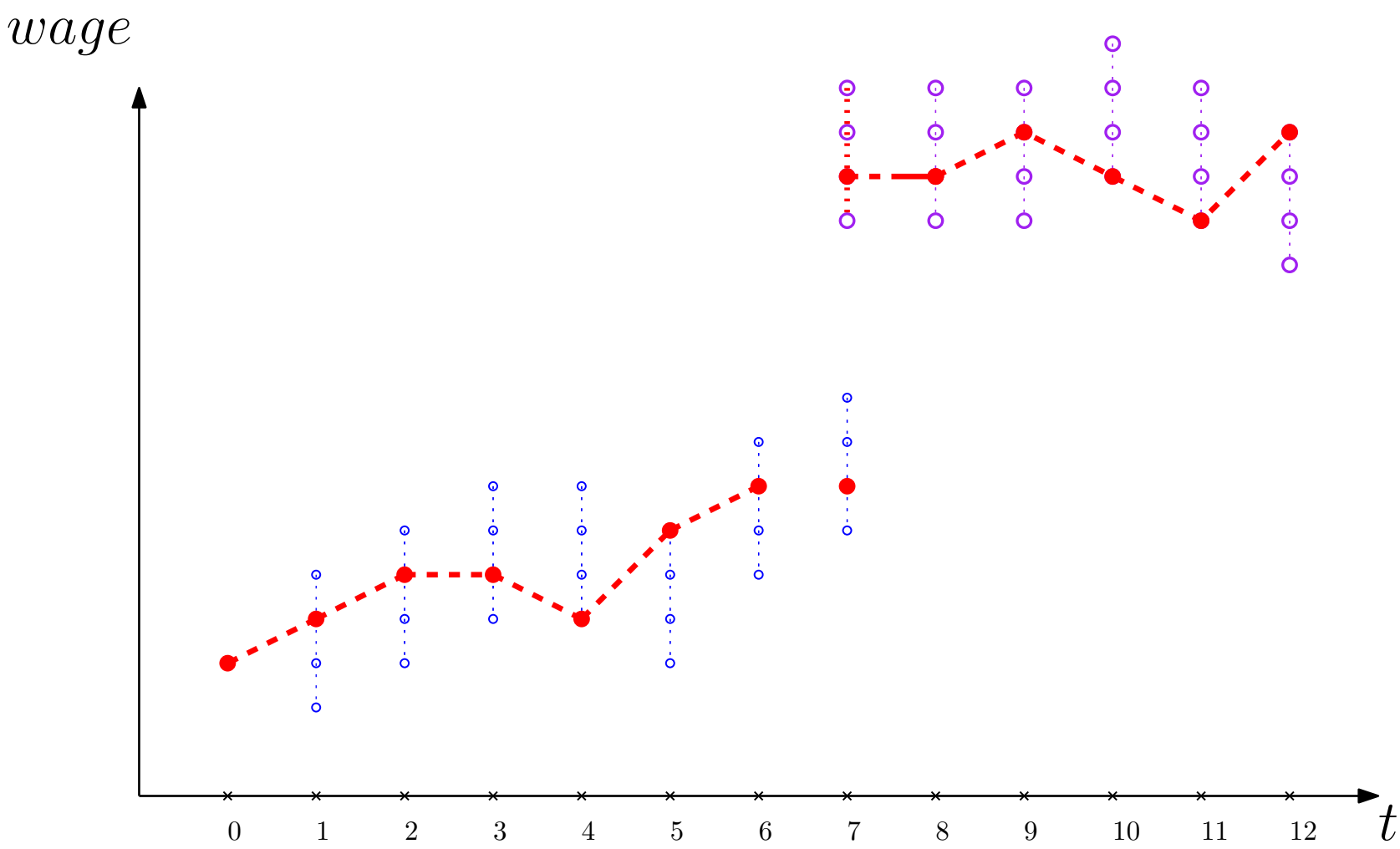

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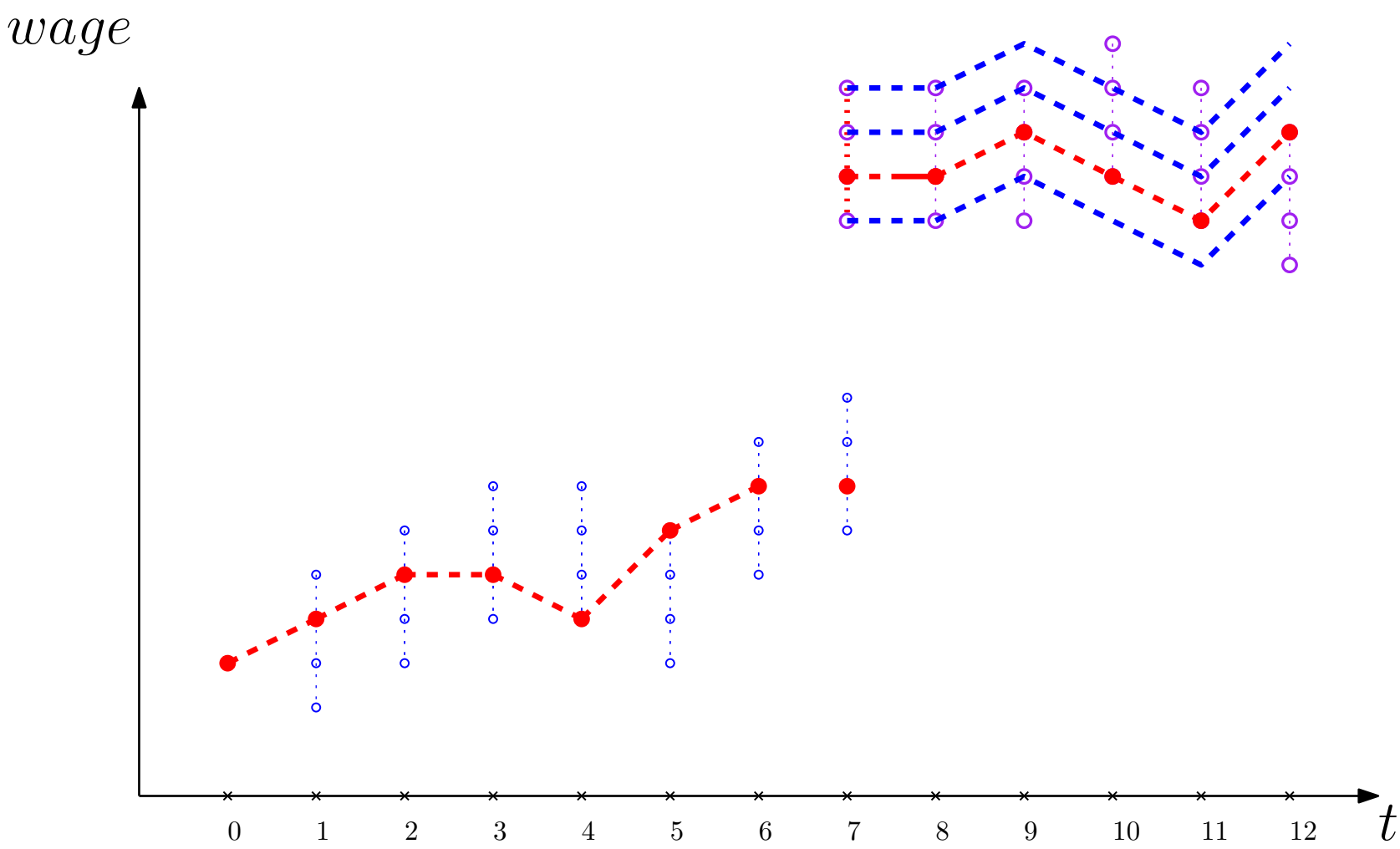


Why does compensation grow faster in larger firms?

Three sets of poaching offers

Three sets of outside firms s':

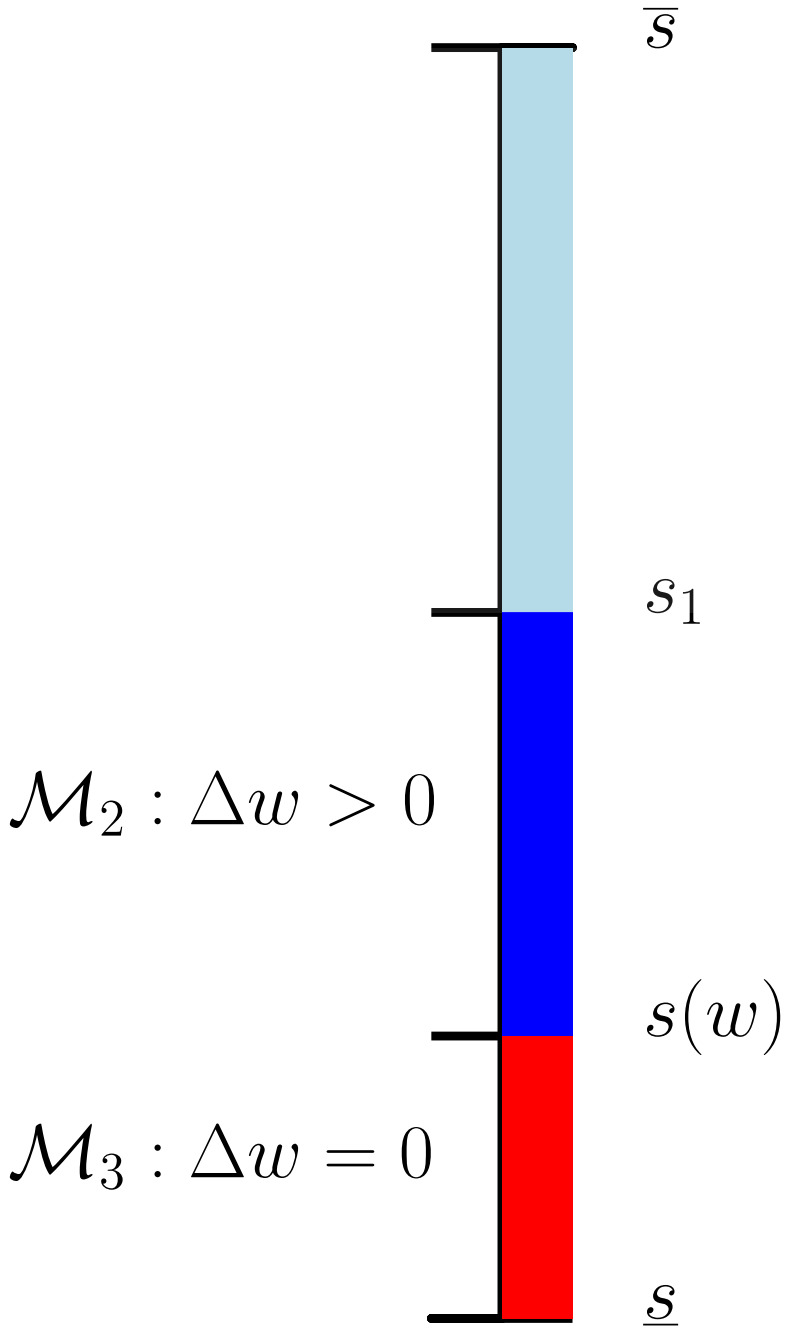
$\mathcal{M}_1 : s' \geq s$, lead to job turnovers

