Why do larger firms pay executives more for performance?

Performance-based versus labor market incentives

VU Finance Lunch Seminar

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Introduction

Introduction

- Industry: Competition for executive matters for incentive contracts.
  - Apple proxy statement 2016:
    "experienced personnel ... are in high demand, ... (the contract incentives are designed) to attract and retain a talented executive team and align executives interests with those of shareholders ..."
  - Amazon proxy statement 2016:
    The core philosophy concerning executive incentive package is *"to attract and retain the highest caliber employees"*
  - ...

Introduction

- Academia: The mechanism linking the managerial labor market and incentive contract design is not clear.
  - *Direction for future research* in Edmans et al. 2017

    "Most models of incentives in market equilibrium are static. It would be useful to add a dynamic moral hazard problem where incentives can be provided not only through contracts, but also by ... the promise of being hired by a larger firm. This would, among other things, analyze how contracting incentives interact with ... hiring incentives. These different incentive channels may conflict with as well as reinforce each other."

Research Questions

- How does the managerial labor market competition impact the incentive contracts?
- Explain two important empirical puzzles
  1. Firm-size premium in compensation growth
     Compensation growth is higher in larger firms, controlling for total compensation at the beginning.
  2. Firm-size premium in performance-based incentives
     Performance-based incentives are higher in larger firms controlling for total compensation.

Motivating 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

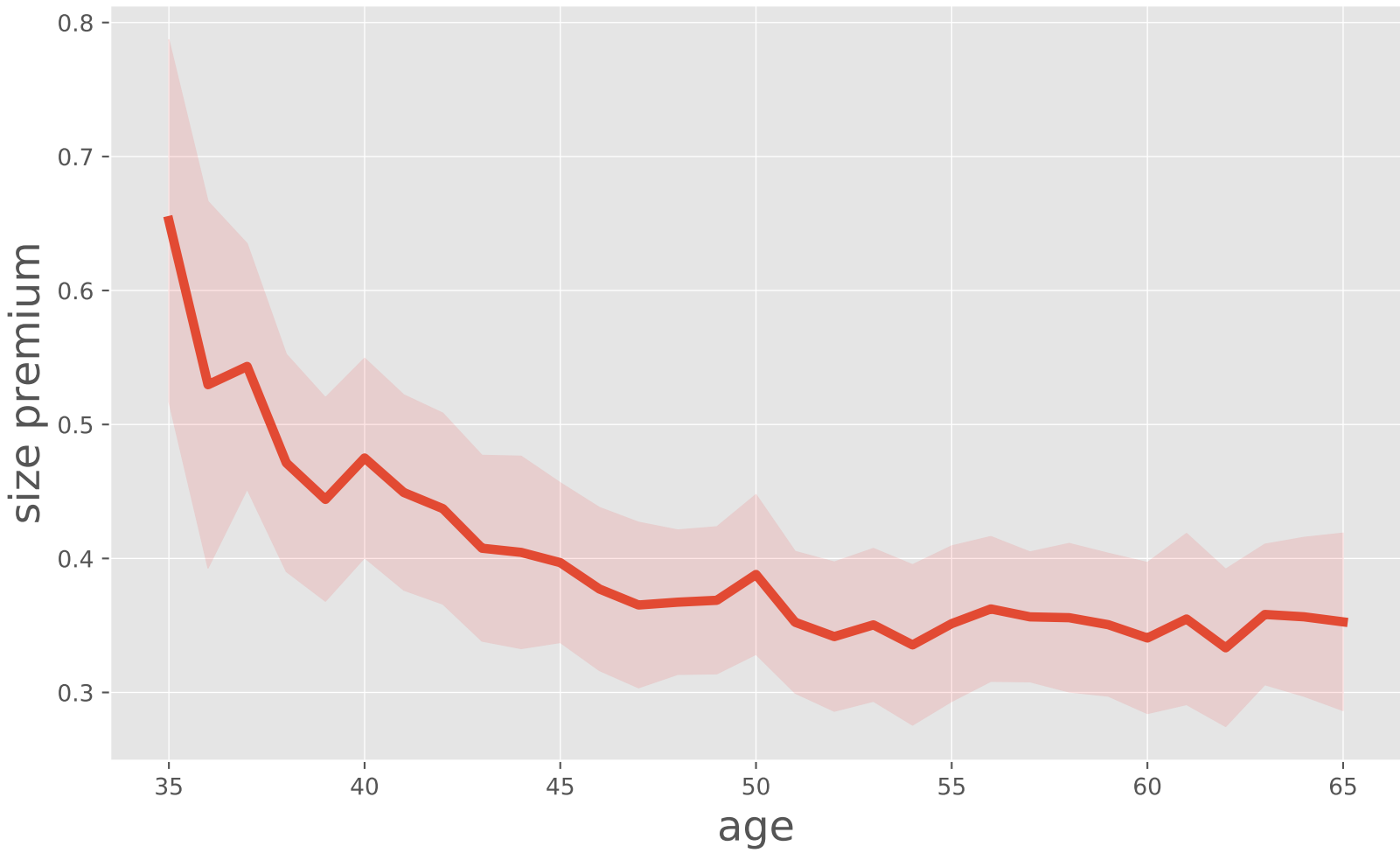
$$\text{delta} = \frac{\Delta\text{Wealth(in dollars)}}{\Delta\text{Firm Value(in percentage)}}$$

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)
$log(firm\ size)_{-1} \times EE90$			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

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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age

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Model

- embed dynamic moral hazard into an equilibrium search framework
- managerial labor market: *search frictional* and *on-the-job search*
- executives are poached by outside firms, and poaching offers have impacts on *compensation level* and *contract incentives*
- a hierarchical job ladder towards larger firms

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Explain firm-size premium in compensation growth

- executives use poaching offers to renegotiate with the current firm
- larger firms are more capable of countering outside offers

Explain firm-size premium in performance-based incentives

1. Poaching offers generate *labor market incentives*
    - poaching firms are willing to bid higher for more productive executive
    - executive productivity depends on past effort
    - taking effort today will lead to a more favorable offer from the same poaching firm

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3. Labor Market Incentives decrease in firm size
   - executives in larger firms are less likely to receive competitive outside offers
   - executives in larger firms have a higher certainty equivalent of expected utility in the future; subjectively they are less sensitive to wealth variation (diminishing marginal utility)

Road Map

1. Model
2. Reduced-form Evidence
3. Structural Estimation
4. Two Counterfactual Analysis

Related Literature

- Assignment Models
  - Edmans, Gabaix and Landier (2009), Edmans and Gabaix (2011)
  - executives in larger firms value leisure more $u(w \times g(e))$.
- Moral Hazard Models
  - Margiotta and Miller (2000), Gayle and Miller (2009), Gayle, Golan and Miller (2015)
  - moral hazard problem is more severe / the quality of signal (about effort) is poor 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

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

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

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

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

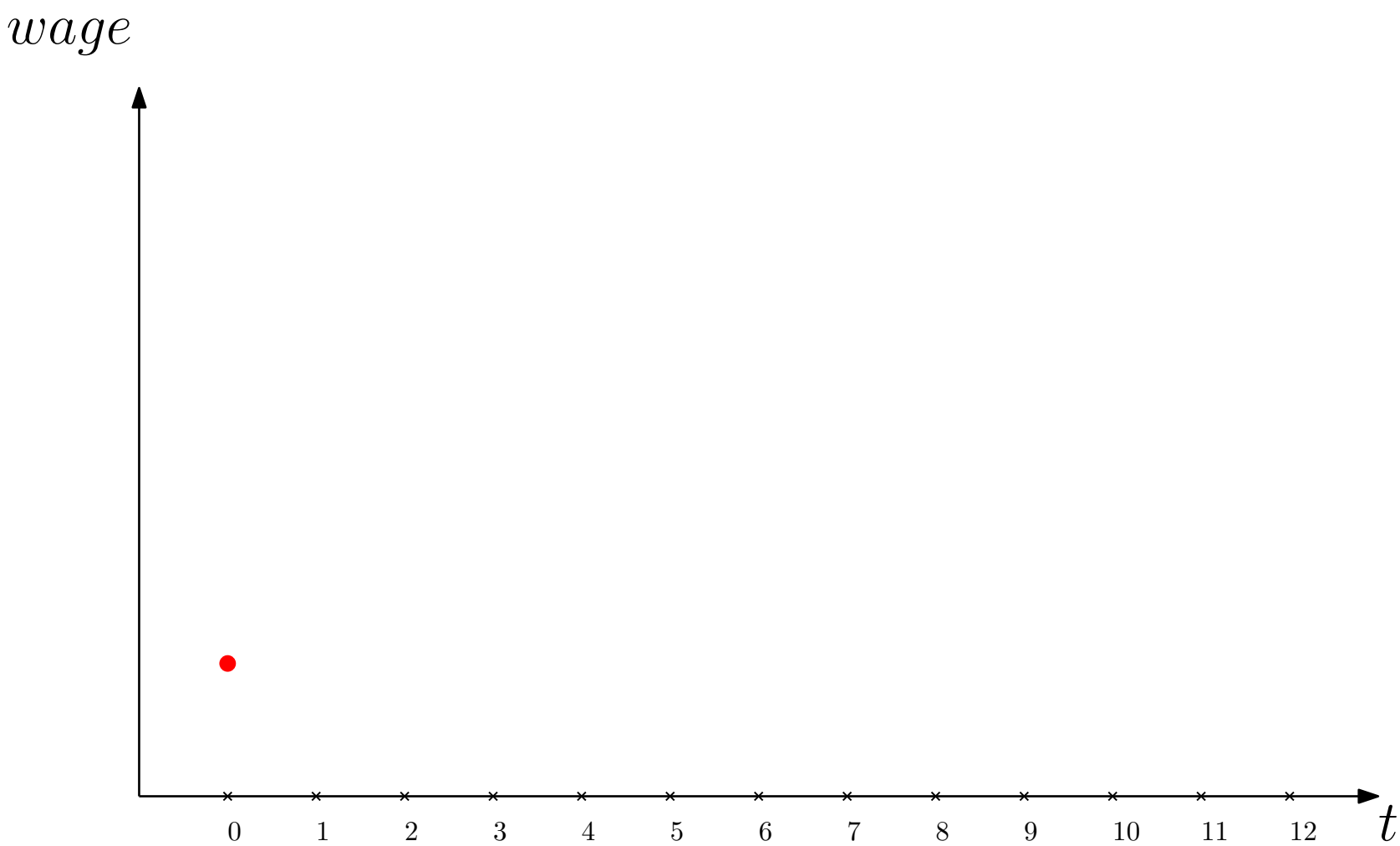
The Equilibrium

An stationary equilibrium is defined by

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

The Optimal Contract

The Optimal Contract



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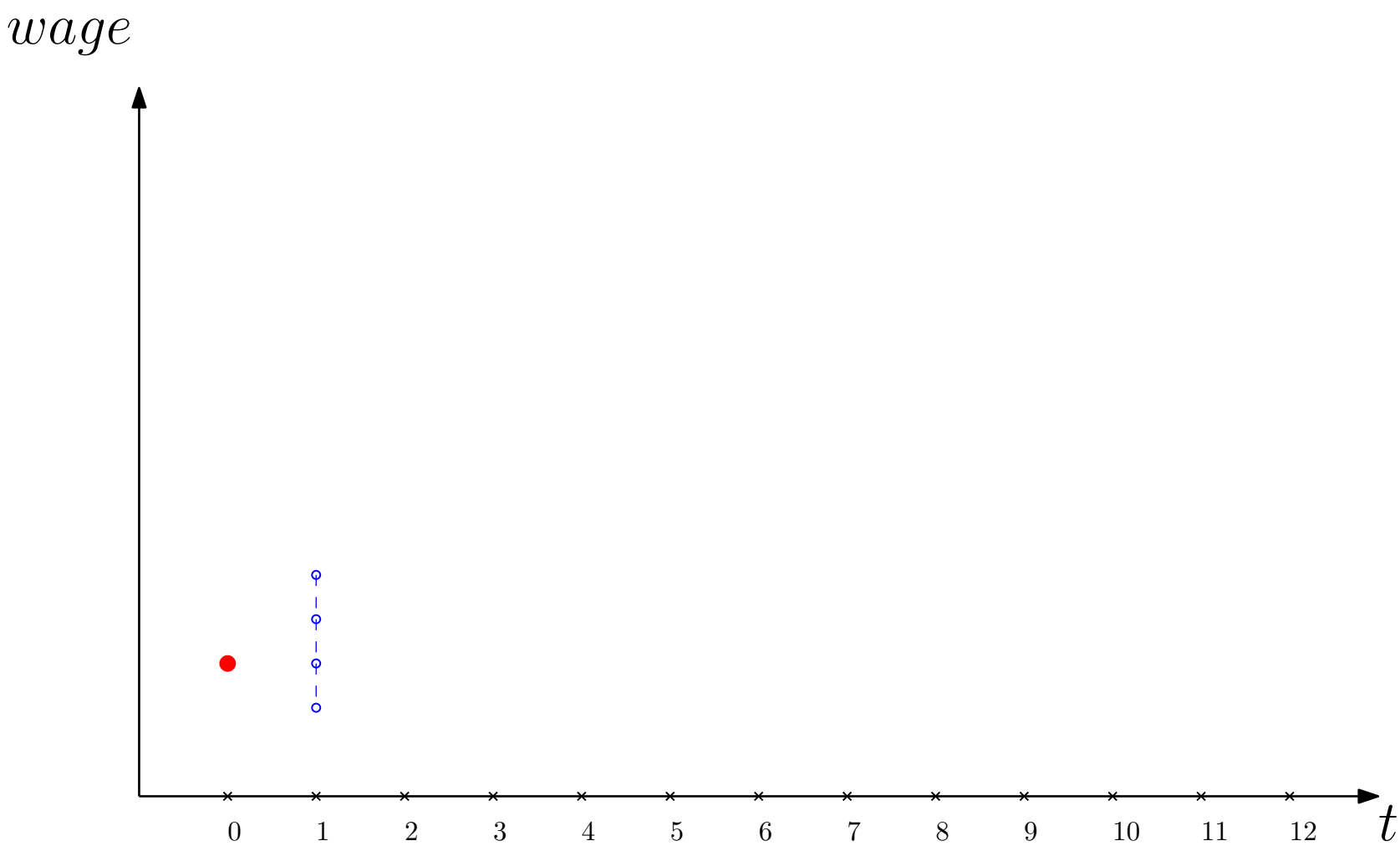

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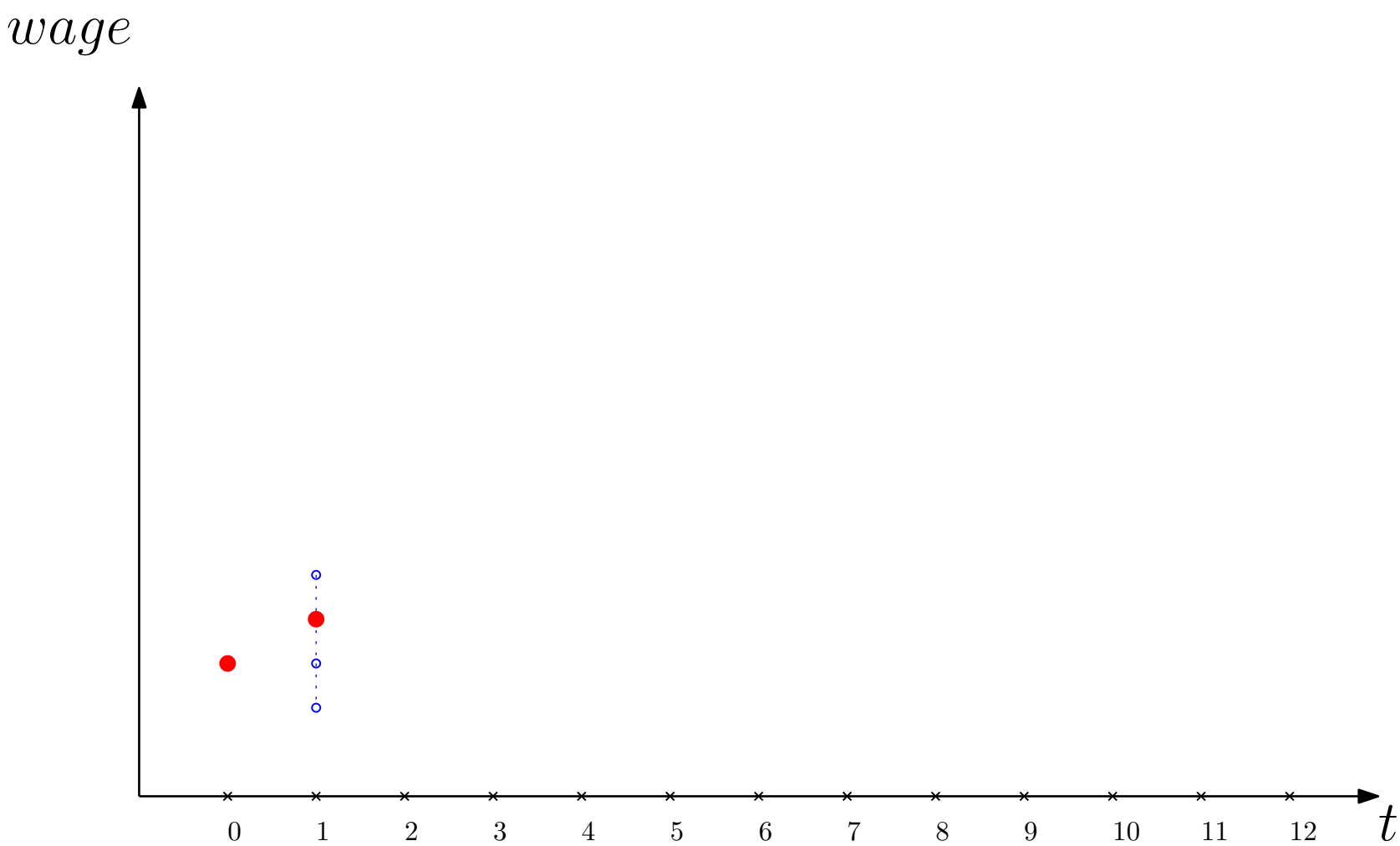

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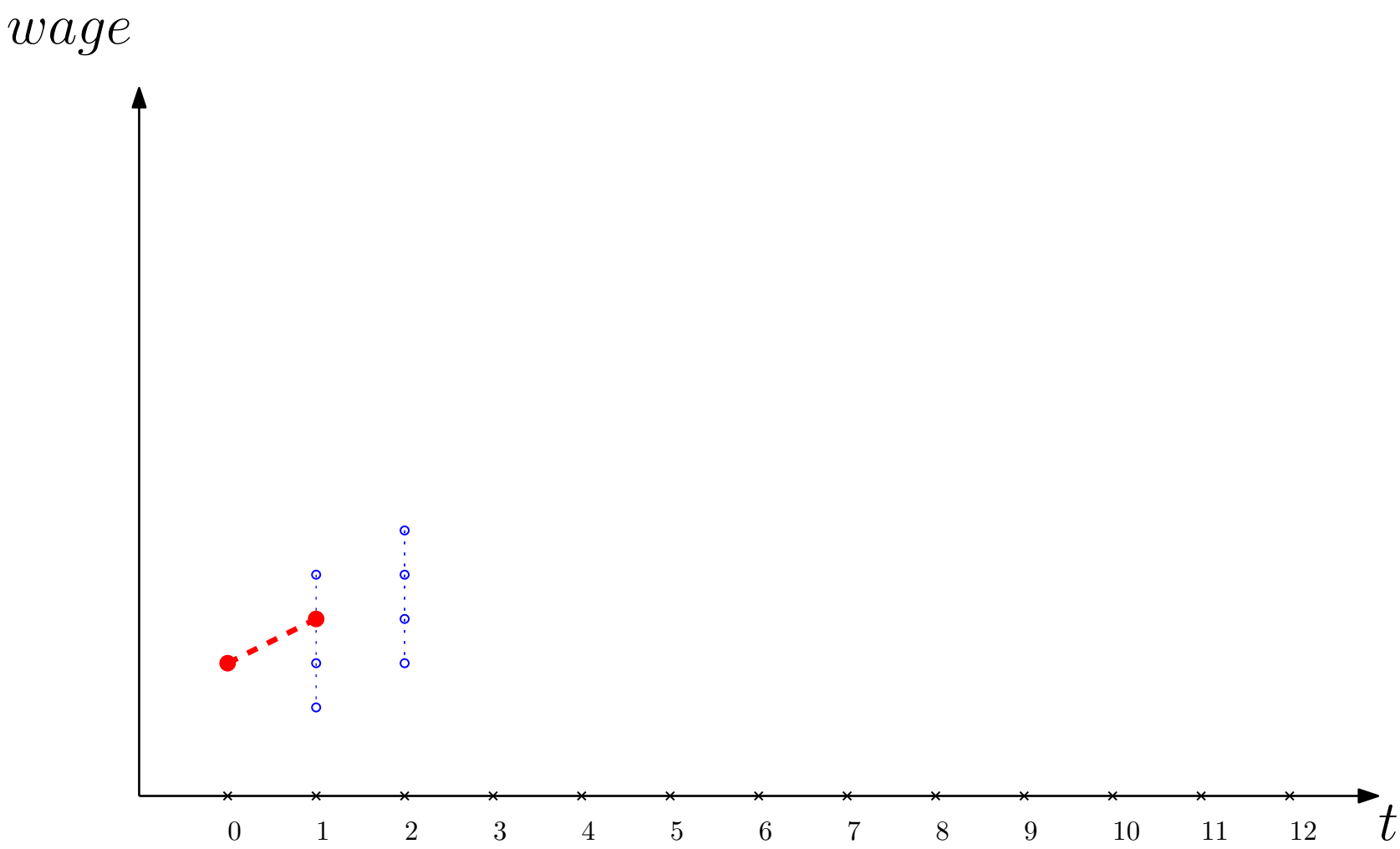

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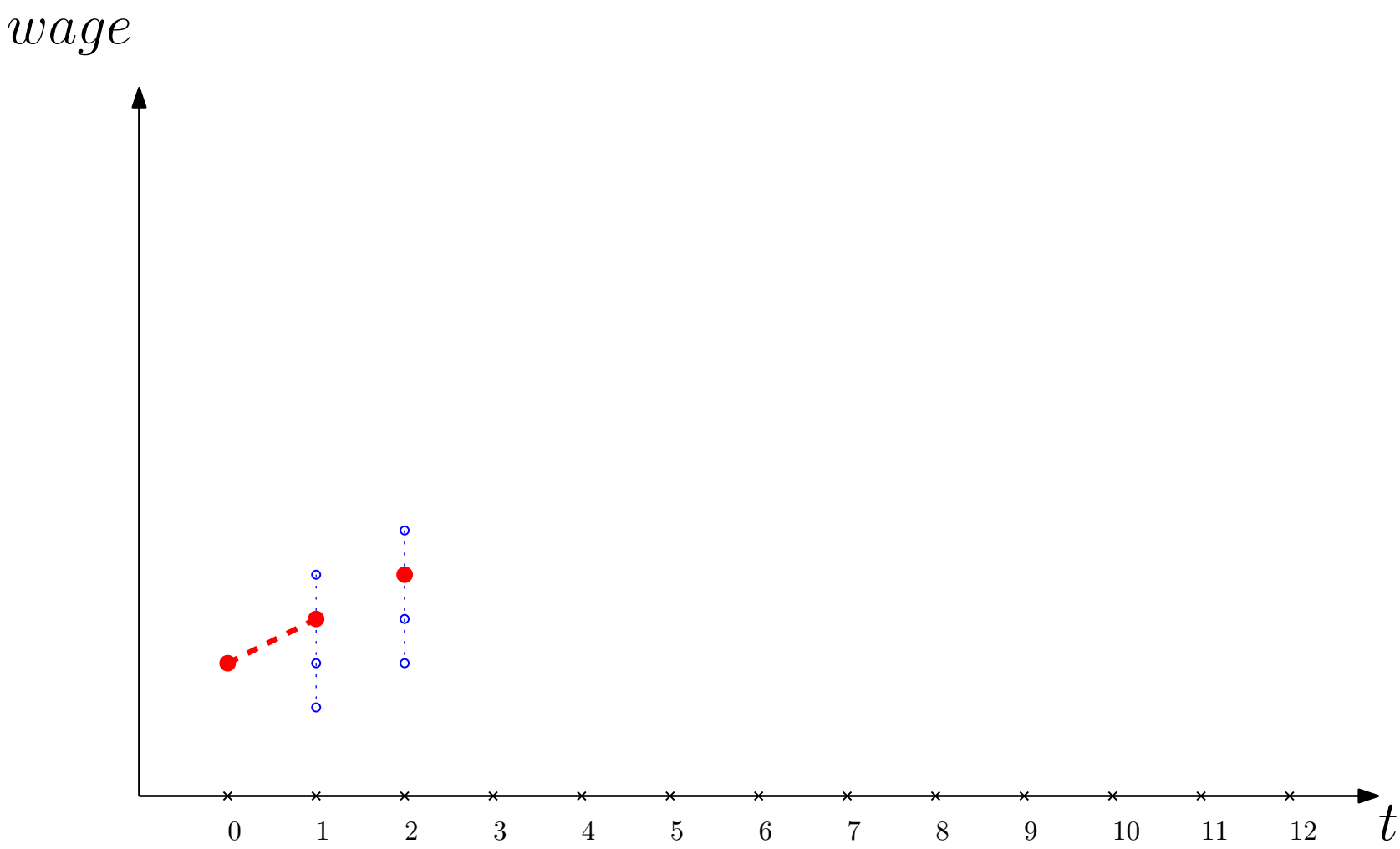

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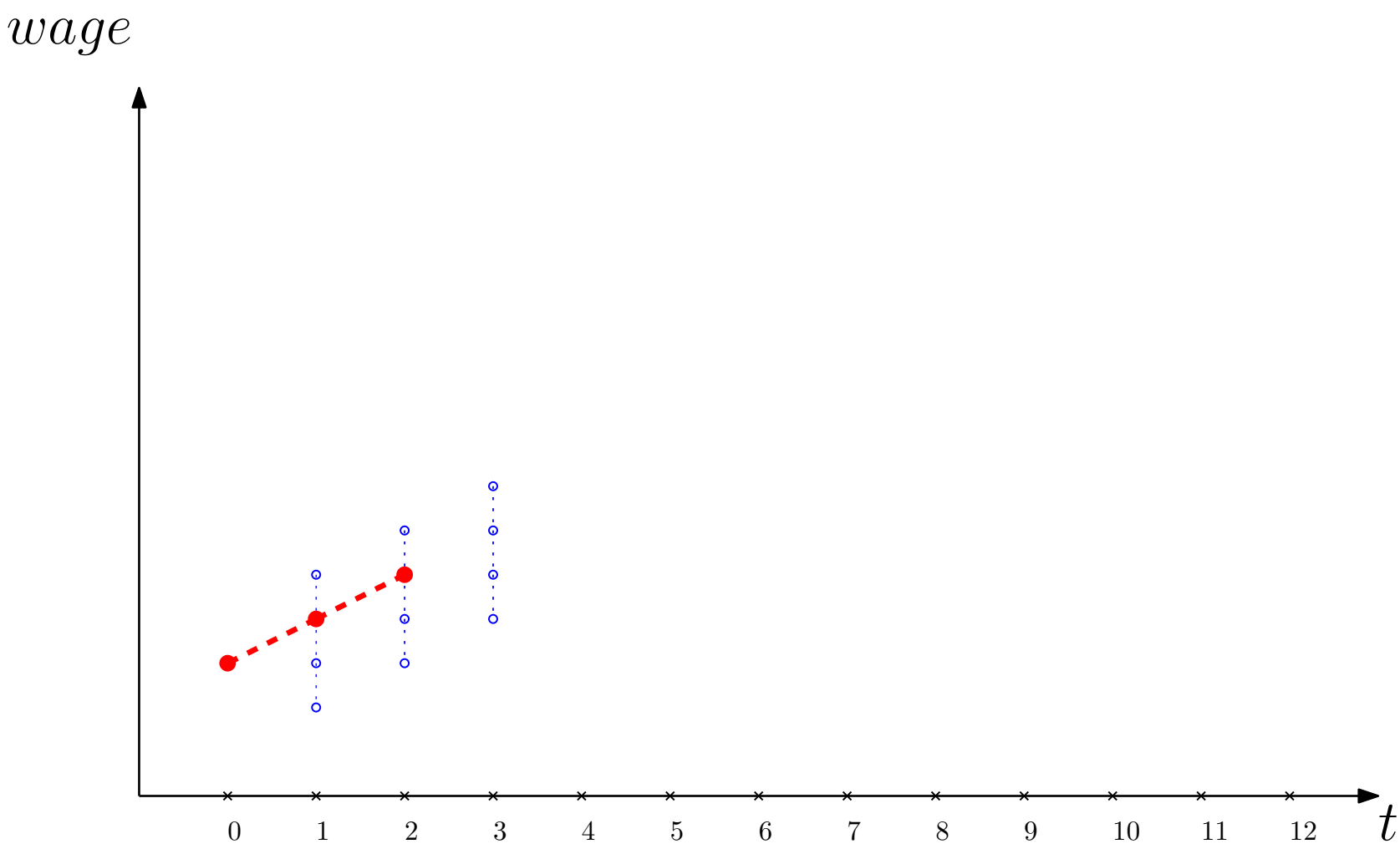

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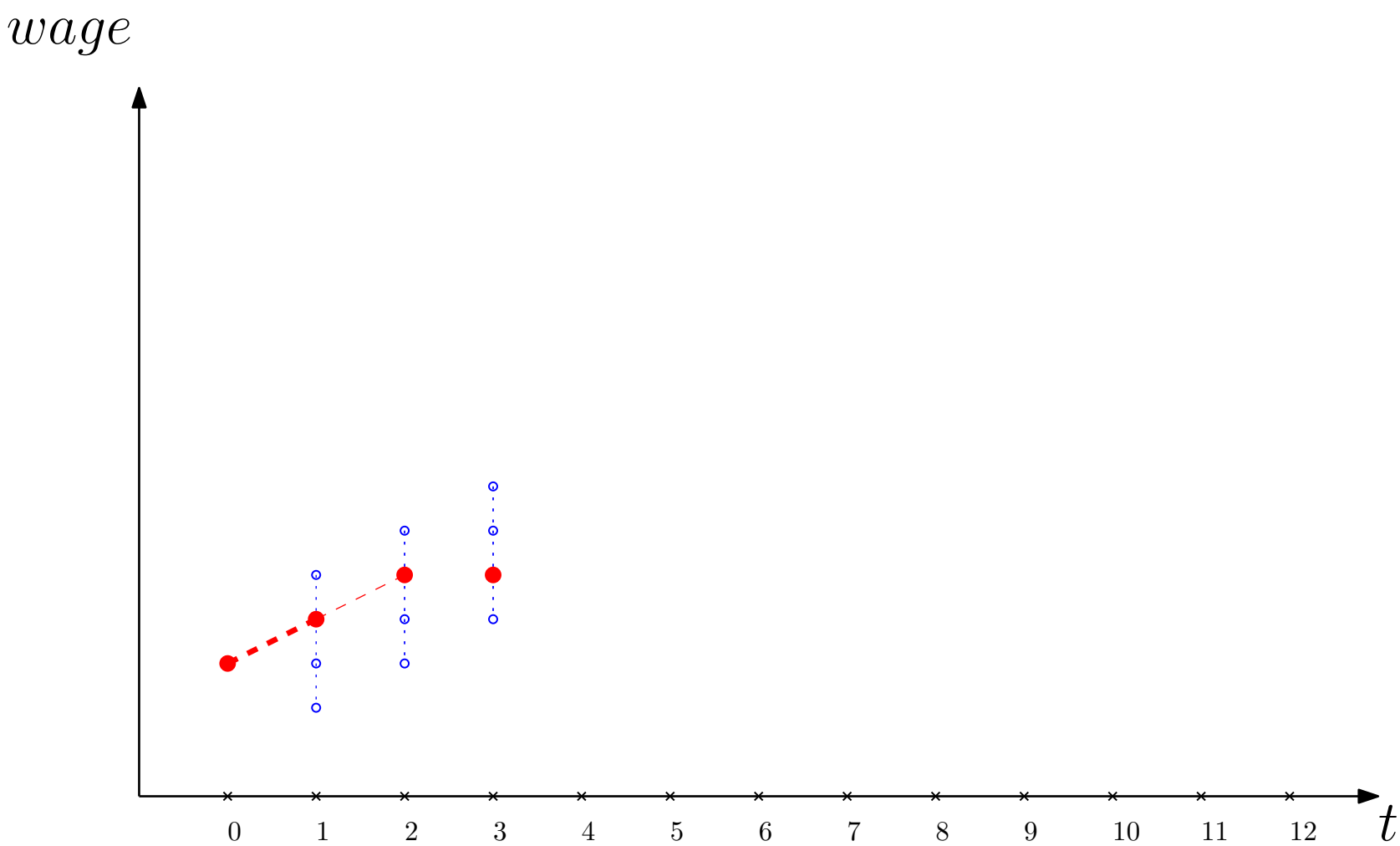

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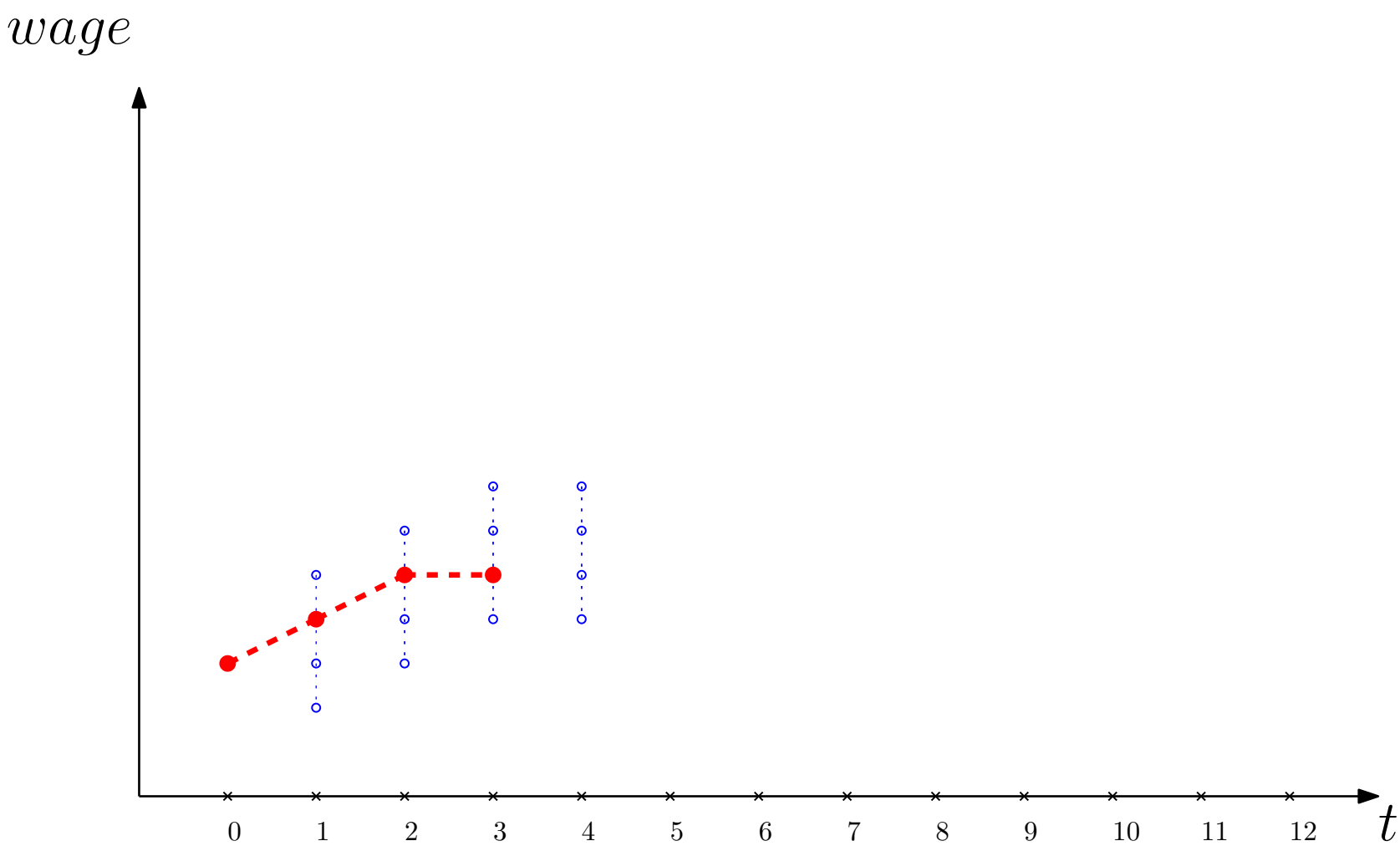