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

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

The continuation value of an executive is

$$\underbrace{\sum_{s' \in \mathcal{M}_1} F(s') \mathbb{E}[\overline{W}(z', s)] + \sum_{s' \in \mathcal{M}_2} \mathbb{E}[\overline{W}(z', s')] F(s')}_{\text{labor market driven}} + \underbrace{\sum_{s' \in \mathcal{M}_3} F(s') \mathbb{E}[W(z')]}_{\text{promise driven}}$$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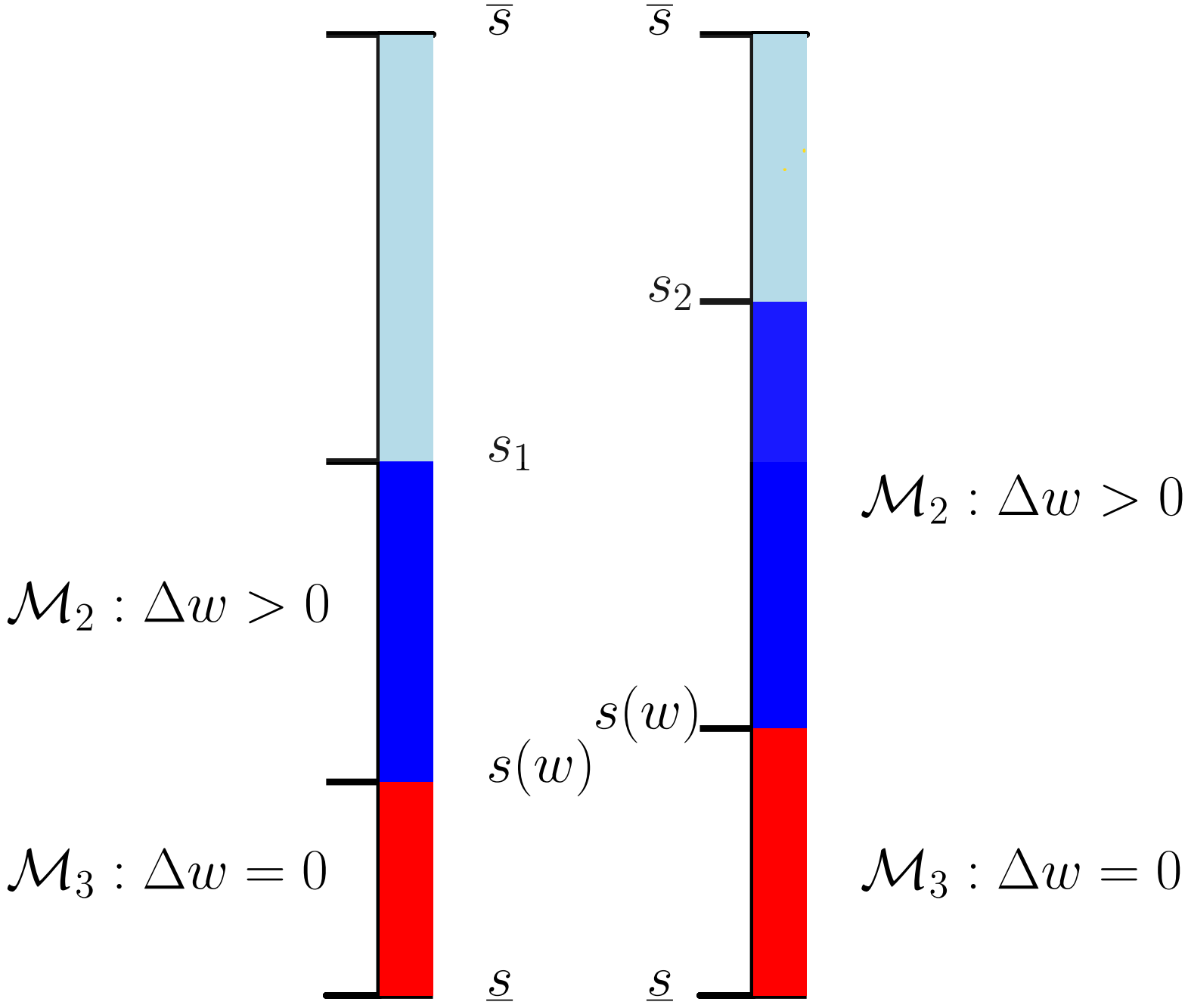
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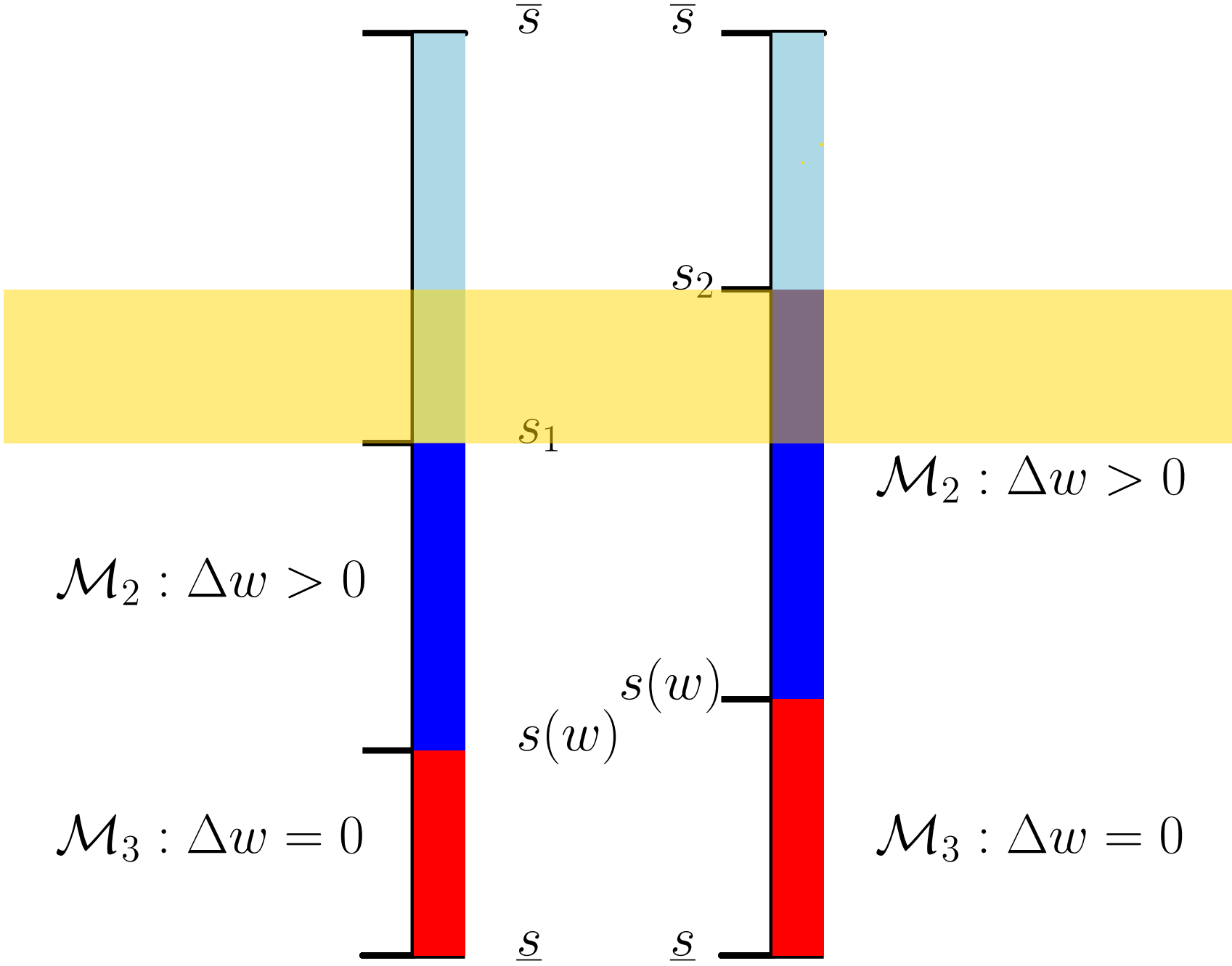
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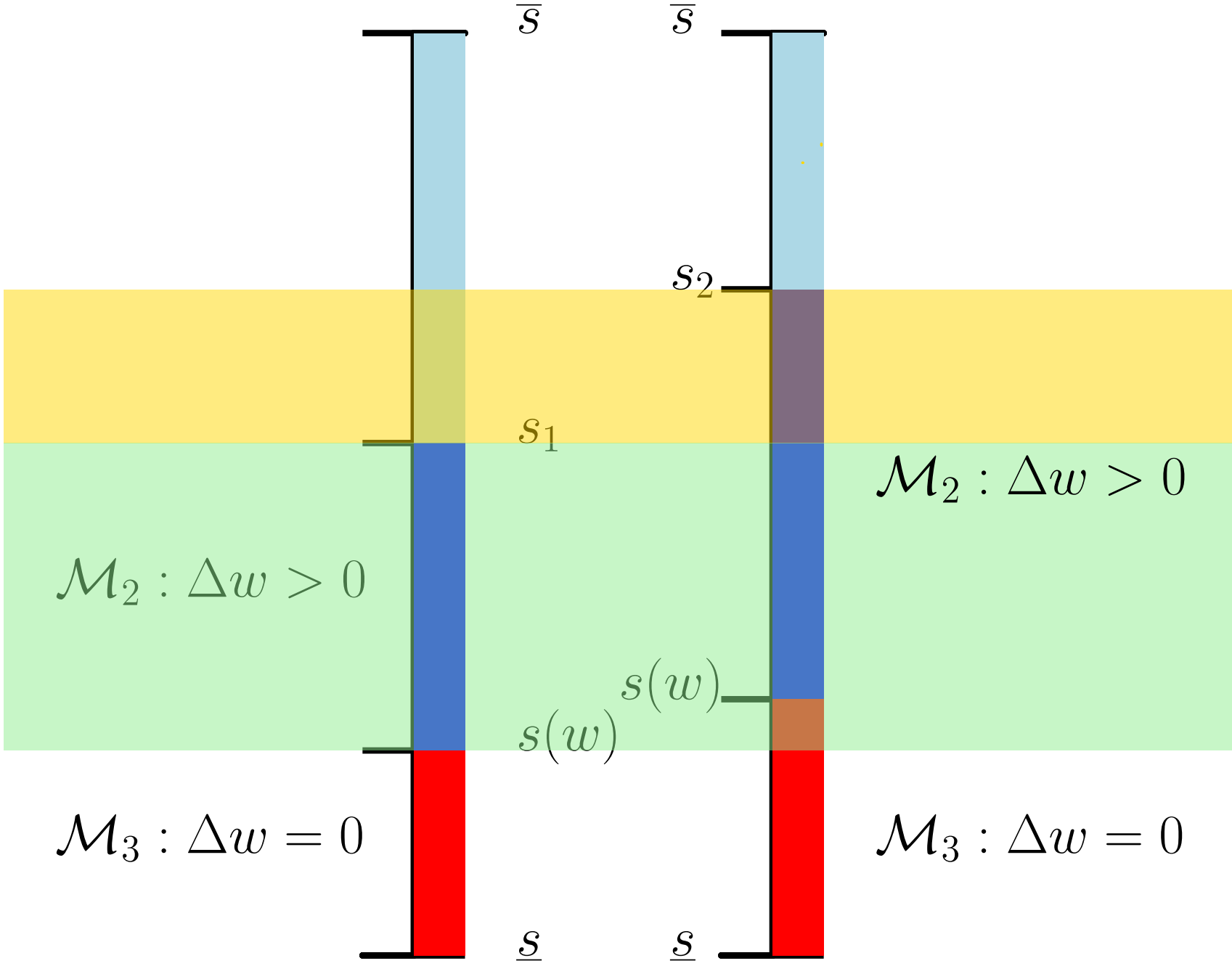
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Why do performance-based incentives increase in firm size?