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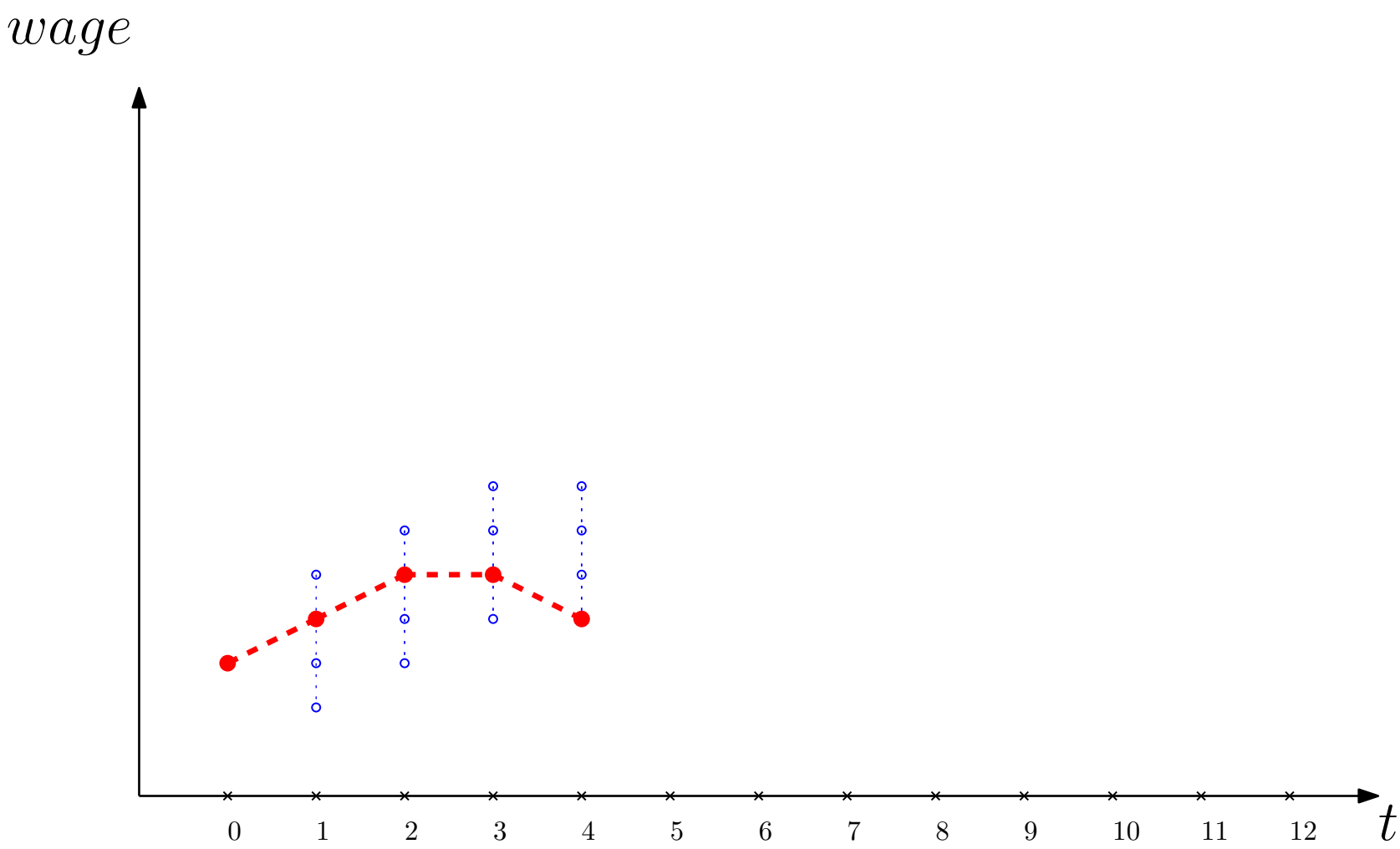

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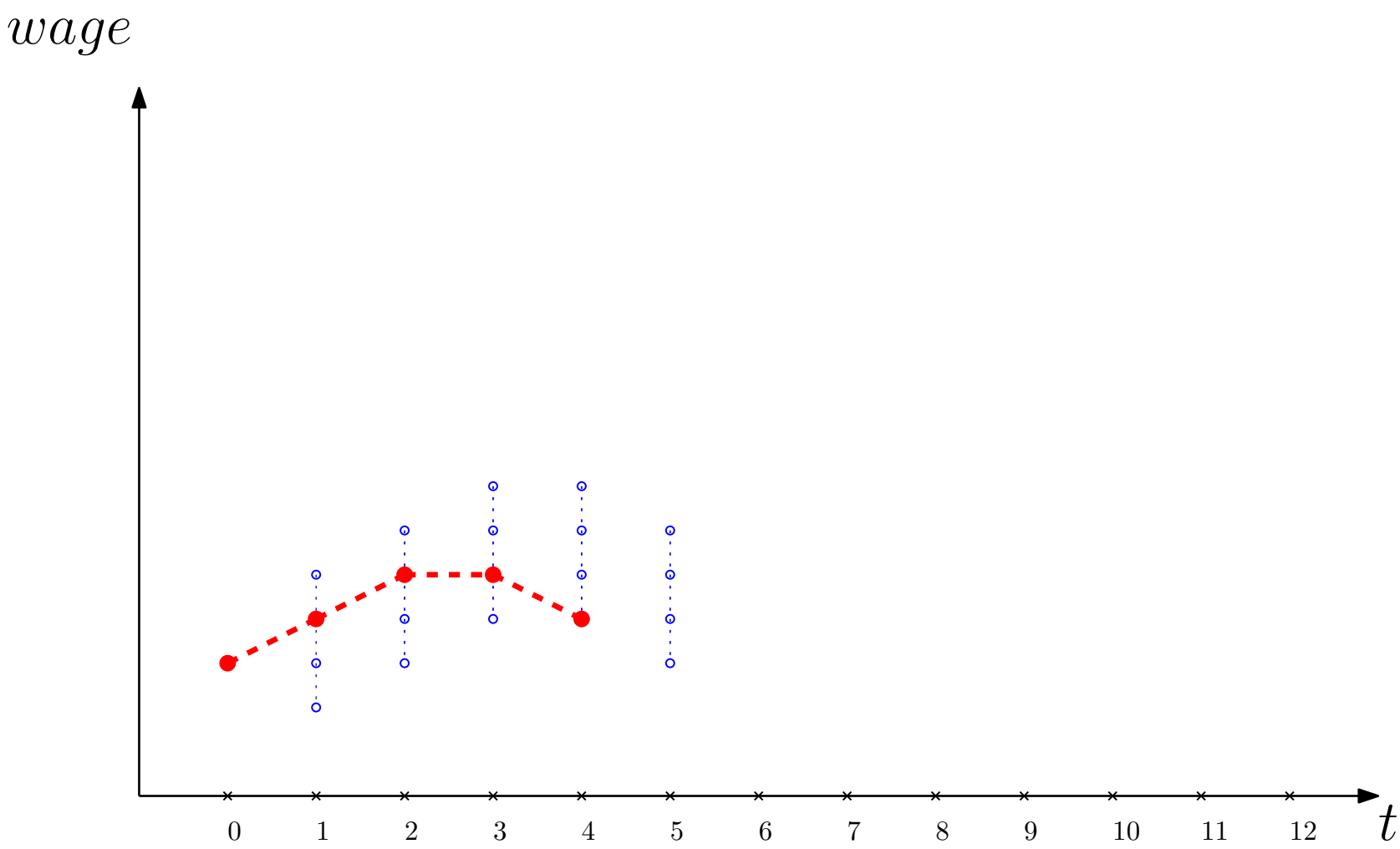

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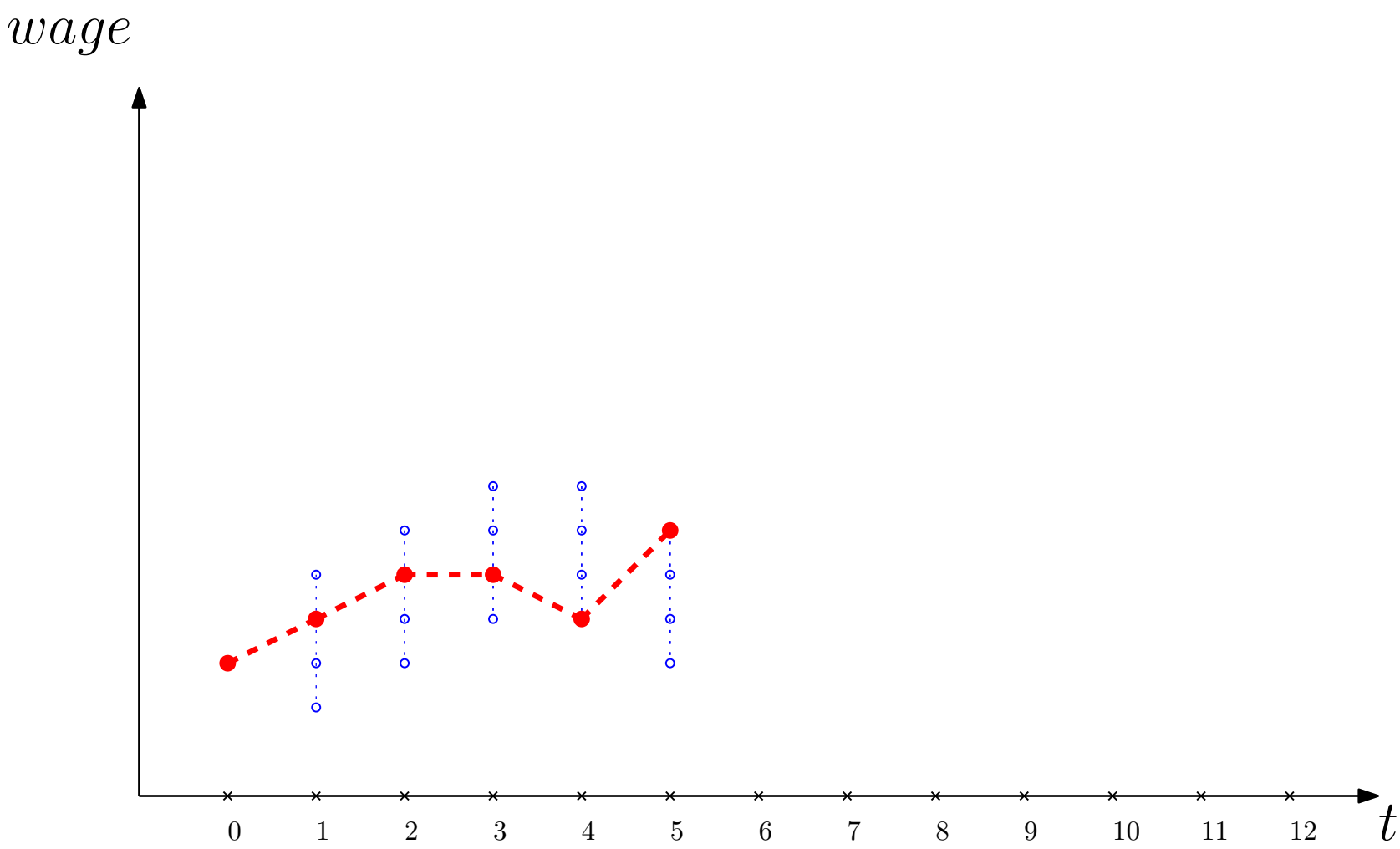

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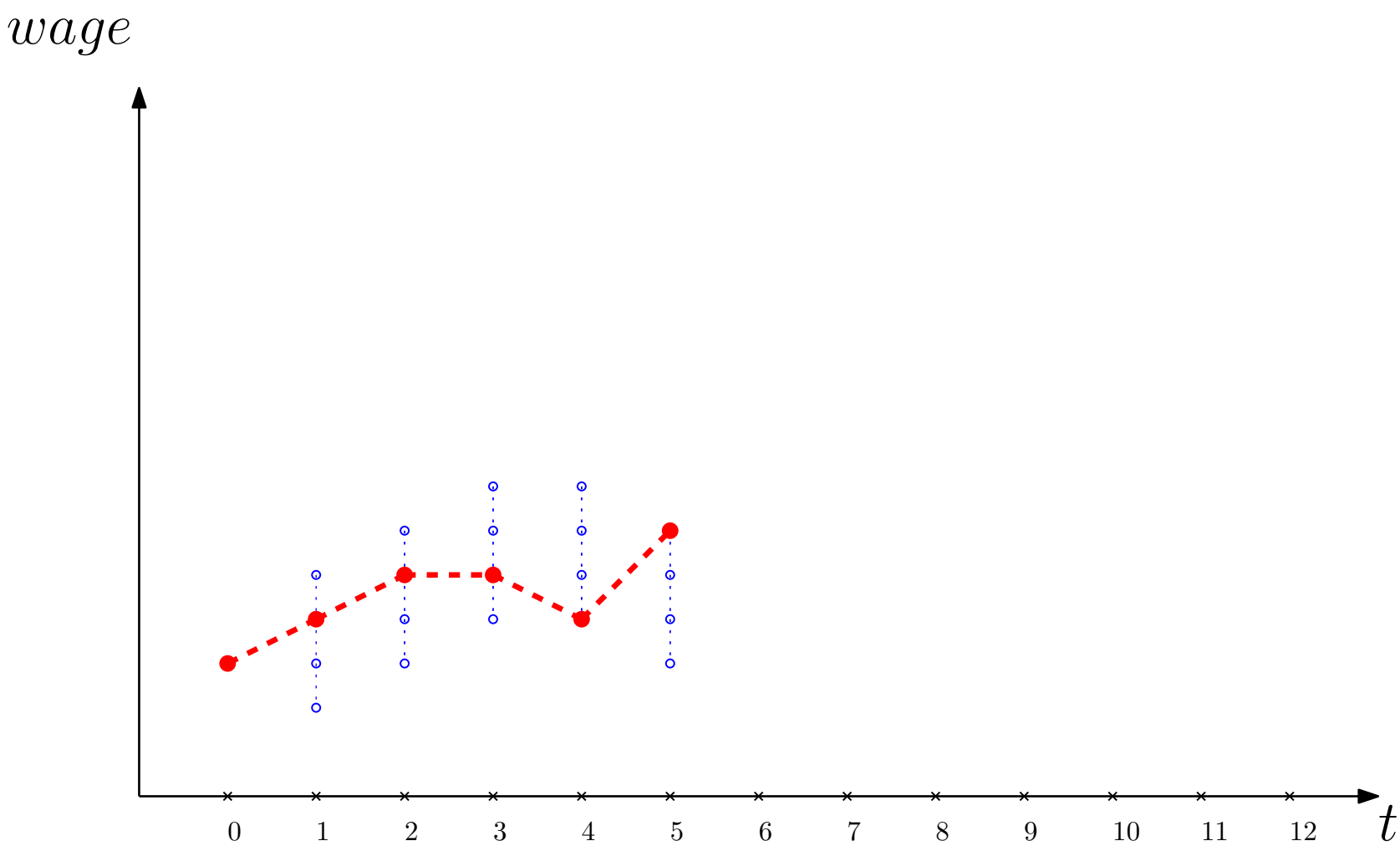