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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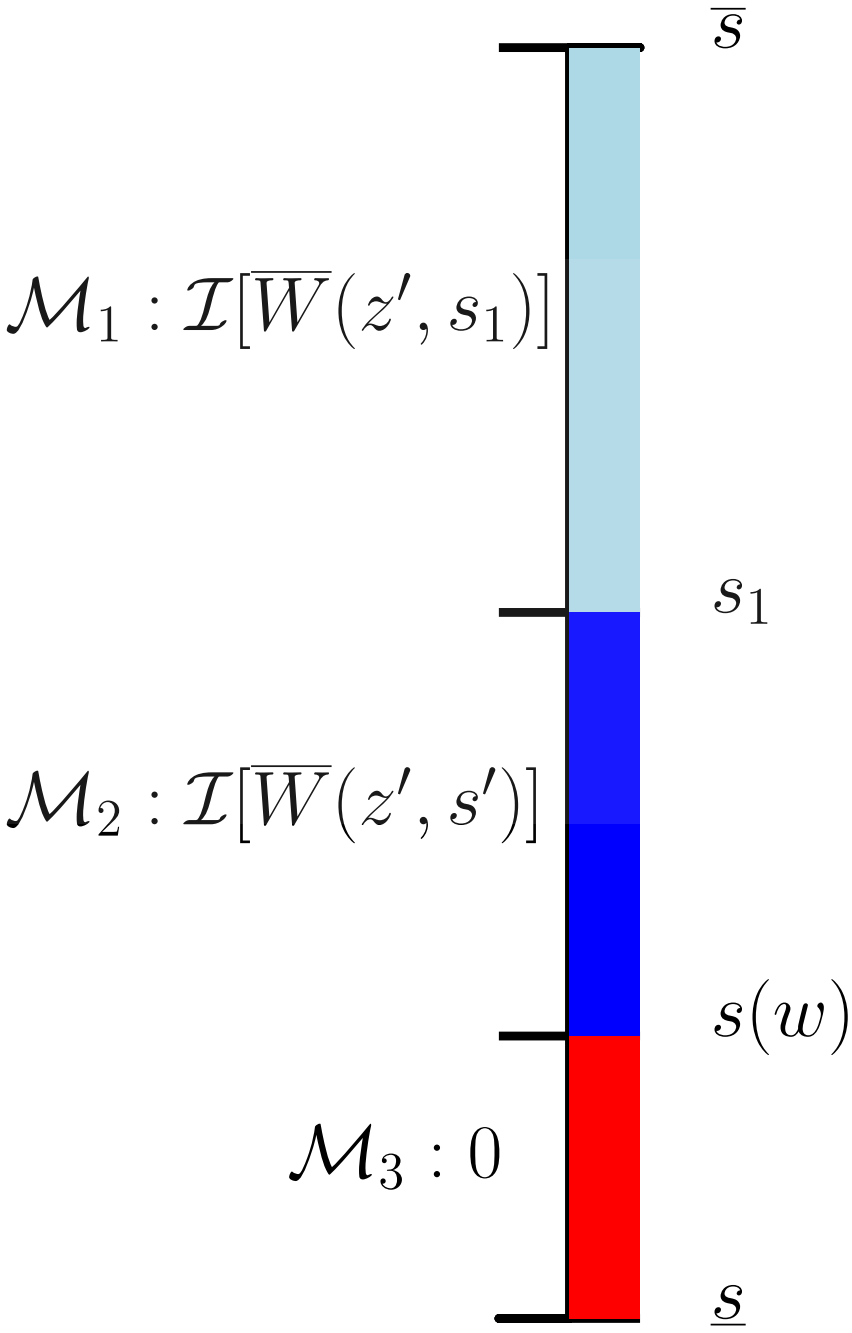
$$\underbrace{\sum_{s' \in \mathcal{M}_1} F(s')\mathcal{I}[\overline{W}(z', s)] + \sum_{s' \in \mathcal{M}_2} \mathcal{I}[\overline{W}(z', s')]F(s')}_{\text{Labor Market Incentives}} + \underbrace{\sum_{s' \in \mathcal{M}_3} F(s')\mathcal{I}[W(z')]}_{\text{Performance-based Incentives}} \geq c.$$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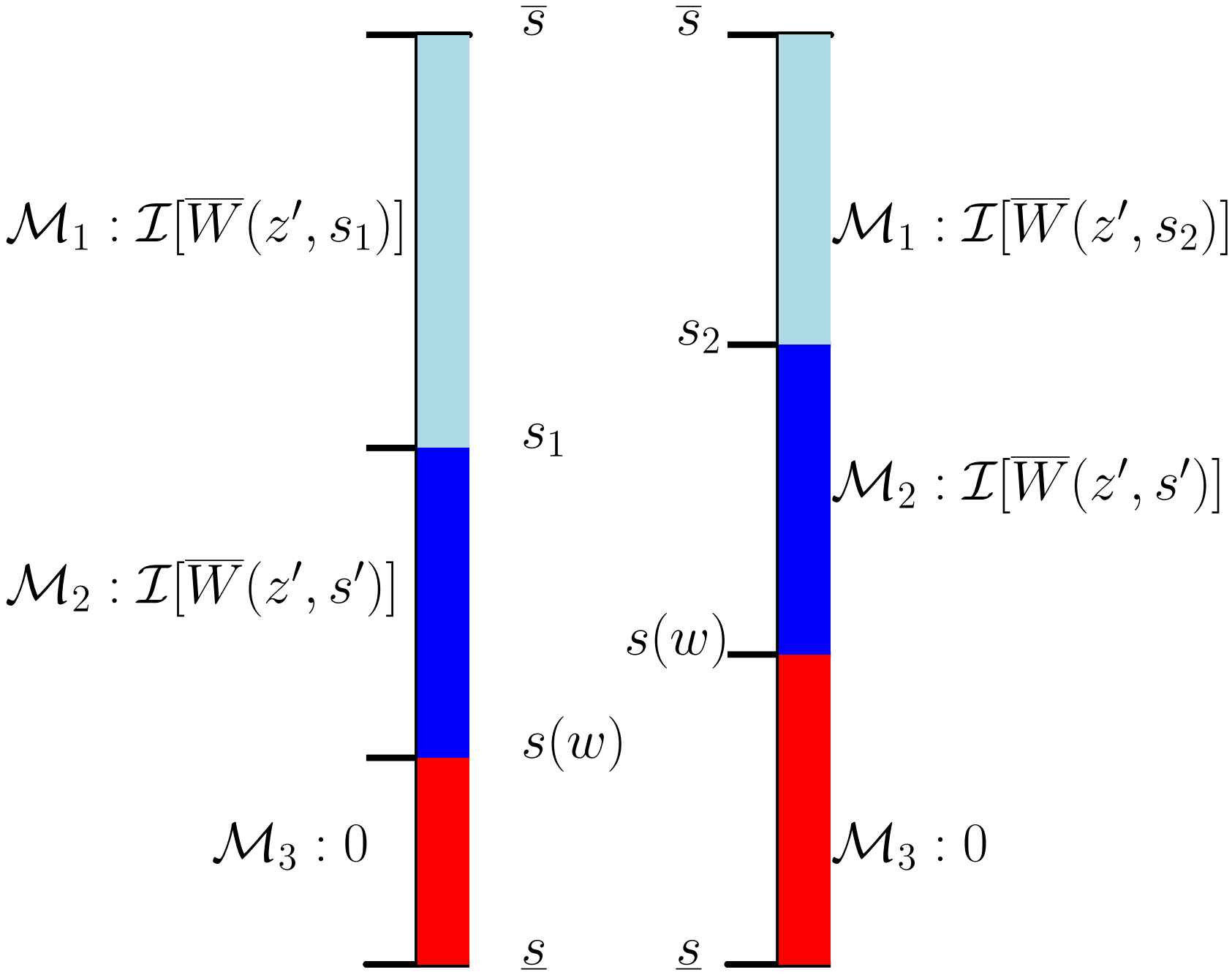
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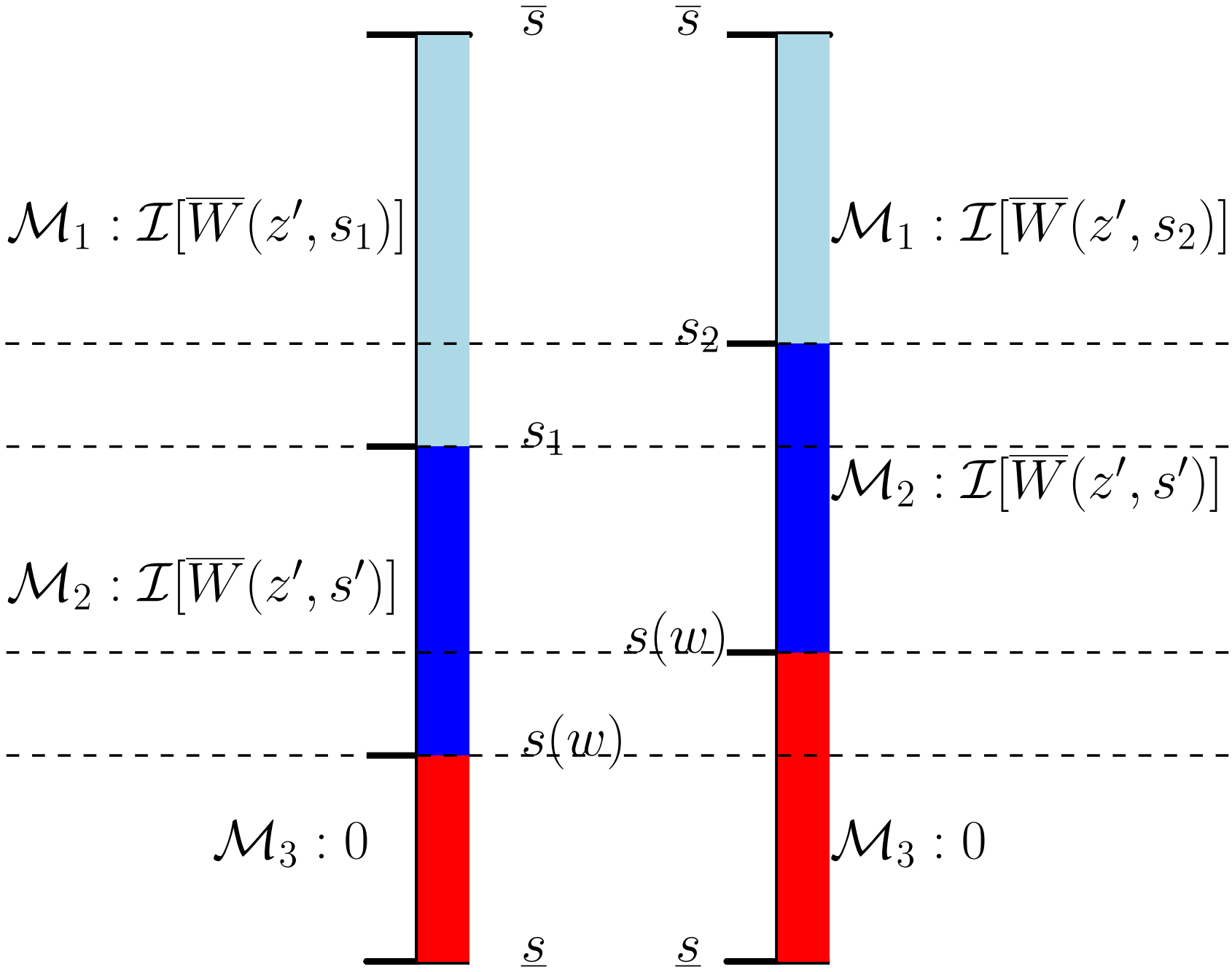
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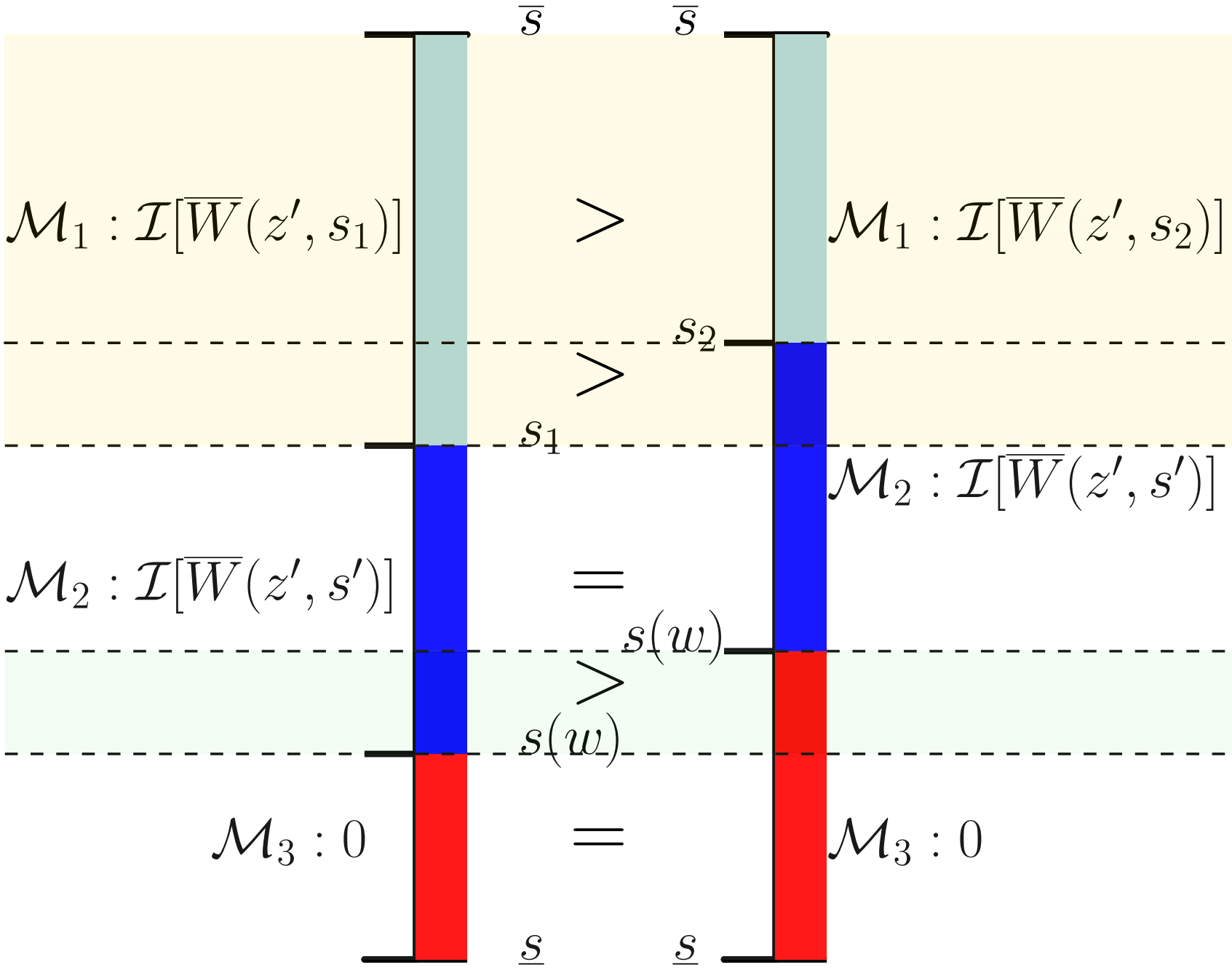
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$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_1)]$
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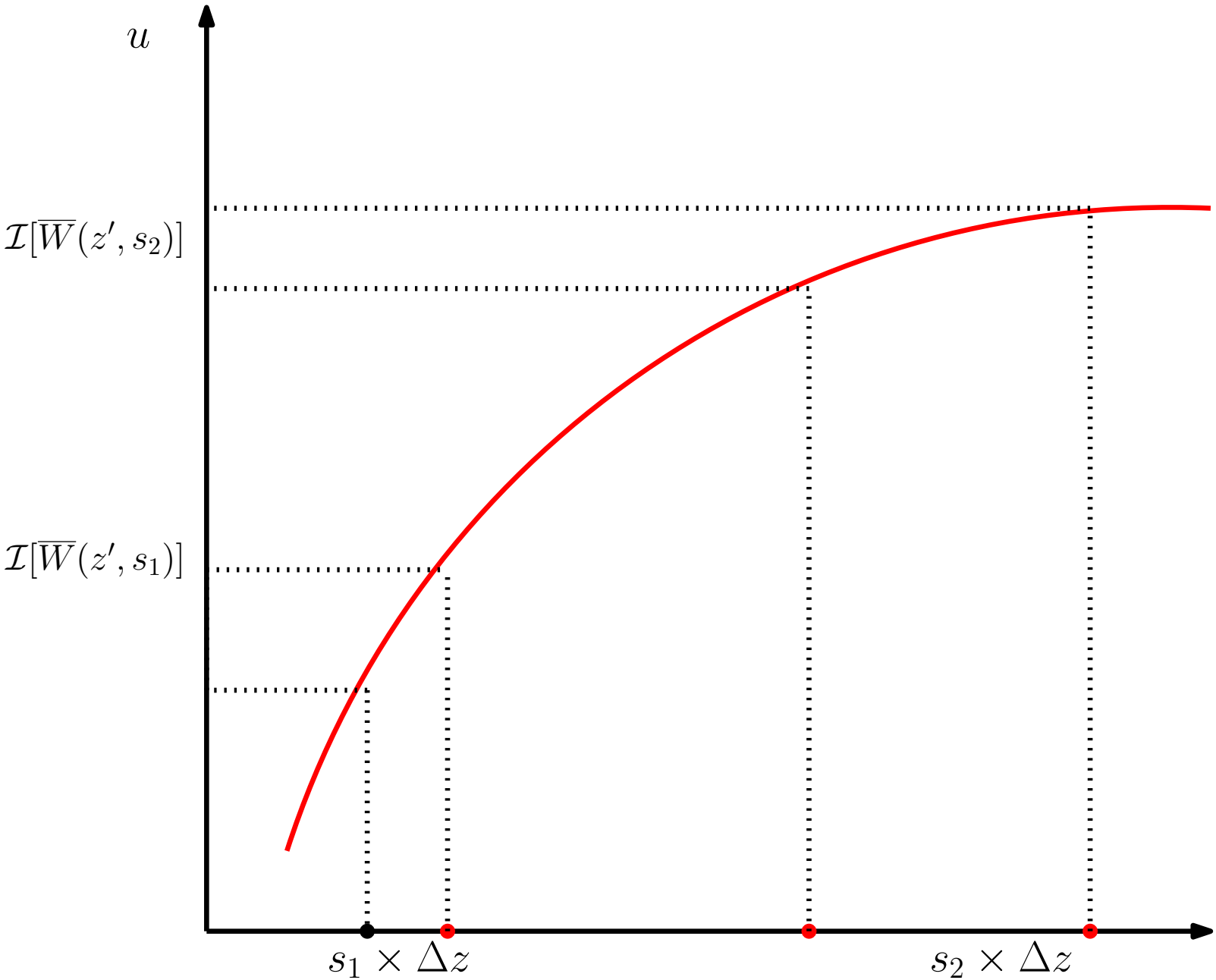
$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_2)]$
s_2
$>$
s_1
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
$=$
$s(w)$
$>$
$s(w)$
$\mathcal{M}_3 : 0$
$=$
$\mathcal{M}_3 : 0$
$\underline{s}$
$\underline{s}$