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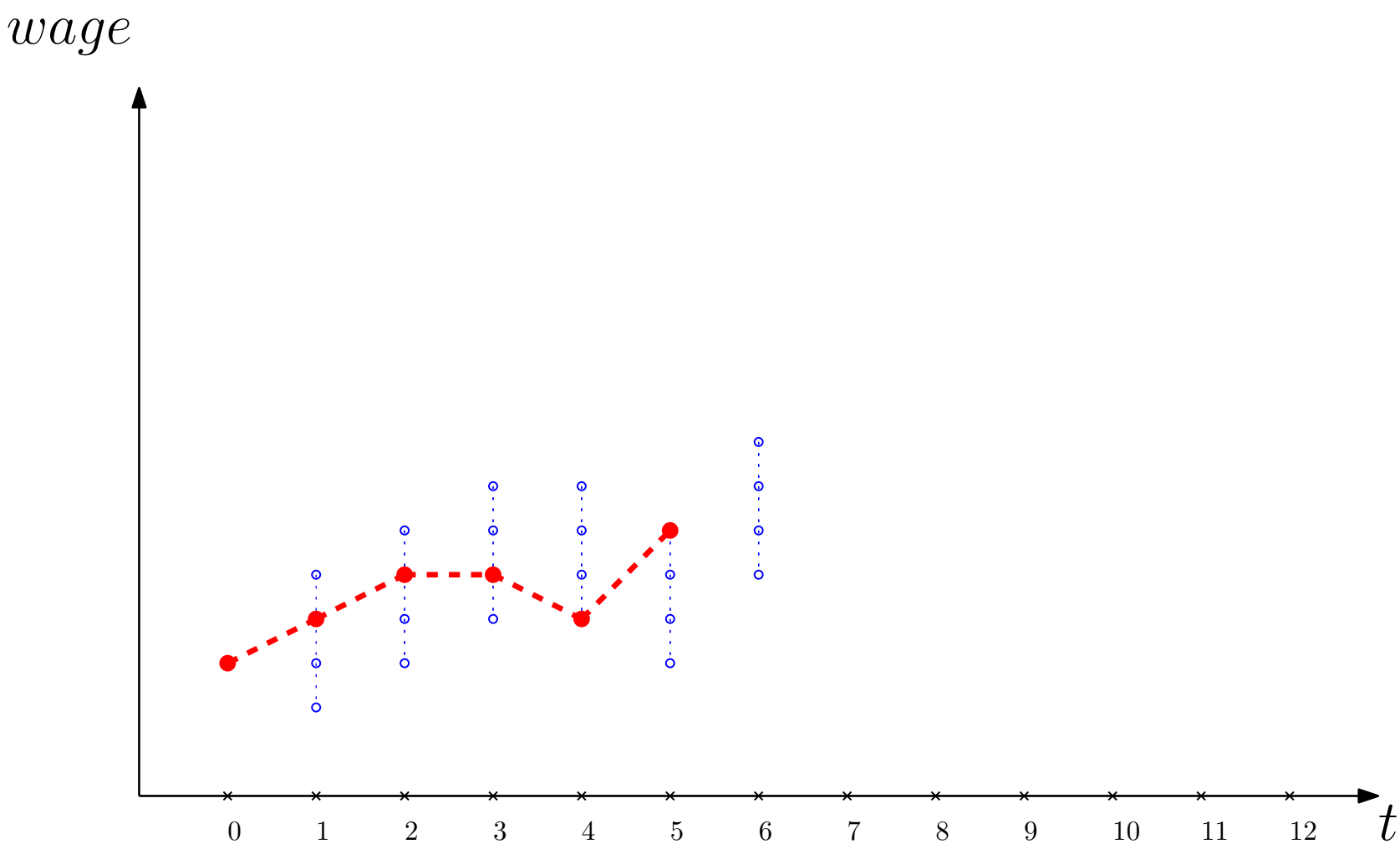

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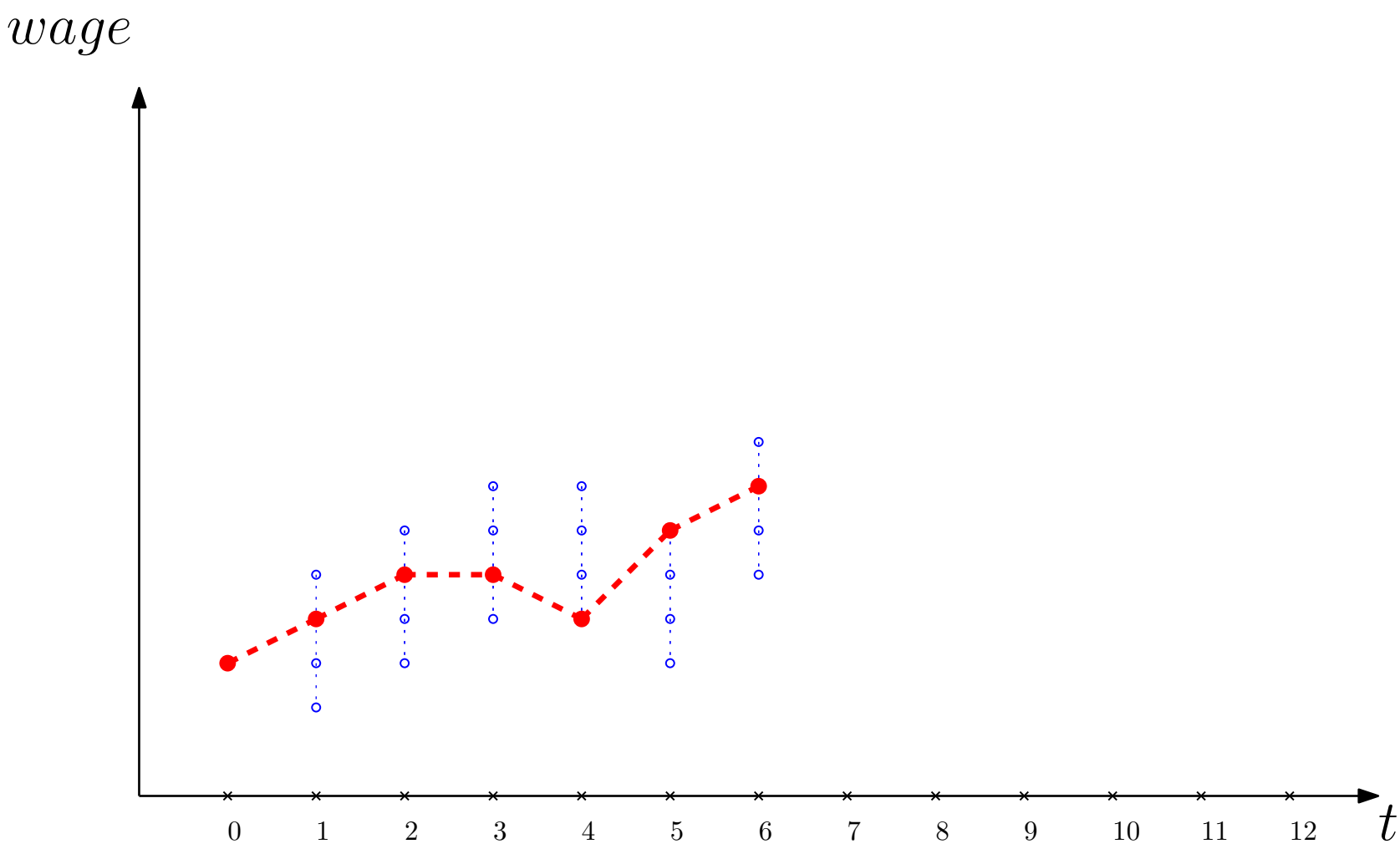

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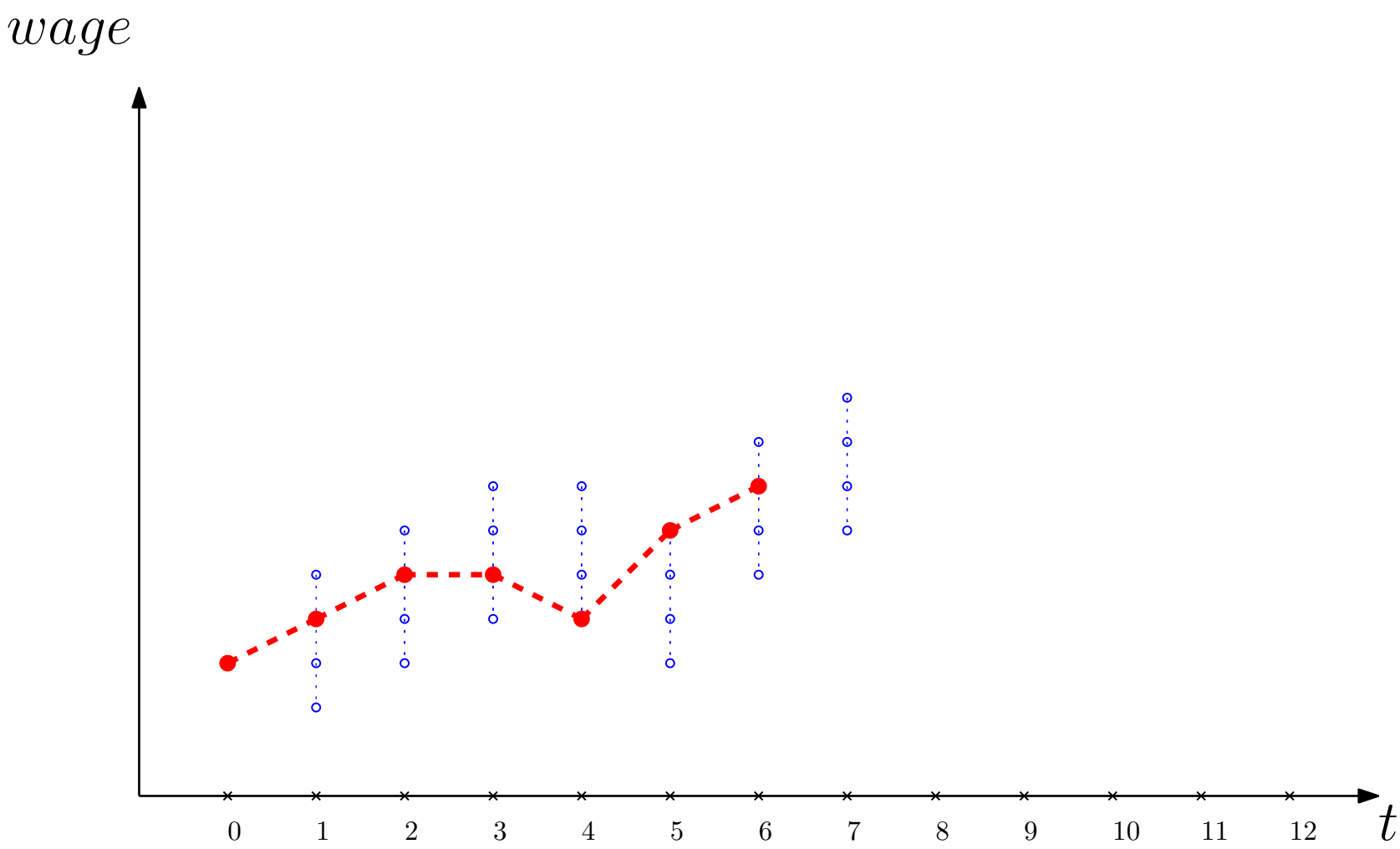

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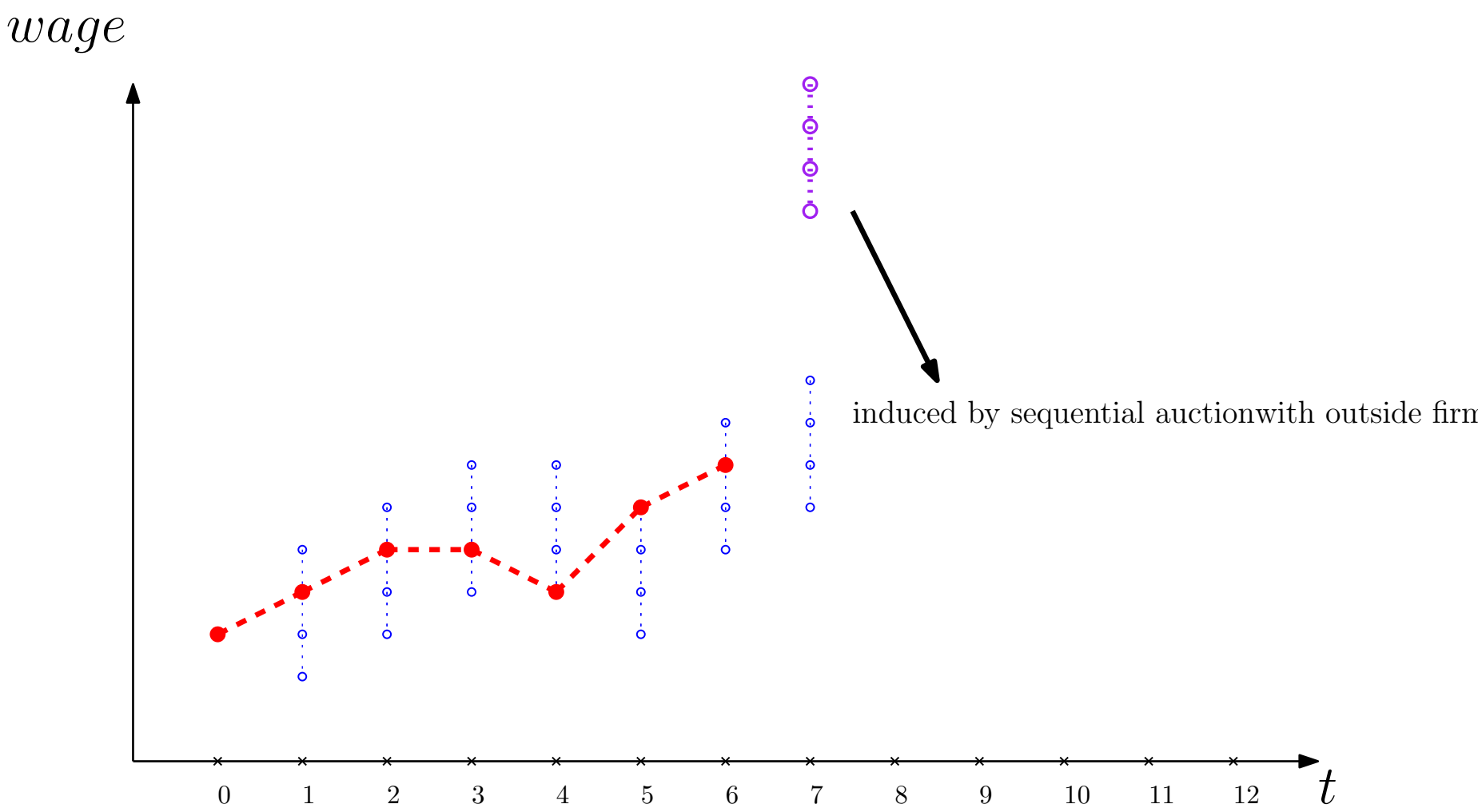

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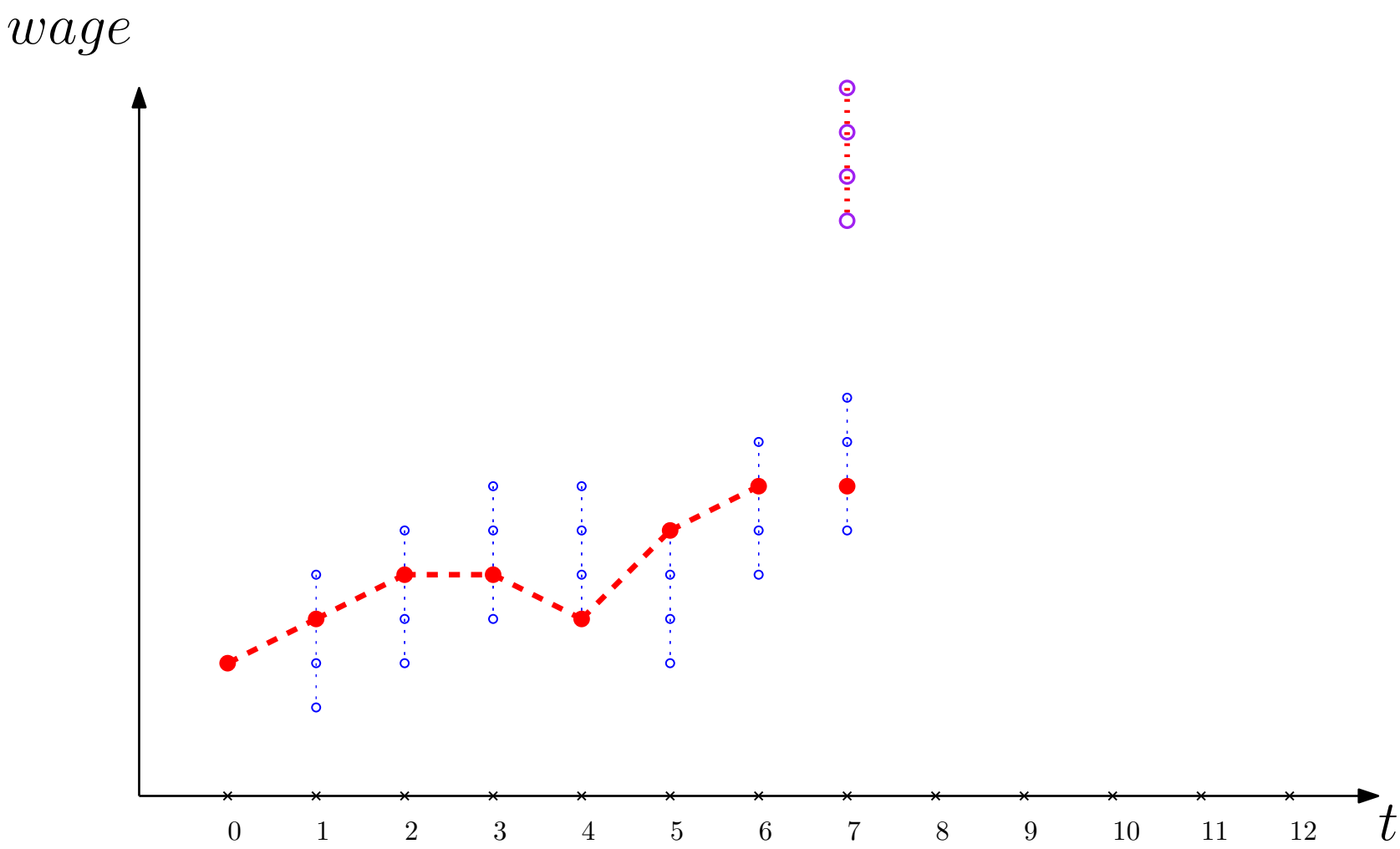

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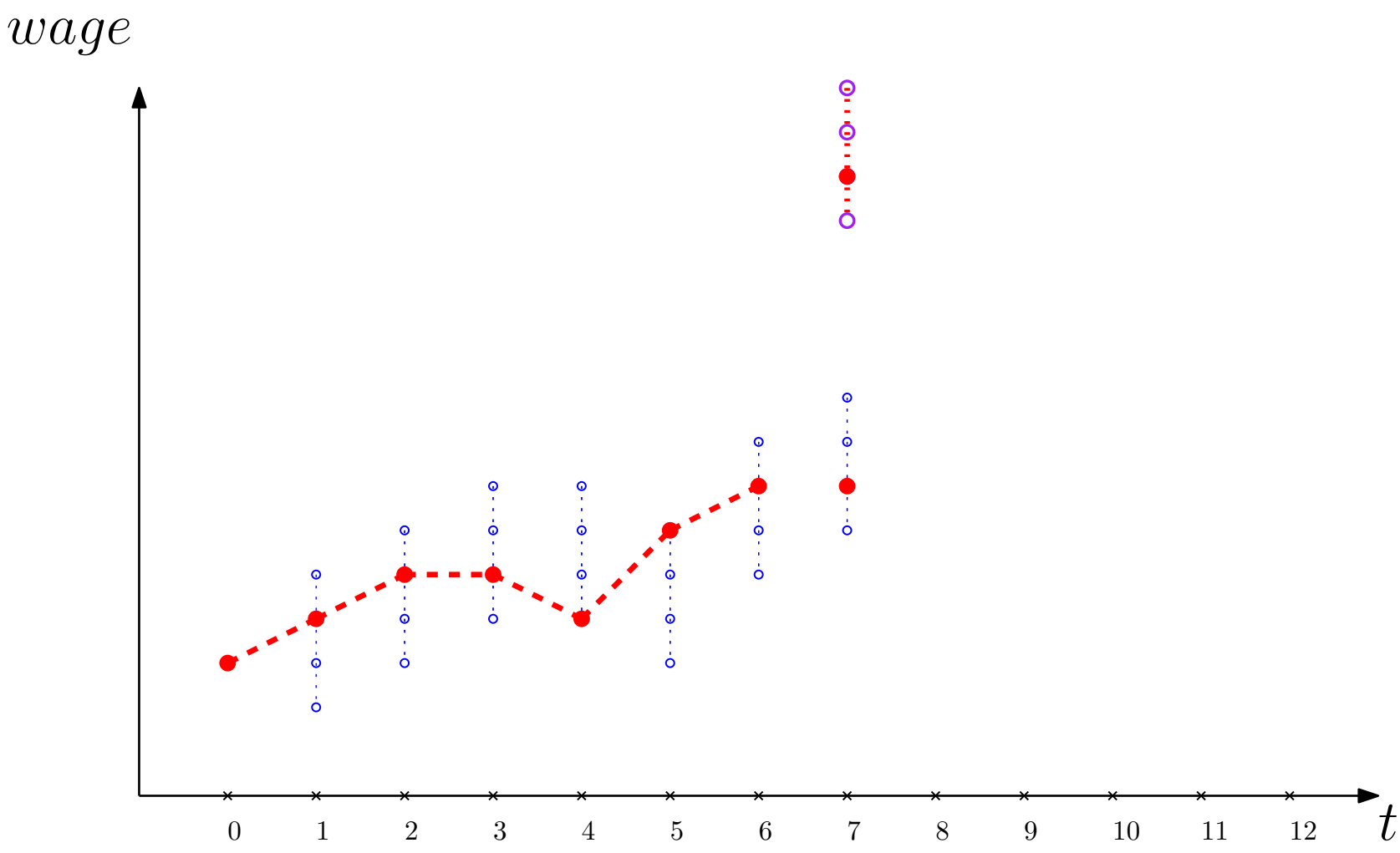

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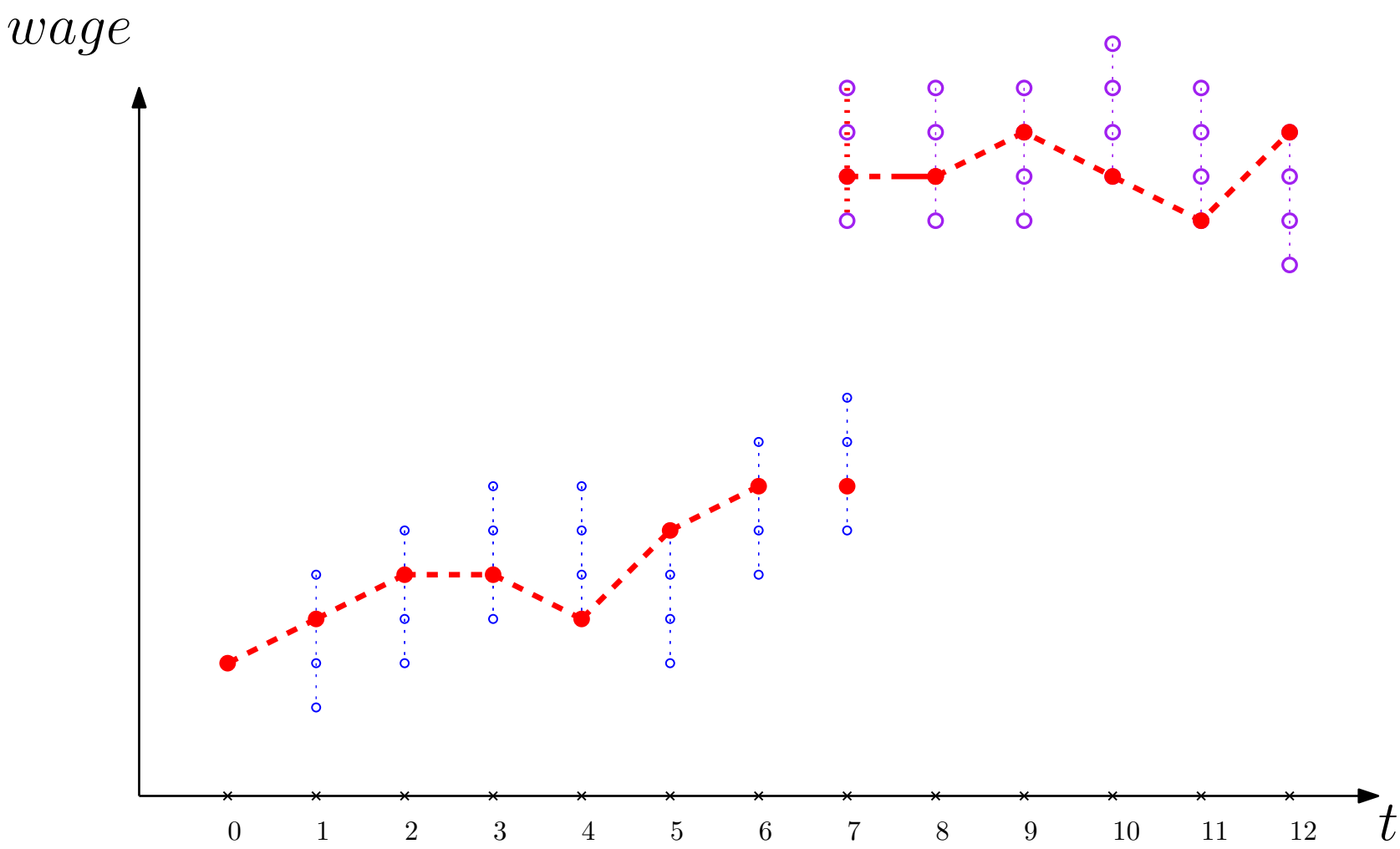

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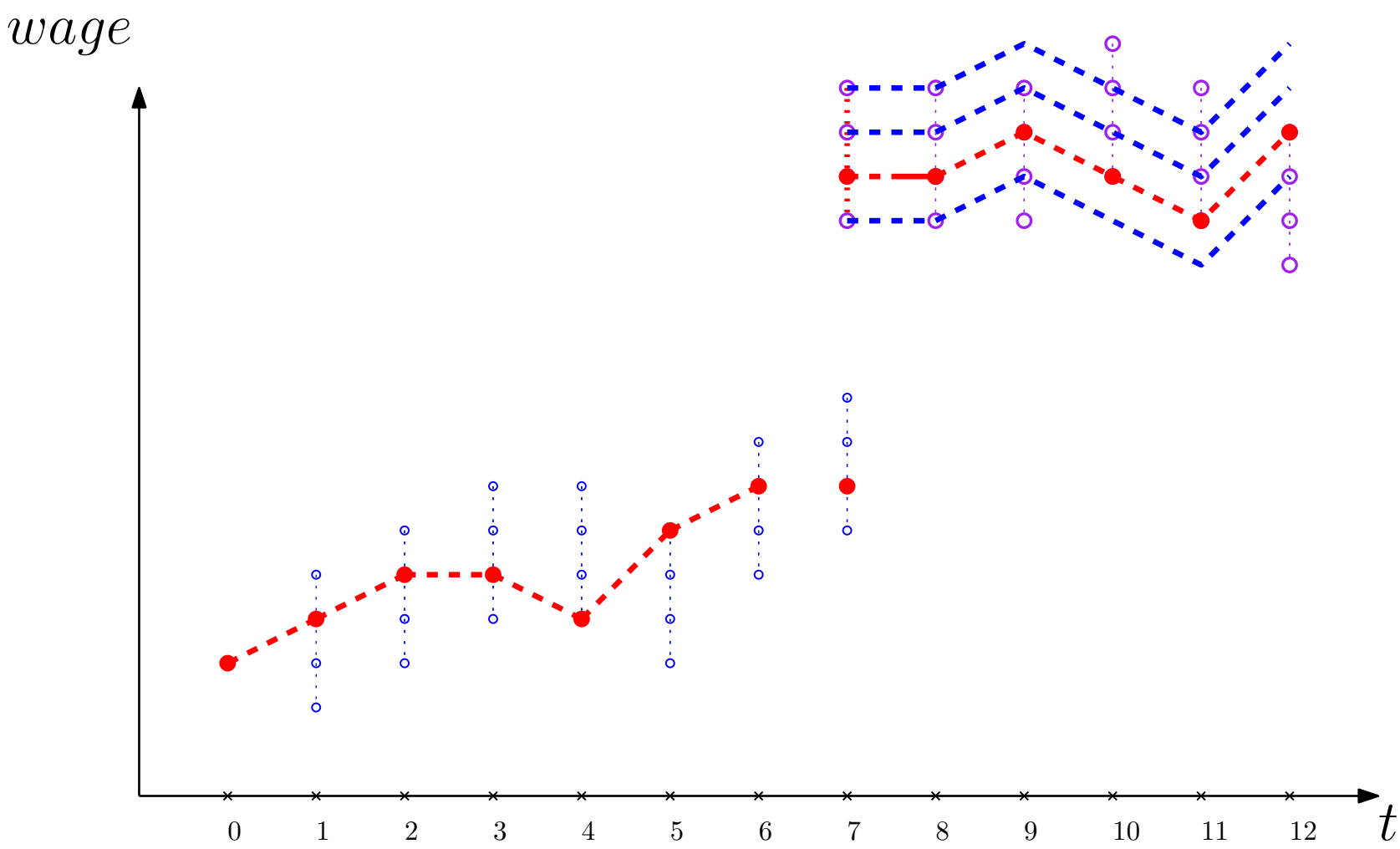

Explain size premium in compensation growth

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

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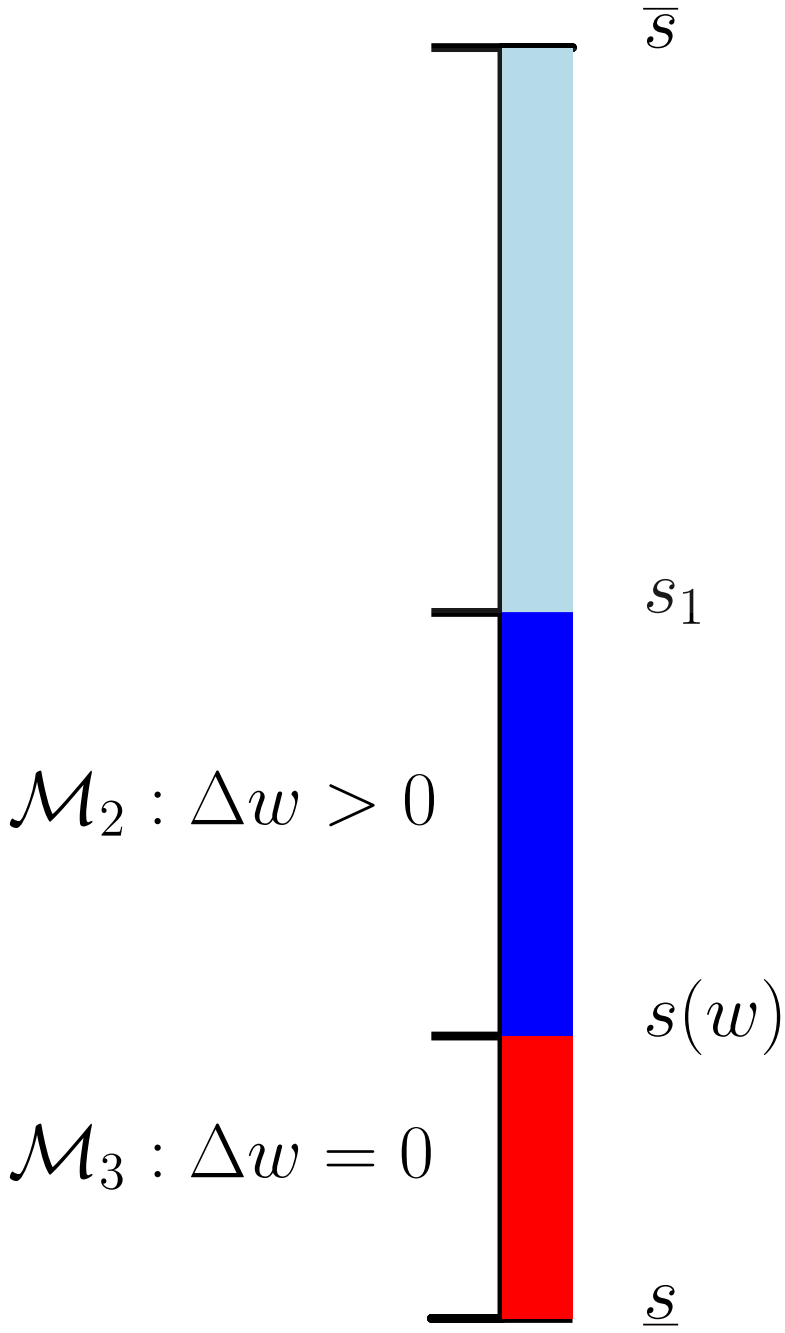
The continuation value of an executive is