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 $\mathcal{I}\Big(\overline{W}(z', s)\Big)$ 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.

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

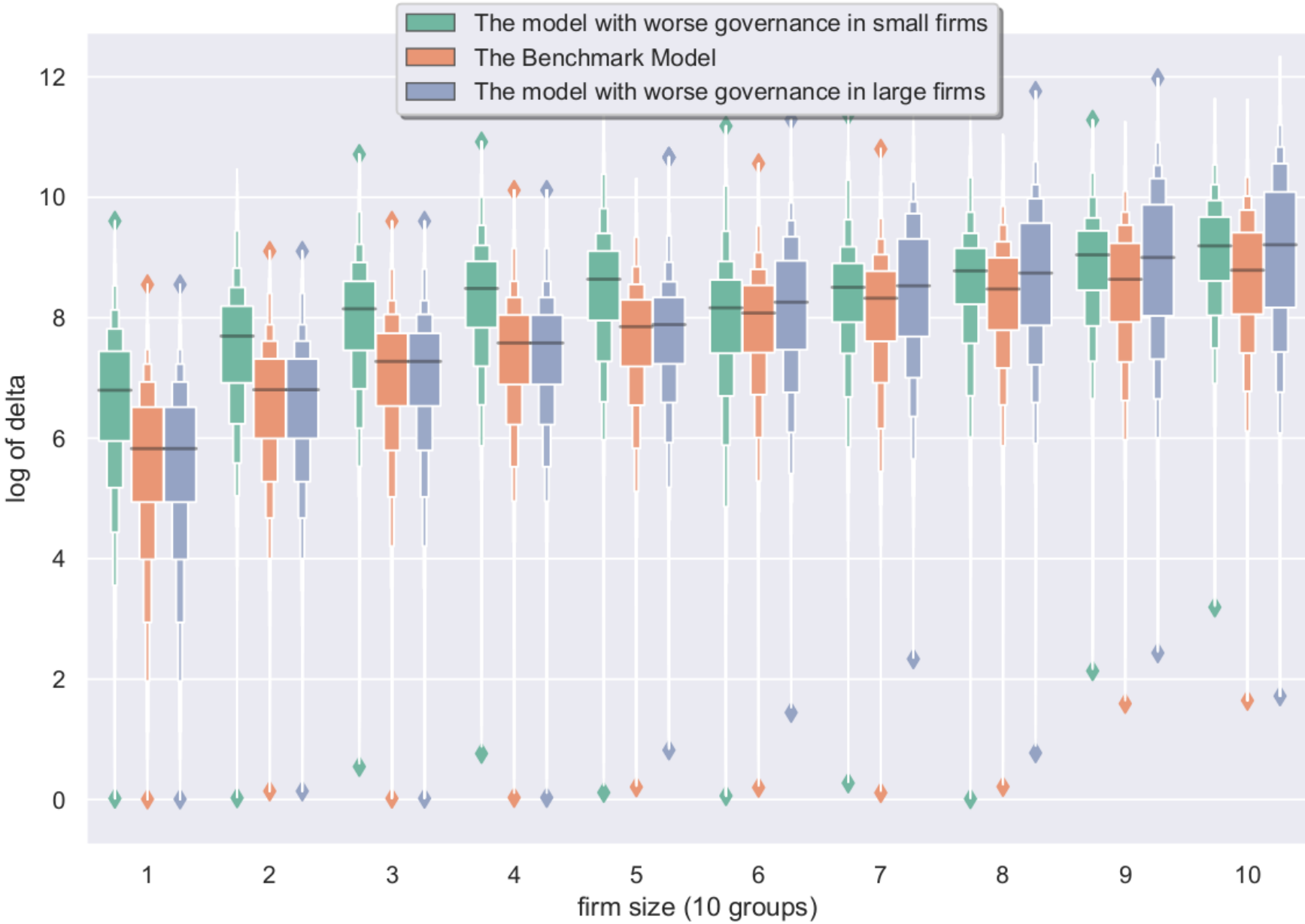
- These moments are not targeted.
- They are predicted by the estimated model.
- The model quantitatively captures the two premiums. Details

Policy Implication

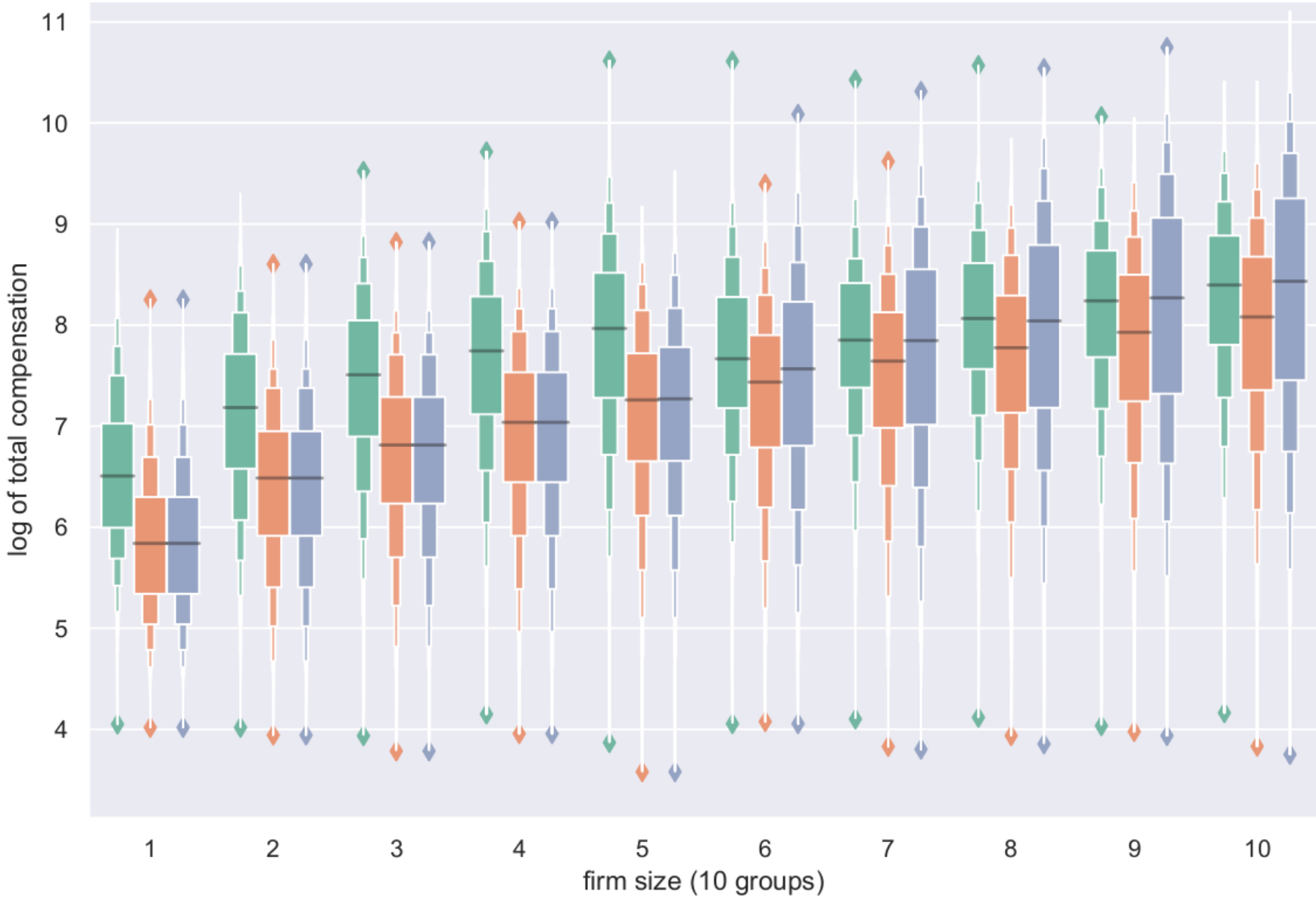
Policy: Spillover effect

- 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

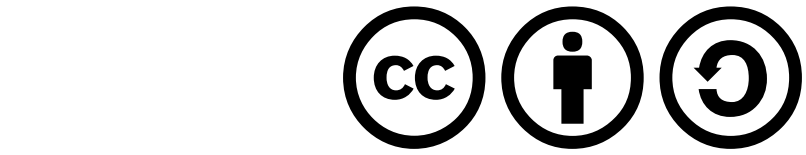
Conclusion

- 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.

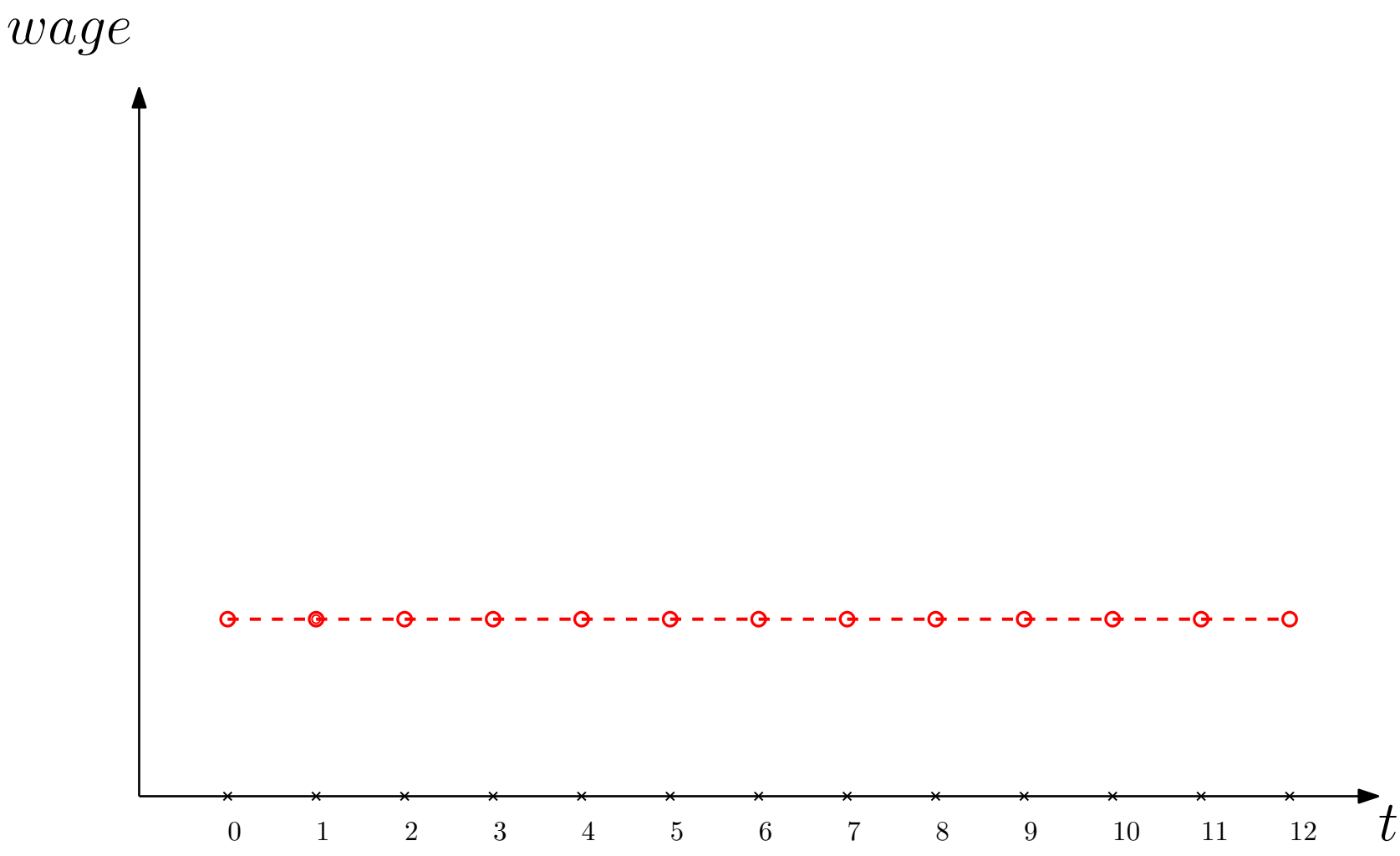
- Structure estimates show the model captures the firm size premium in compensation growth and performance-based incentives.

Thanks you for your attention.