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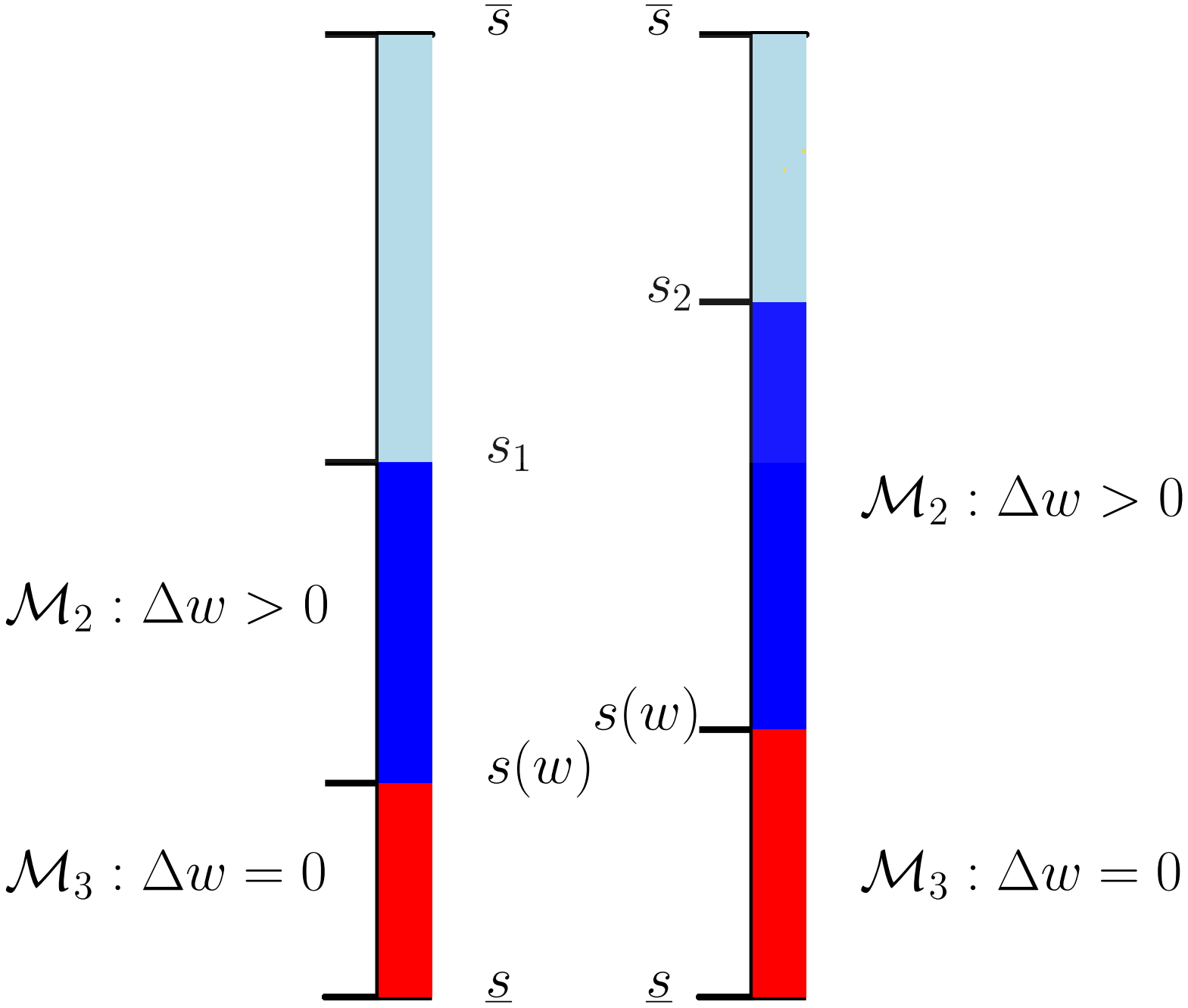
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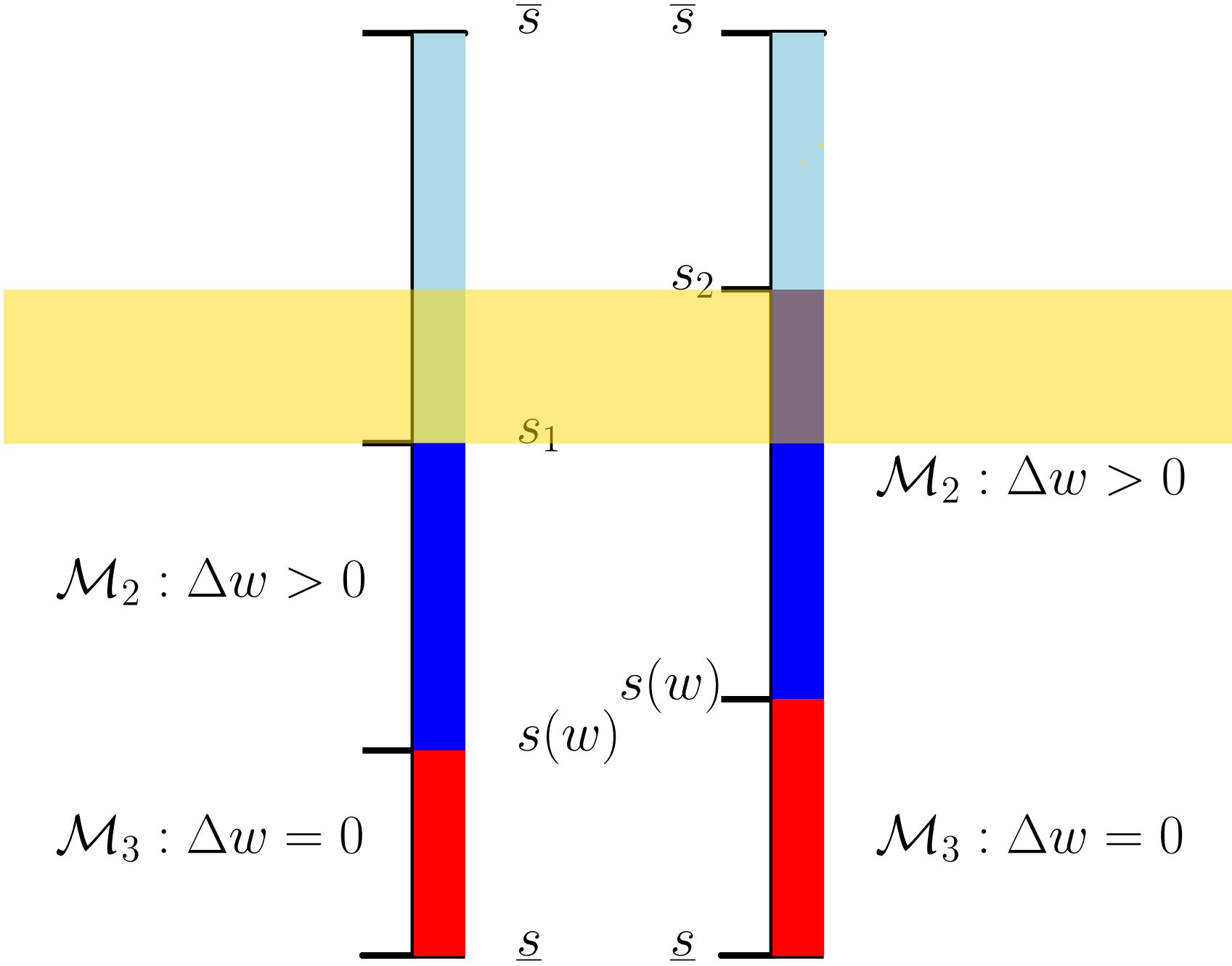
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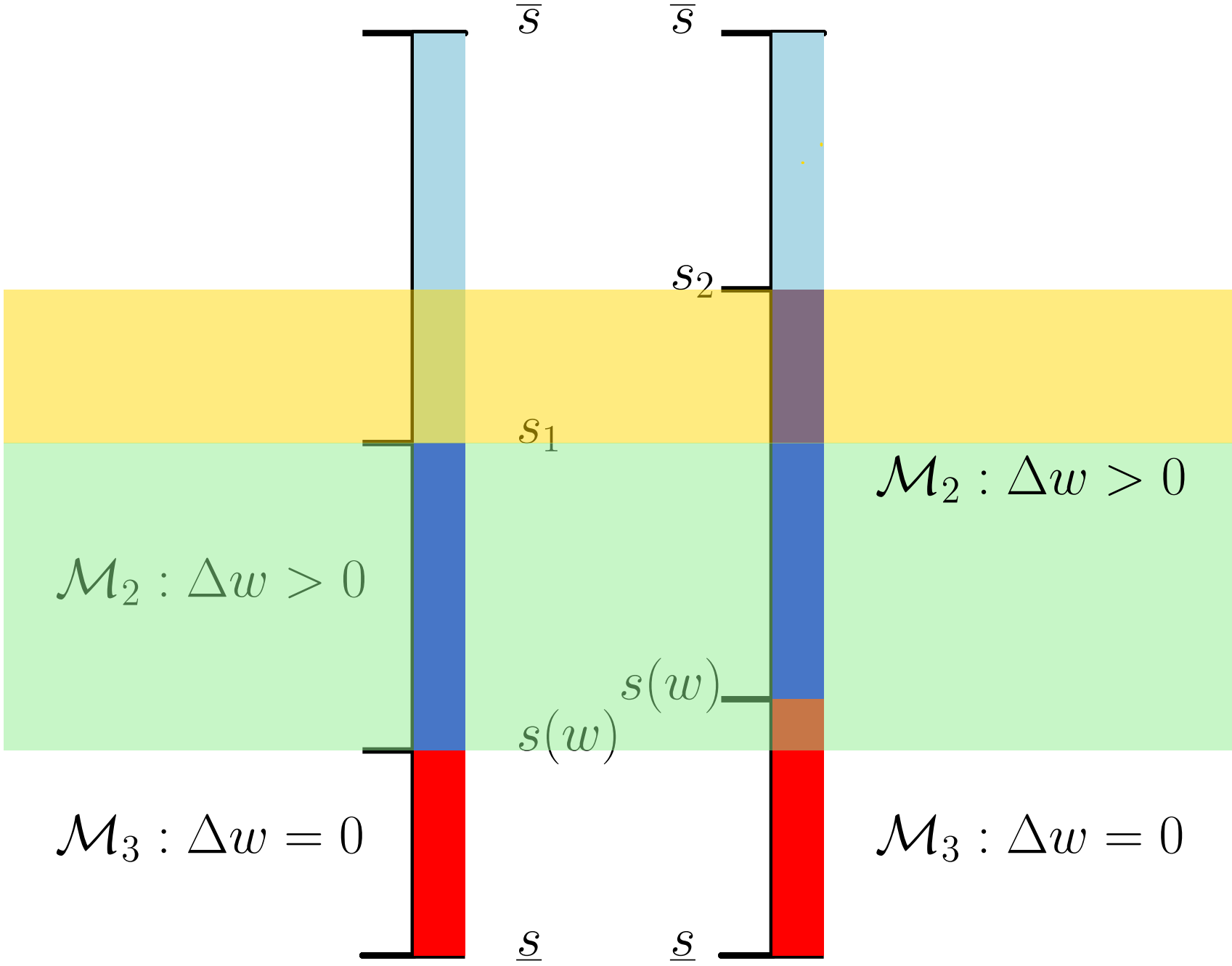
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Explain size premium in performance-based incentives

Incentive Compatibility Constraint

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

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

Incentive Compatibility Constraint

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

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

The incentive compatibility constraint is

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

Sets of outside firms s':