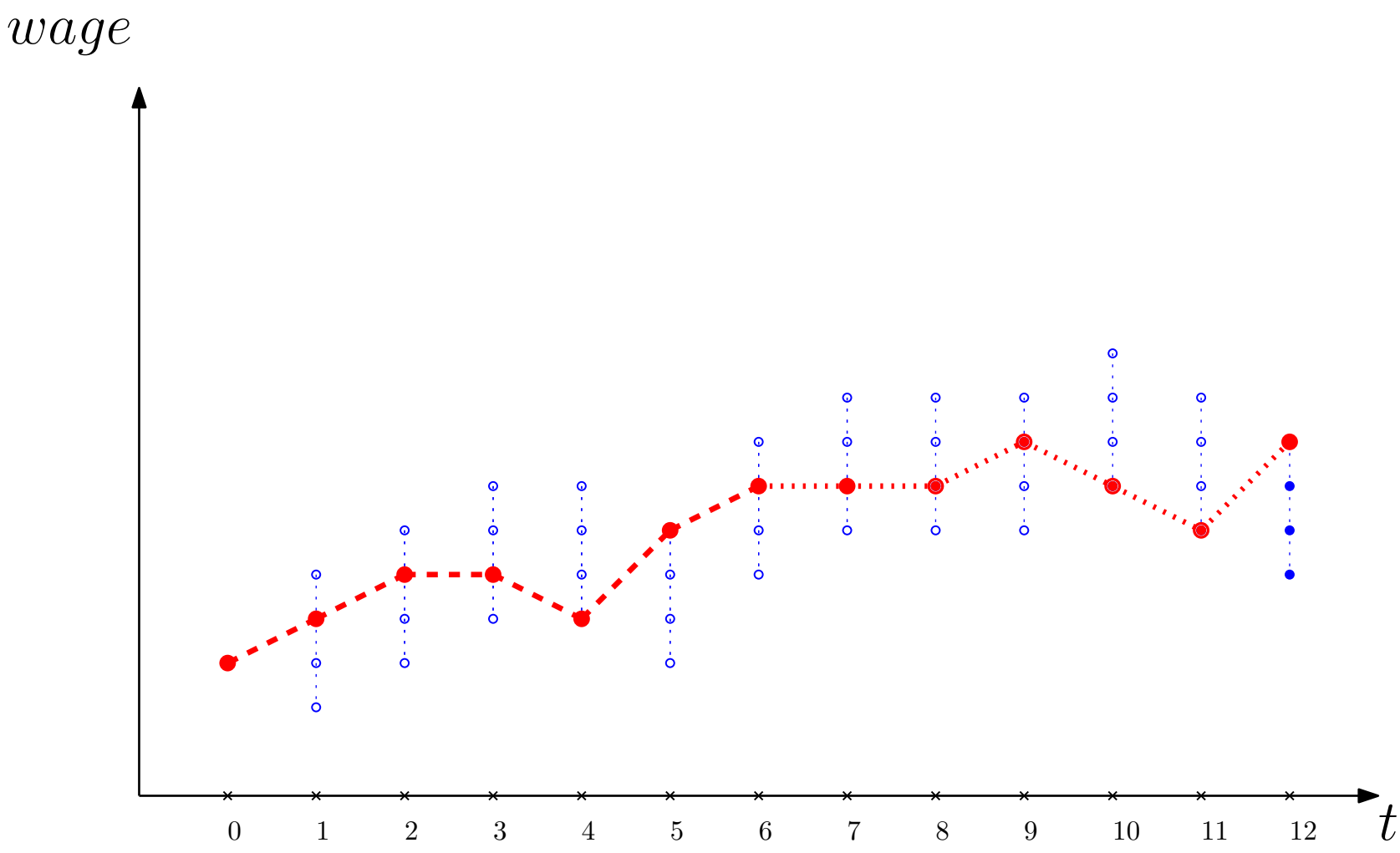
http://bohuecon.github.io



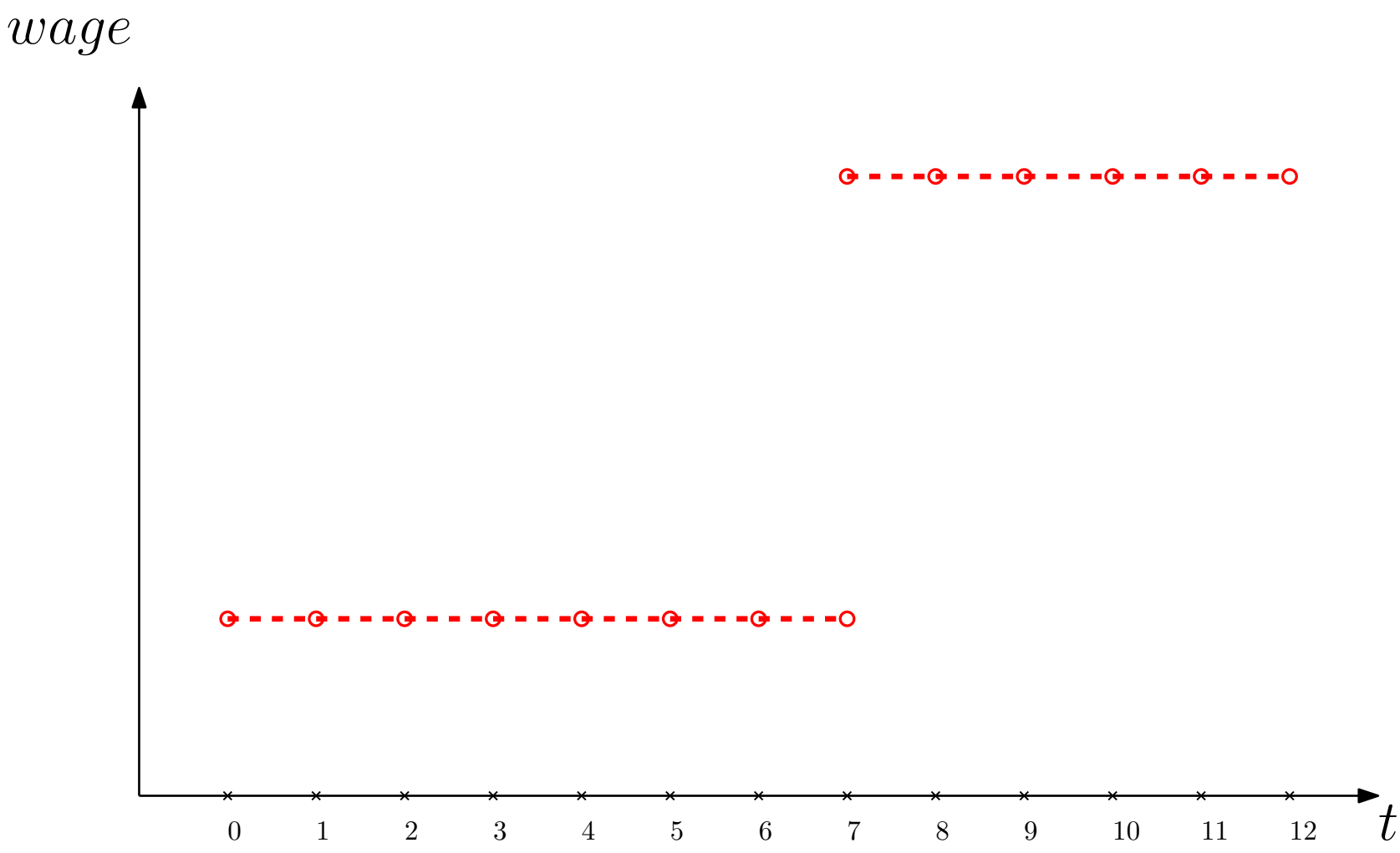
No Moral Hazard, Full Commitment



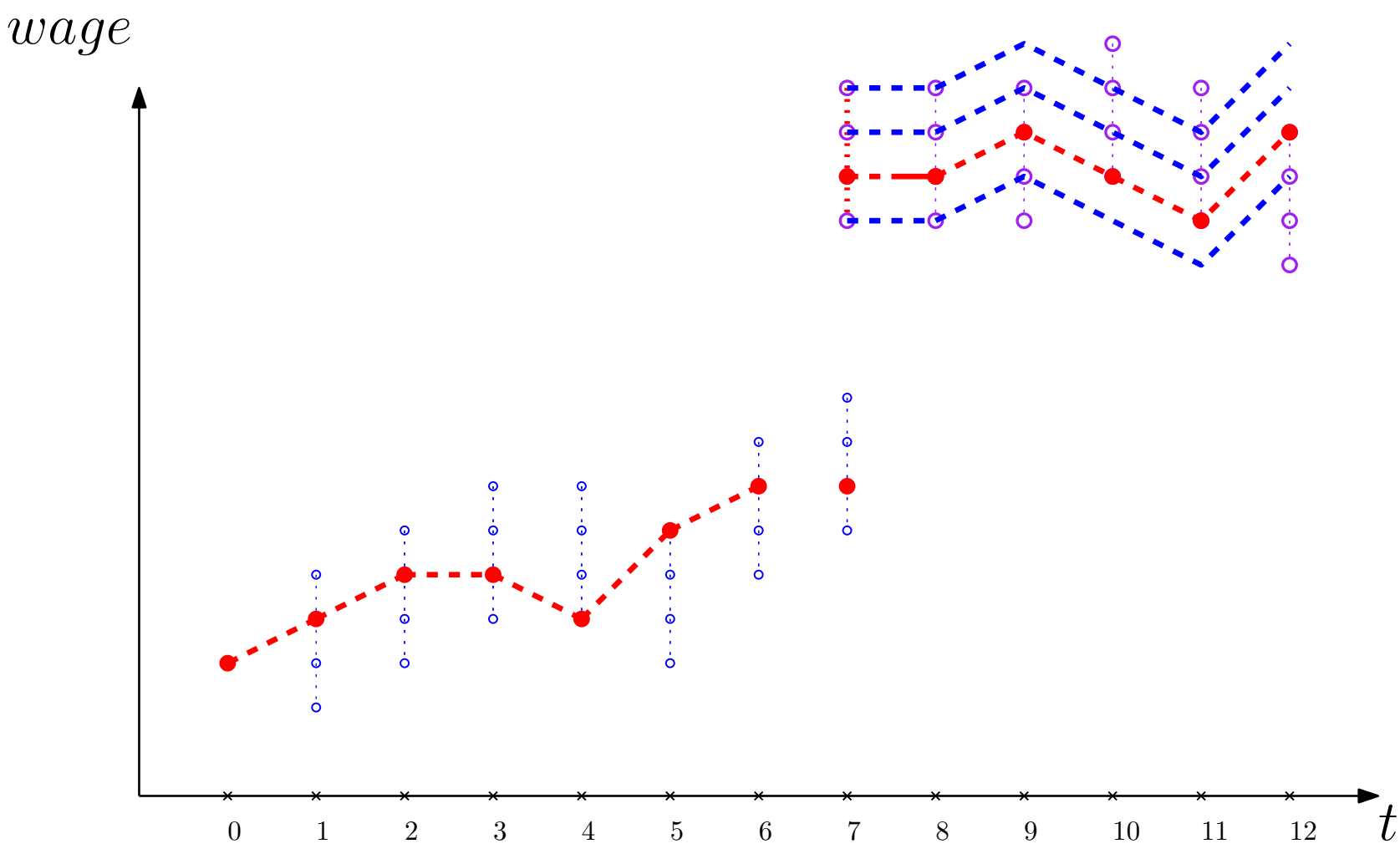
Only Moral Hazard



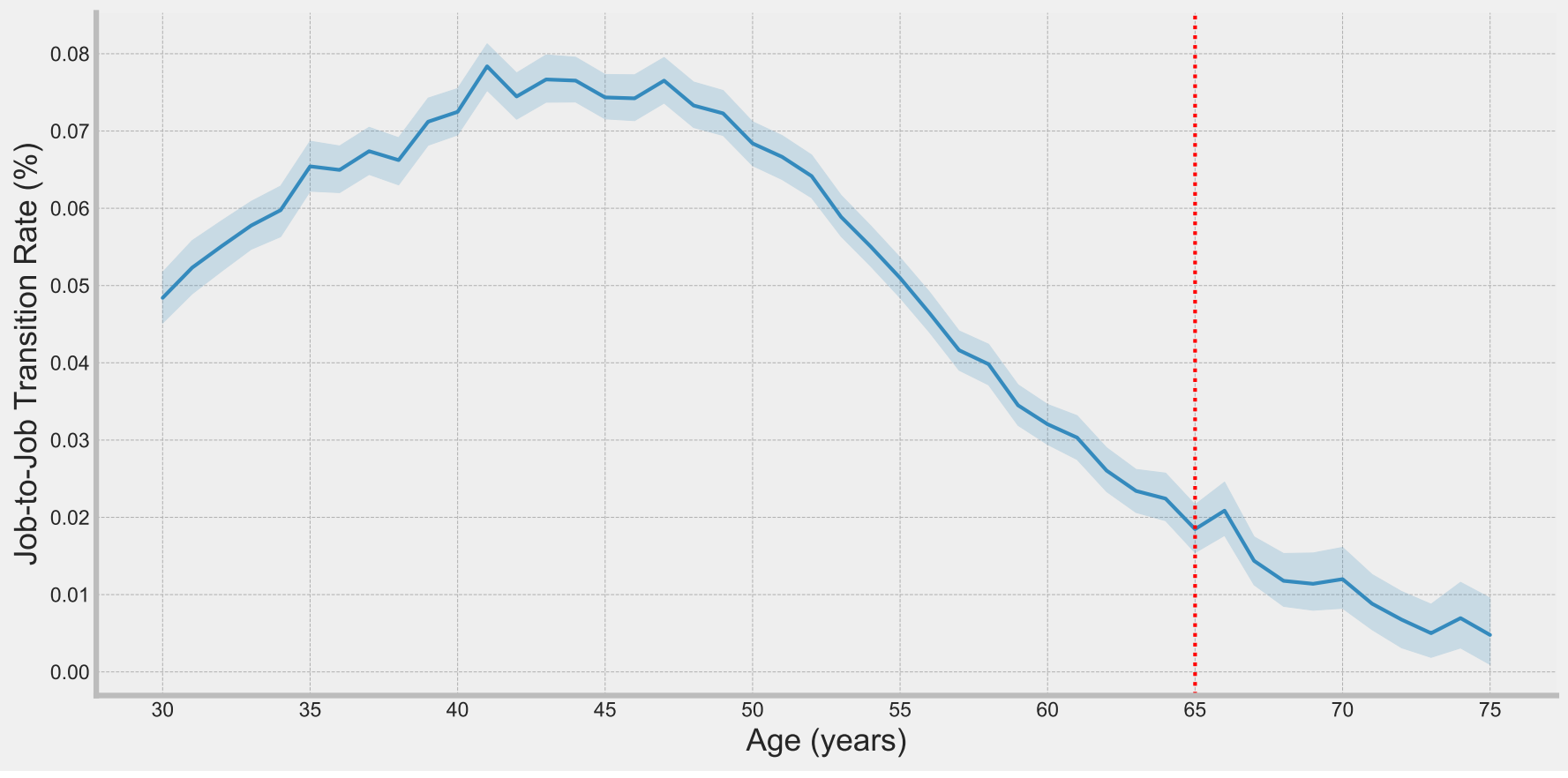
Only Limited Commitment



Optimal Contract



Job-to-job transition rate over age



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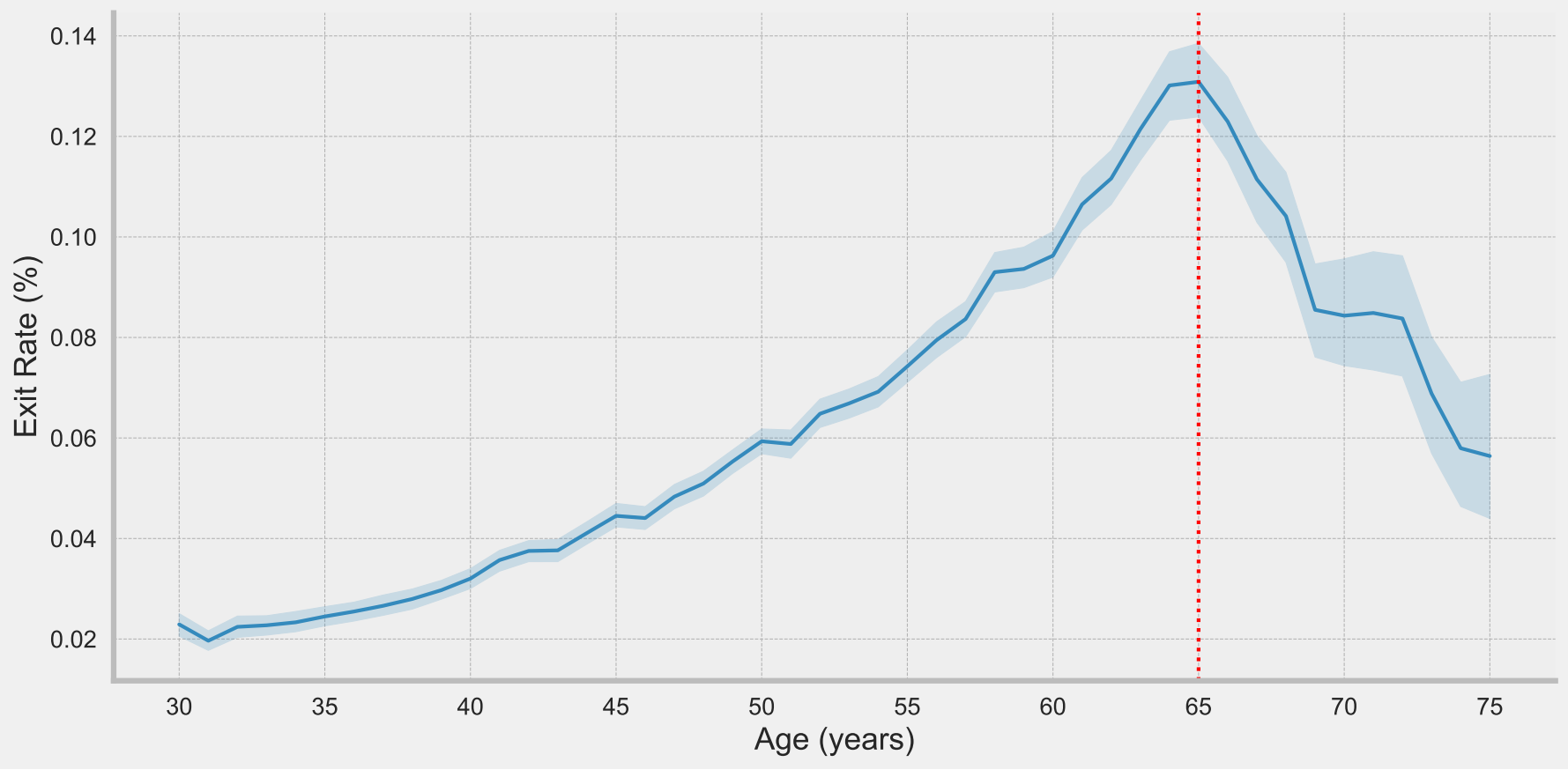
Exit rate over age



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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)
$log(firm\ size)_{-1}$			0.0711*			
$\times$ *EE90*			(0.0403)			
$log(firm\ size)_{-1}$				0.0759**		