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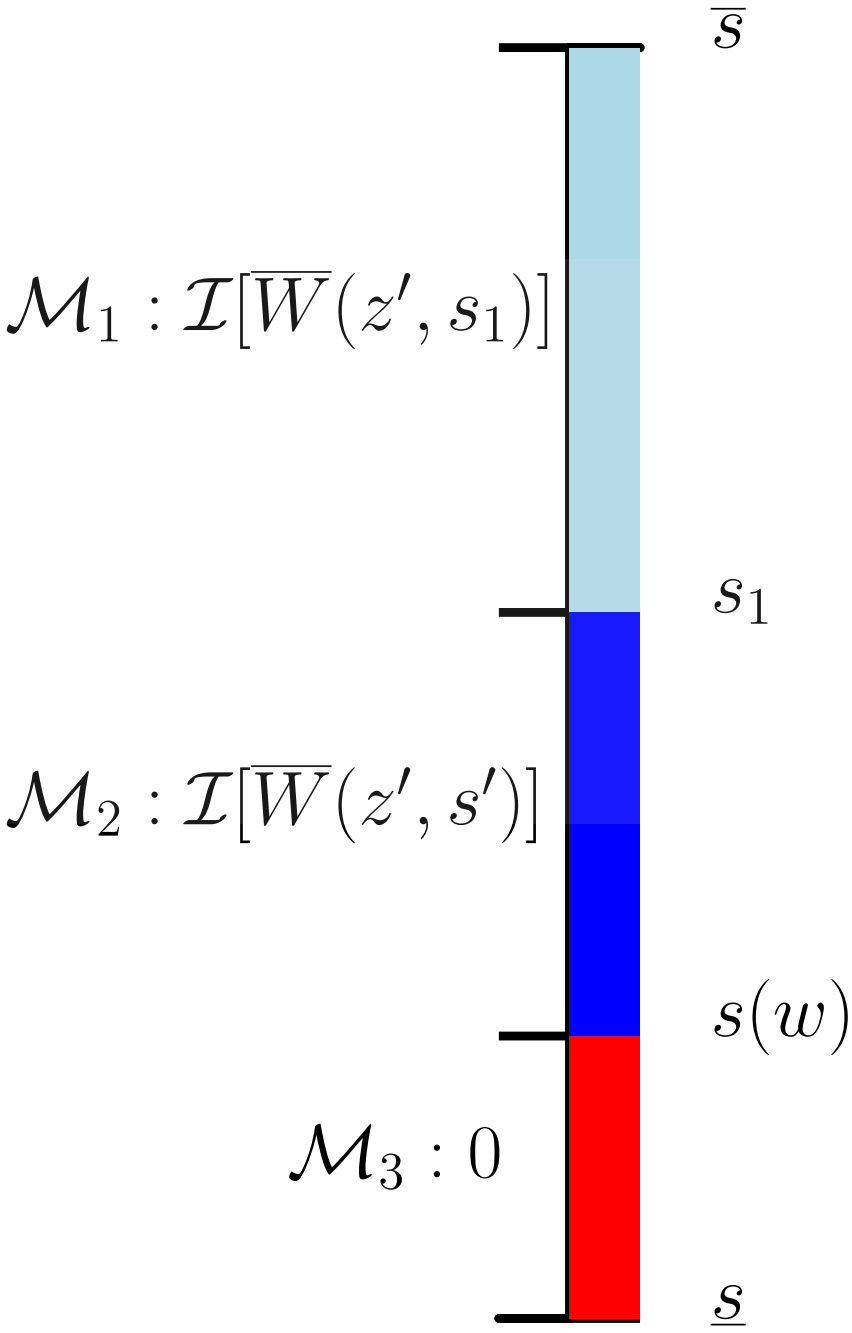
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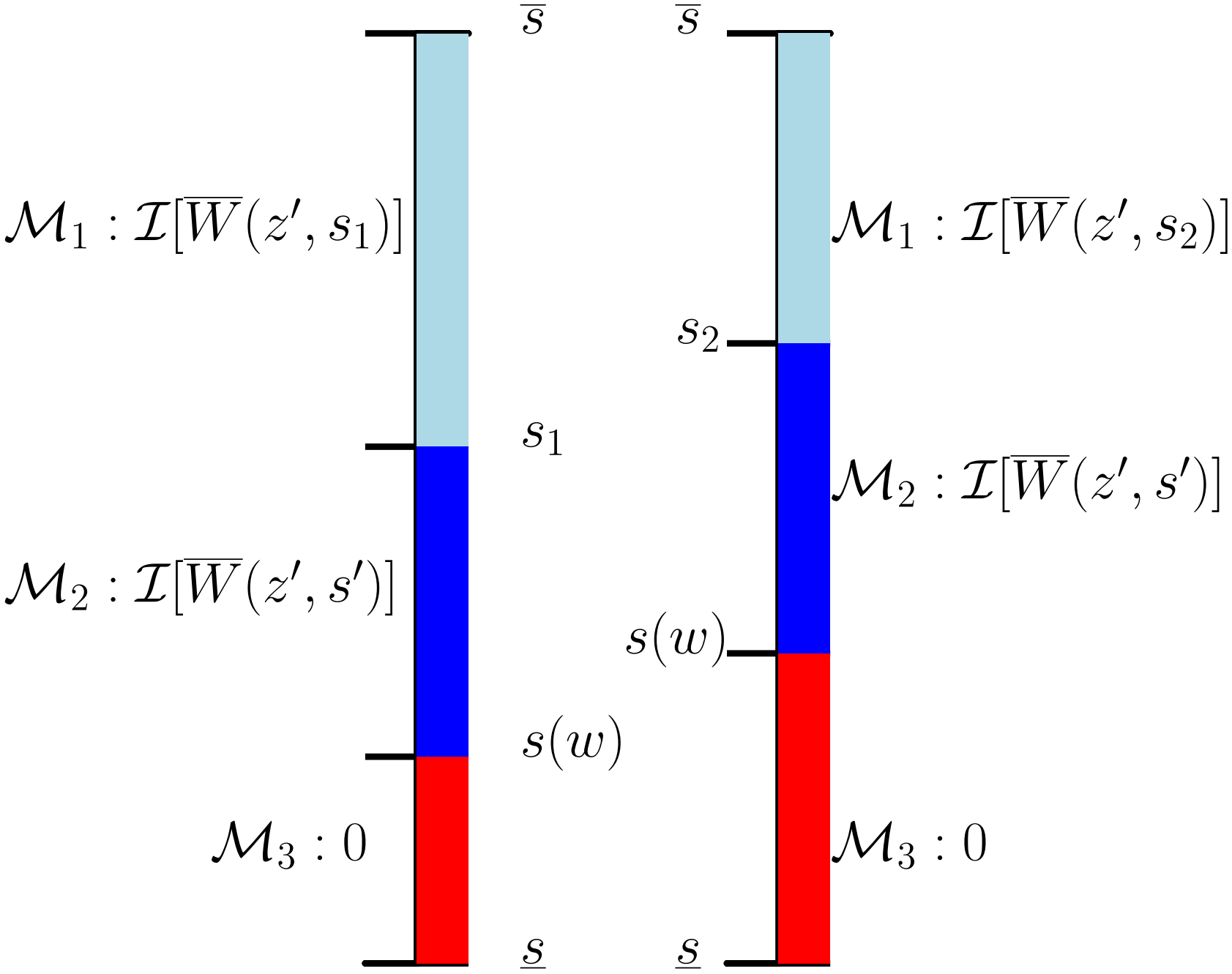
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s_2
s_1
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$s(w)$
$s(w)$
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$\underline{s}$
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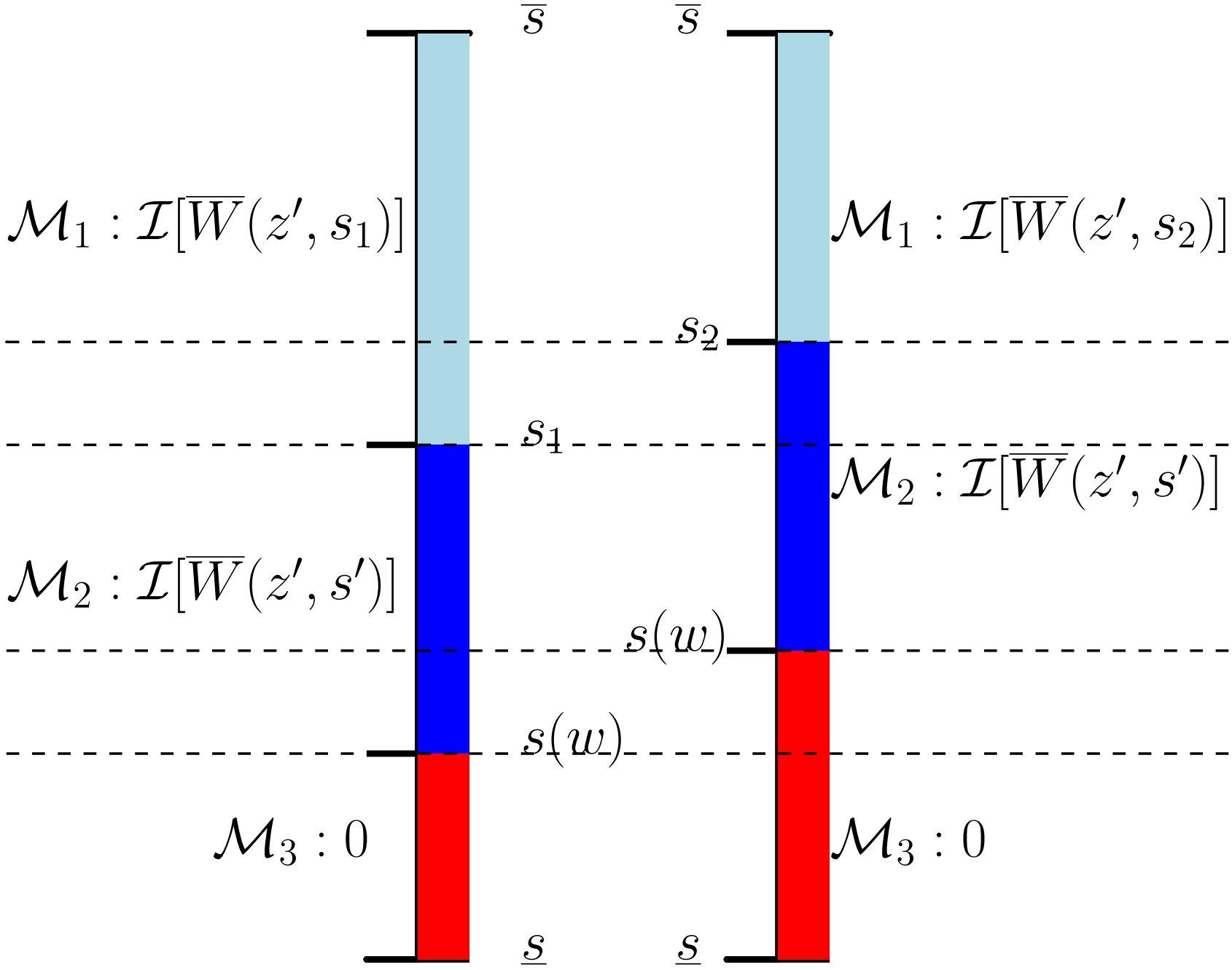
$\overline{s}$
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$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_1)]$
$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_2)]$
s_2
s_1
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
$s(w)$
$s(w)$
$\mathcal{M}_3 : 0$
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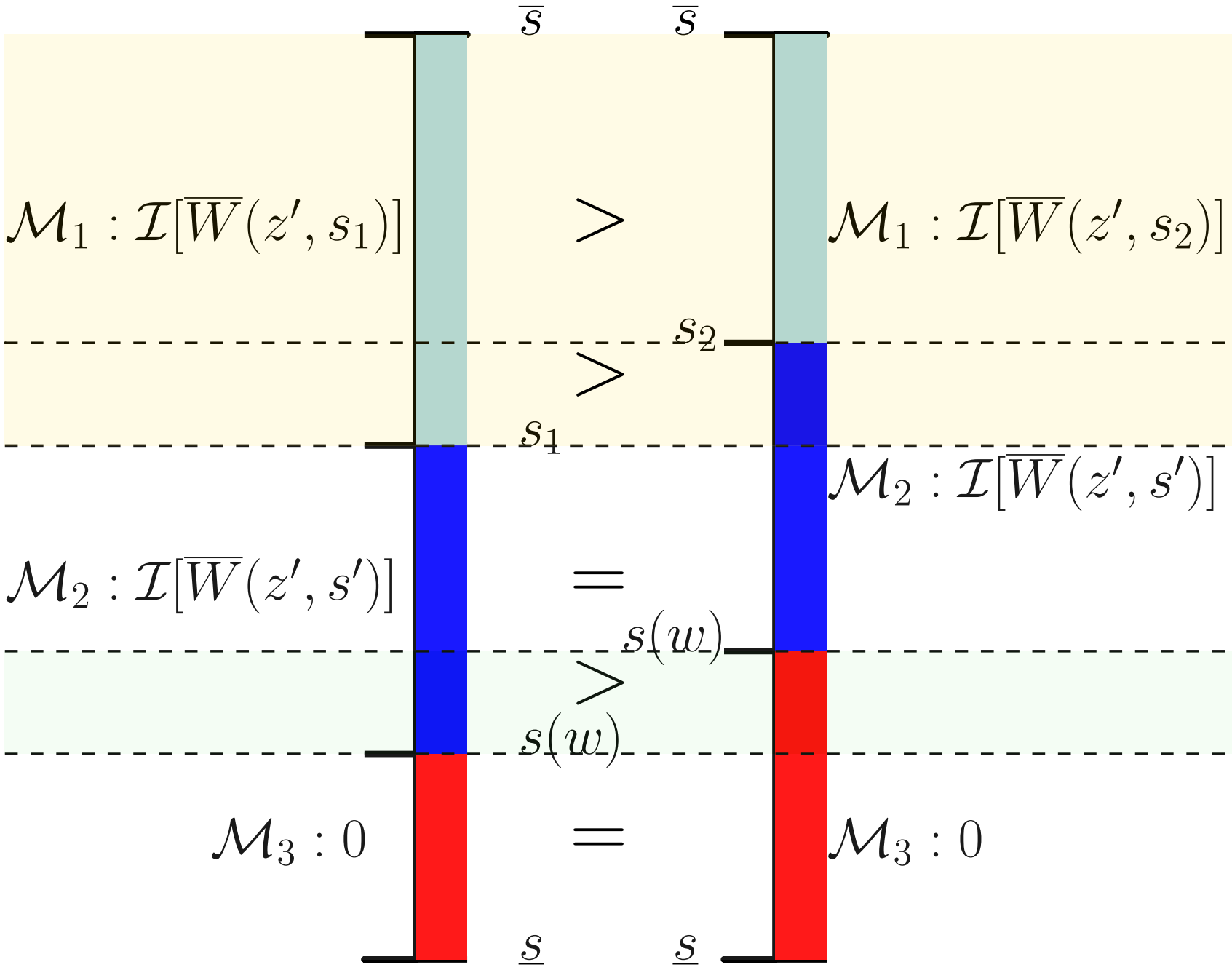
$\overline{s}$
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$\mathcal{M}_1 : \mathcal{I}[\overline{W}(z', s_2)]$
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s_1
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
$\mathcal{M}_2 : \mathcal{I}[\overline{W}(z', s')]$
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$s(w)$
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$s(w)$
$\mathcal{M}_3 : 0$
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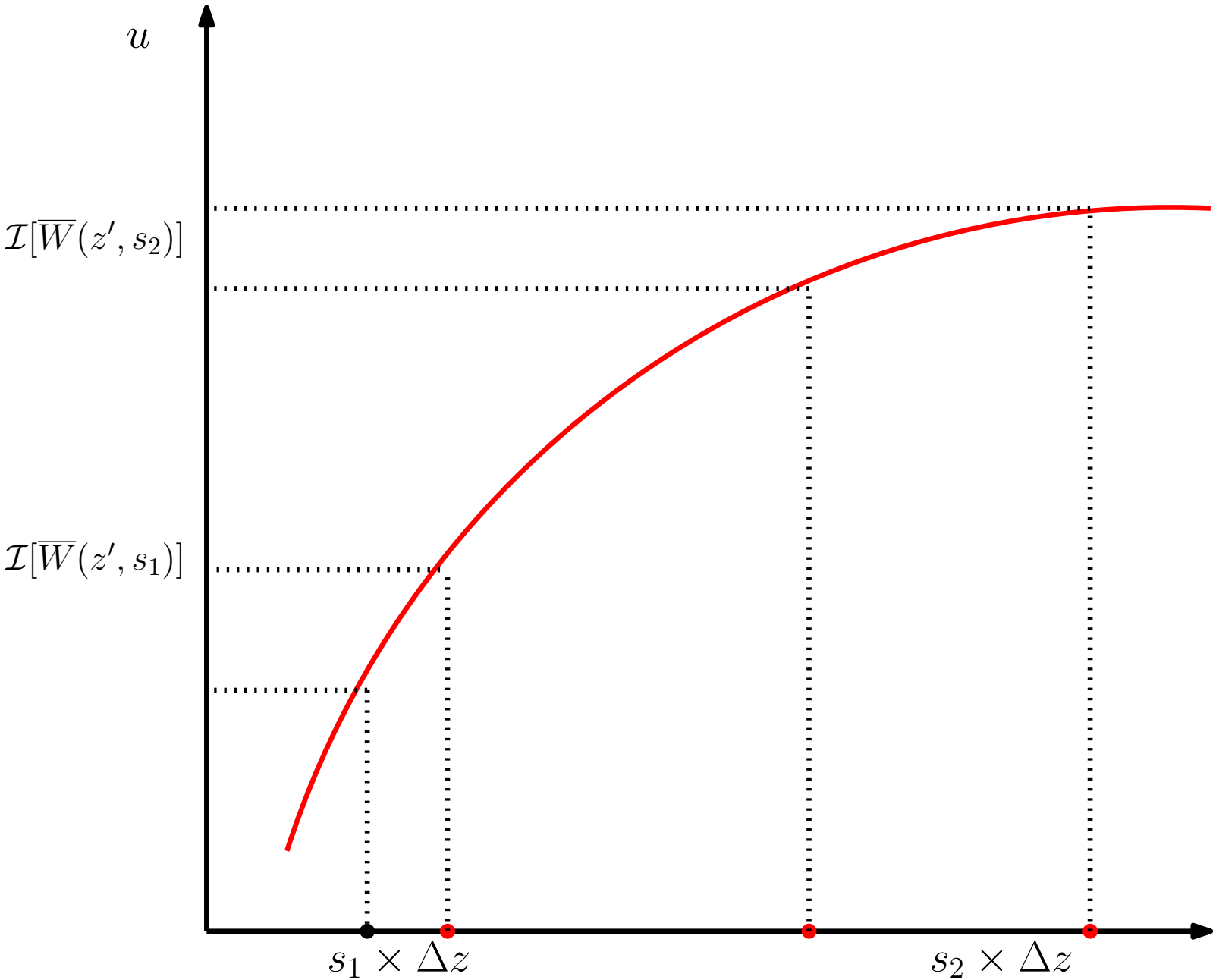
$\mathcal{M}_3 : 0$
$\underline{s}$
$\underline{s}$

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.

- Explain two important empirical puzzles
  1. Firm-size premium in compensation growth
     Larger firms are more capable of countering outside offers.
  2. Firm-size premium in performance-based incentives
     Poaching offers generate labor market incentives which decrease in firm size.

Examine Direct Evidence

Three implications of the model

1. The managerial labor market is active.

2. Managers climb job ladders towards larger firms.

3. Managers in larger firms tend to have less job-to-job transitions.

Data

Data sources

- ExecuComp: compensation and individual features, etc.
- CompuStat: firm performance, etc.
- CRSP: stock return.
- BoardEX: executive employment history.

Define job turnovers

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

Three implications of the model

1. The managerial labor market is active.

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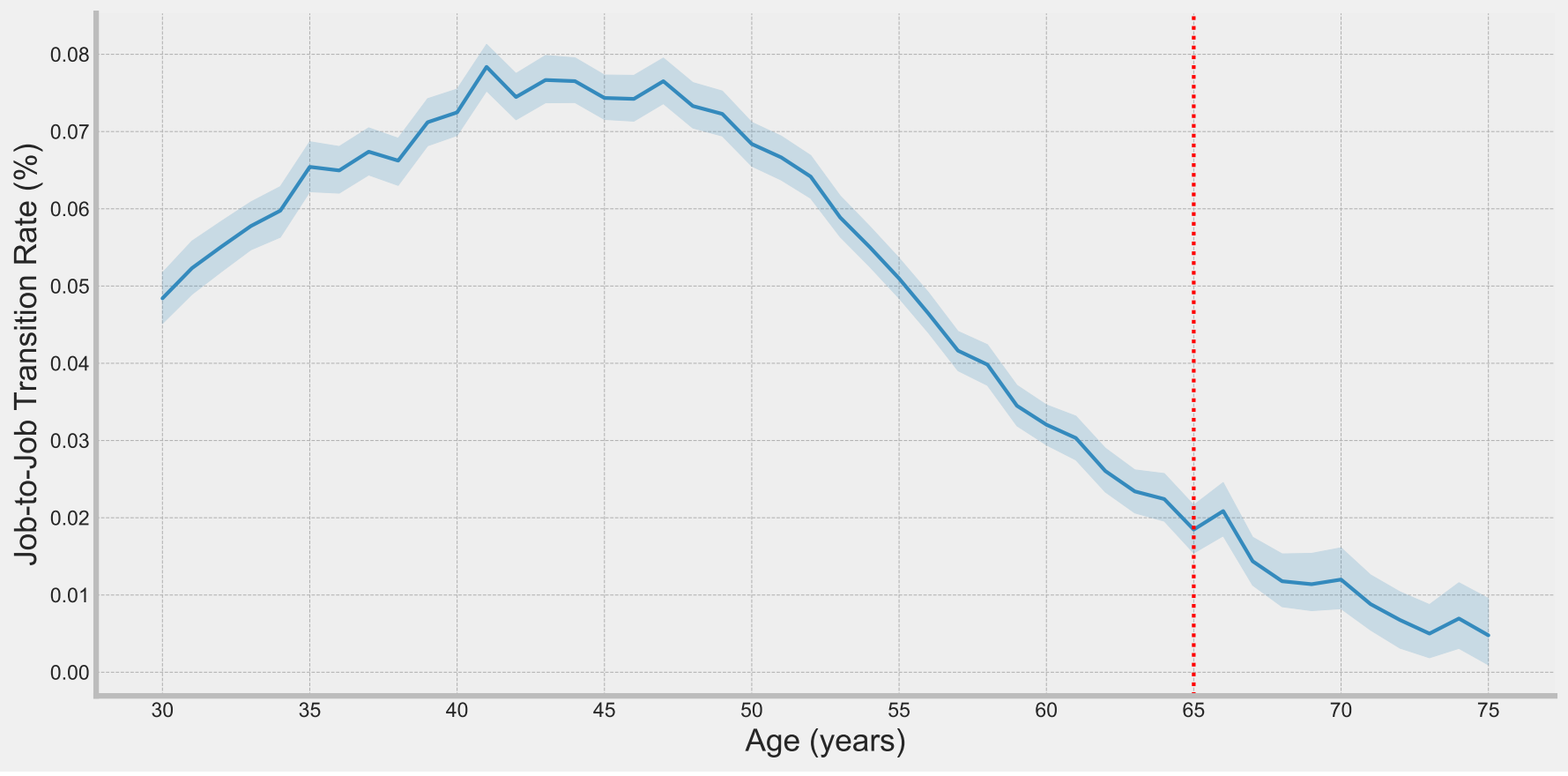
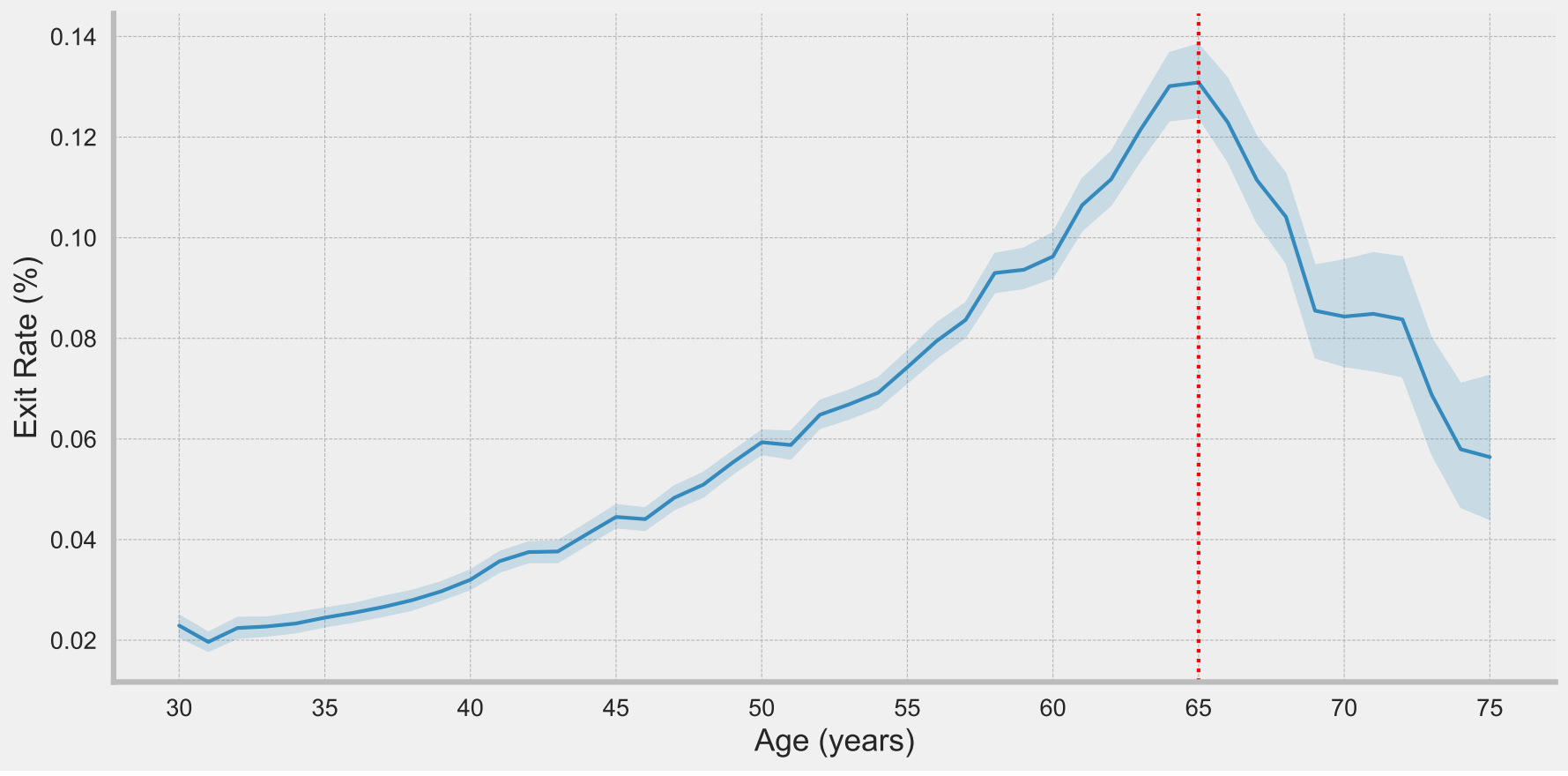
Job-to-job transition rate over age



Exit rate over age



Key implications of the model

1. The managerial labor market is active.

2. Managers climb job ladders towards larger firms.

3. Managers in larger firms tend to have less job-to-job transitions.

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%)

Key implications of the model

1. The managerial labor market is active.

2. Managers climb job ladders towards larger firms.

3. Managers in larger firms tend to have less job-to-job transitions.

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

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	Size premium in compensation growth
$\beta_{delta-size}$	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.