$\times$ *EE190*				(0.0353)		
$log(firm\ size)_{-1}$					0.0233***	
$\times$ *gai*					(0.00546)	
$log(firm\ size)_{-1}$						-0.000232***
$\times$ *inside CEO*						(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) × *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***	-0.251***	-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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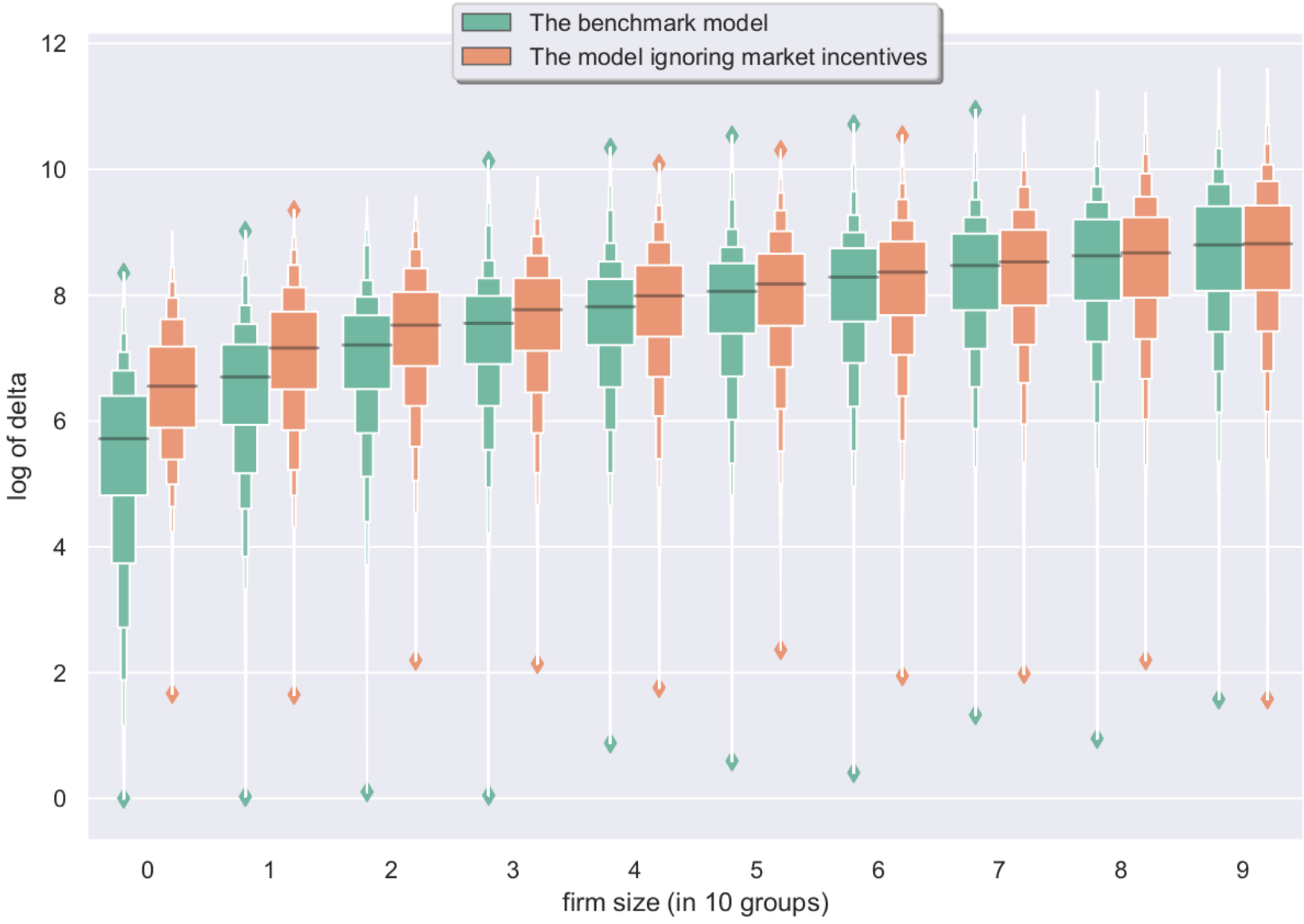
If labor market incentives are ignored ...



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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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