Table 1: Compensation growth increases with firm size

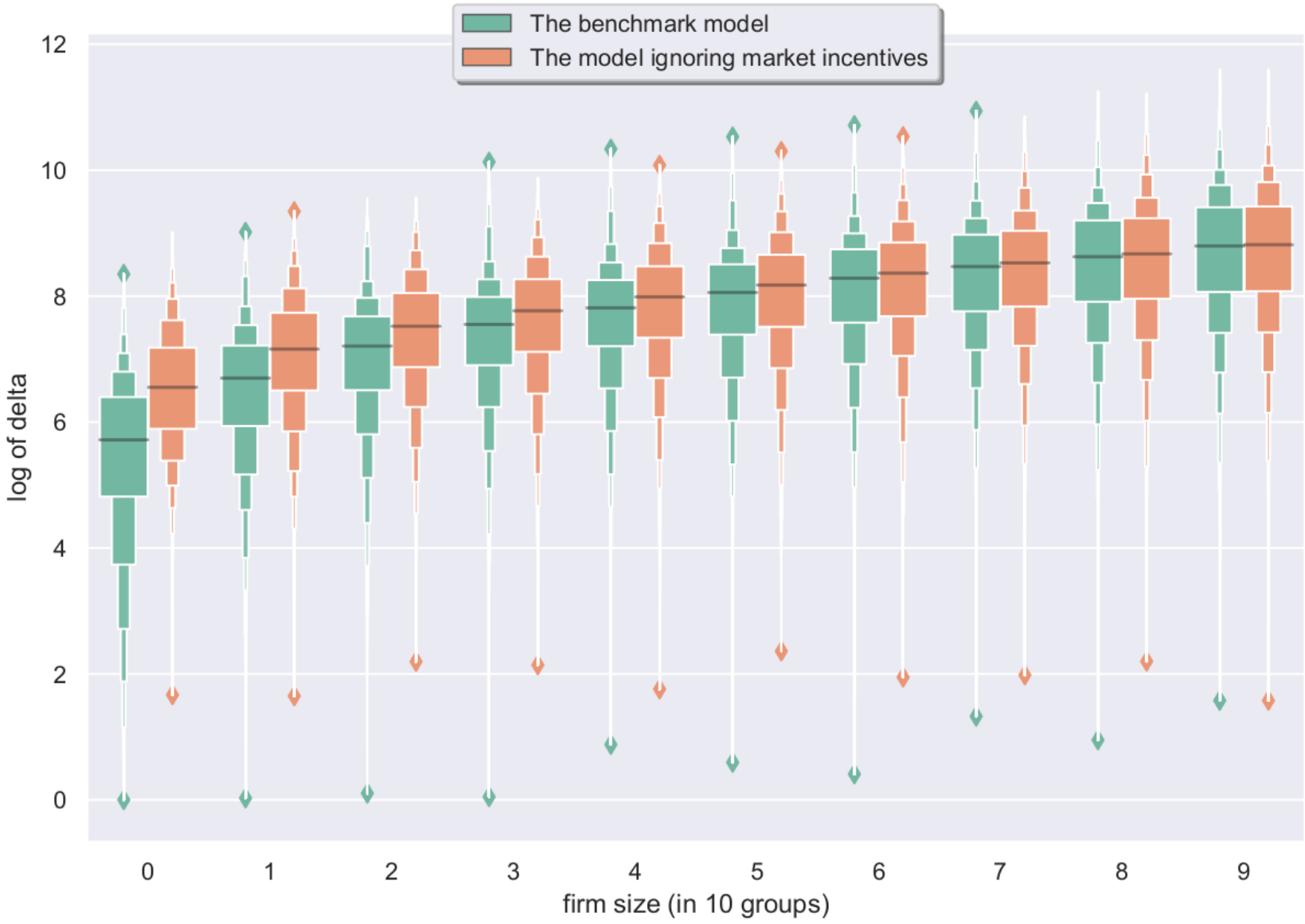
	$\Delta \log(tdc1)$					
	(1)	(2)	(3)	(4)	(5)	(6)
$log(firm\ size)_{-1}$	0.112***	0.154***	0.108***	0.107***	0.141***	0.127***
	(0.00903)	(0.0129)	(0.00183)	(0.00189)	(0.00177)	(0.00489)
$log(firm\ size)_{-1} \times EE90$			0.0711*			
			(0.0403)			
$log(firm\ size)_{-1} \times EE190$				0.0759**		
				(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

Table 2: Performance-based incentives increases with firm size

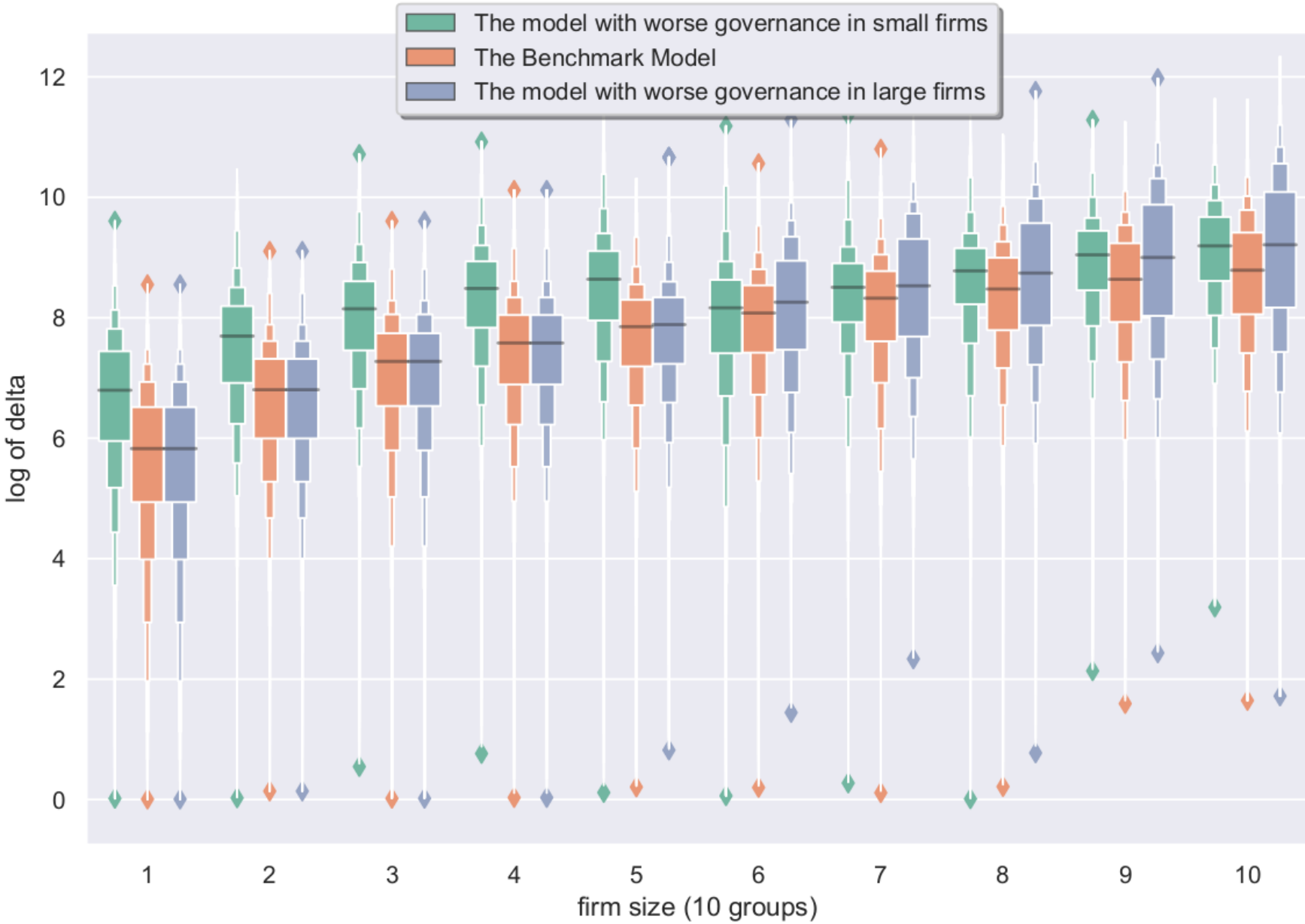
	log(*delta*)					
	(1)	(2)	(3)	(4)	(5)	(6)
log(firm size)	0.604***	0.347***	0.525***	0.529***	0.561***	0.571***
	(0.0141)	(0.0247)	(0.00512)	(0.00499)	(0.00310)	(0.0139)
log(firm size) × *EE90*			0.359*			
			(0.118)			
log(firm size) × *EE190*				0.415**		
				(0.101)		
log(firm size) × *gai*					0.0648***	
					(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

Two Counterfactual Analysis

1. If labor market incentives are ignored ...



2. Spillover effects



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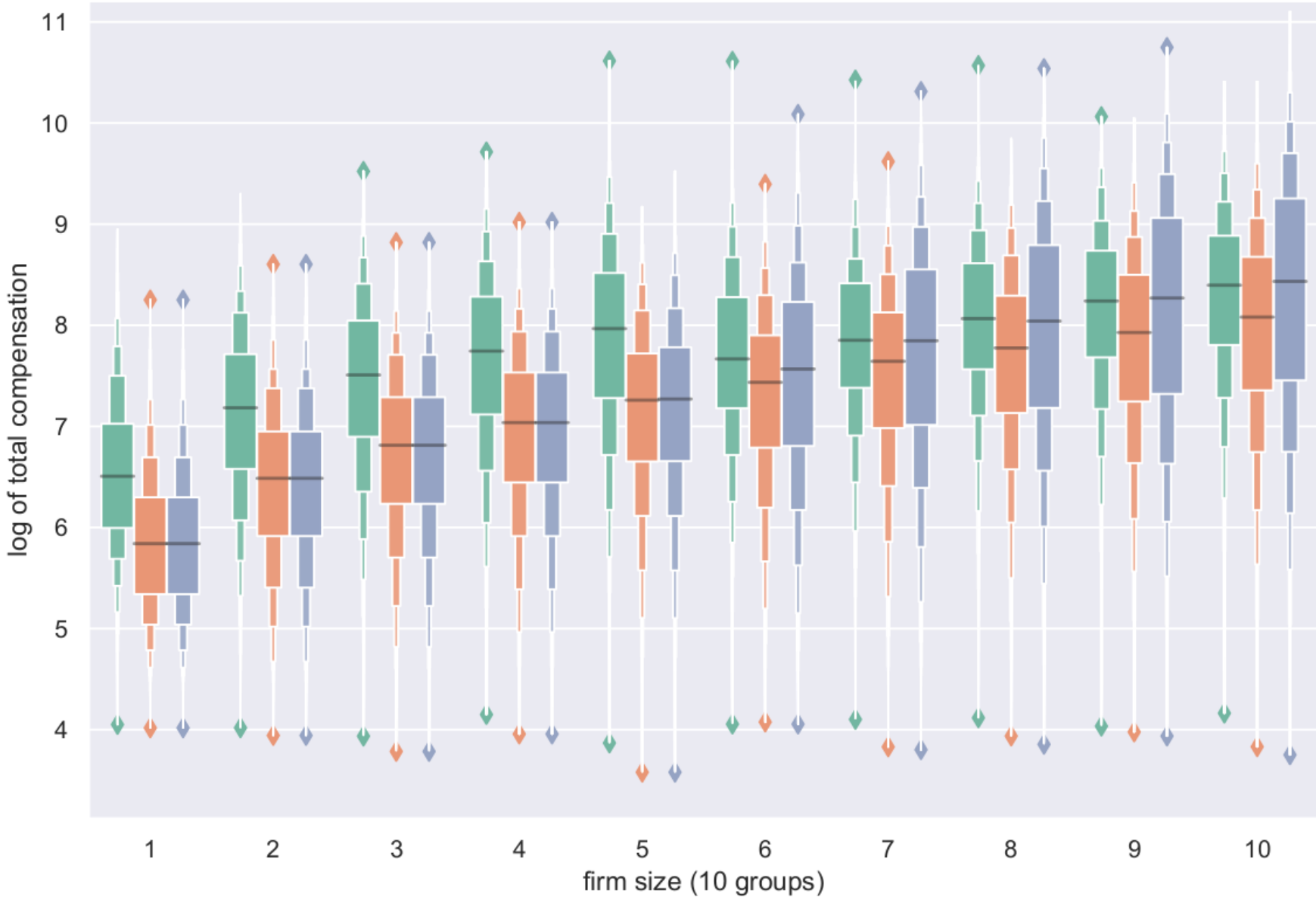


Conclusion

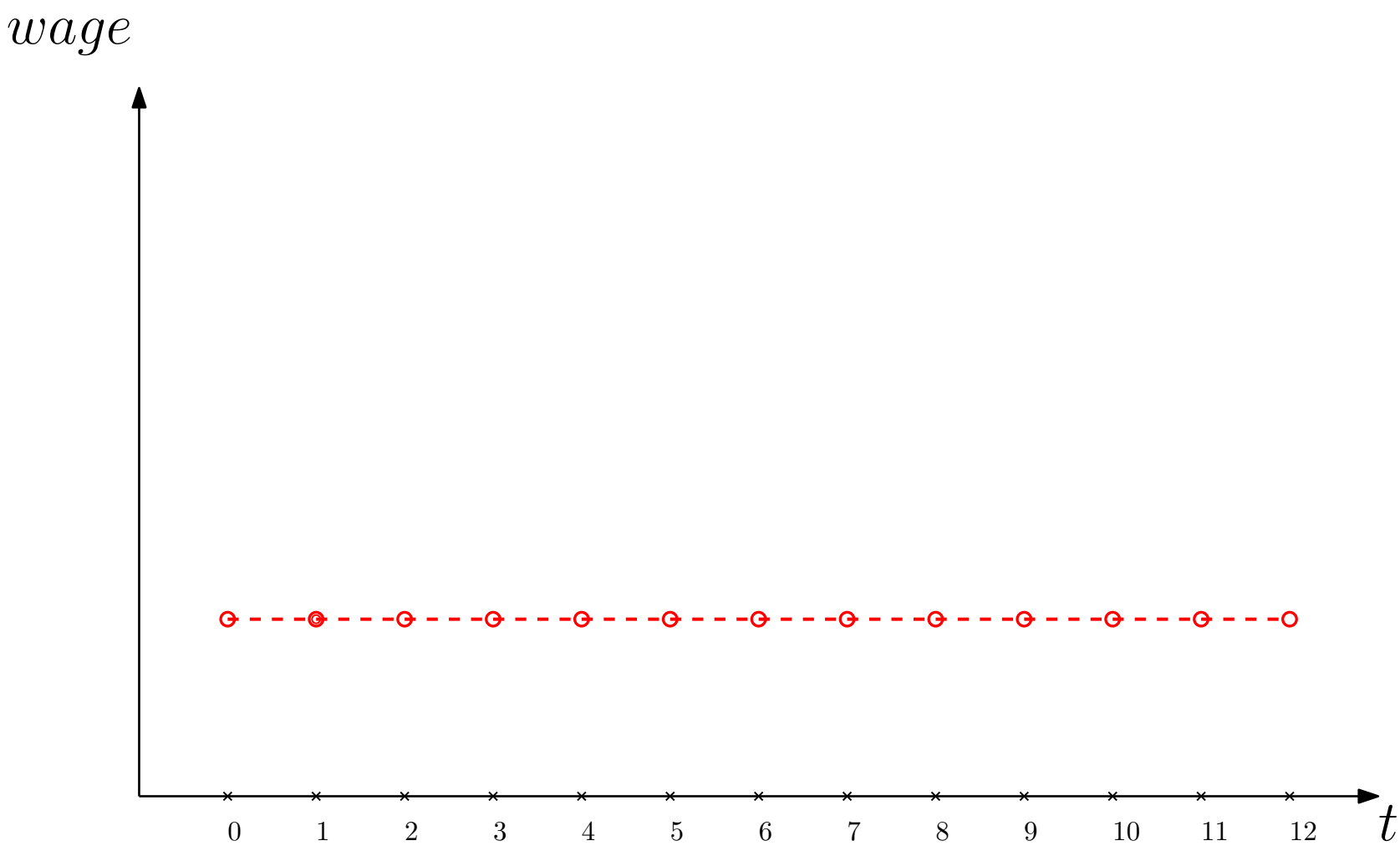
Conclusion

- Managerial labor market competition impacts the incentive contracts on both compensation level and incentives.
- Larger firms are more capable of countering outside offers.
- 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.

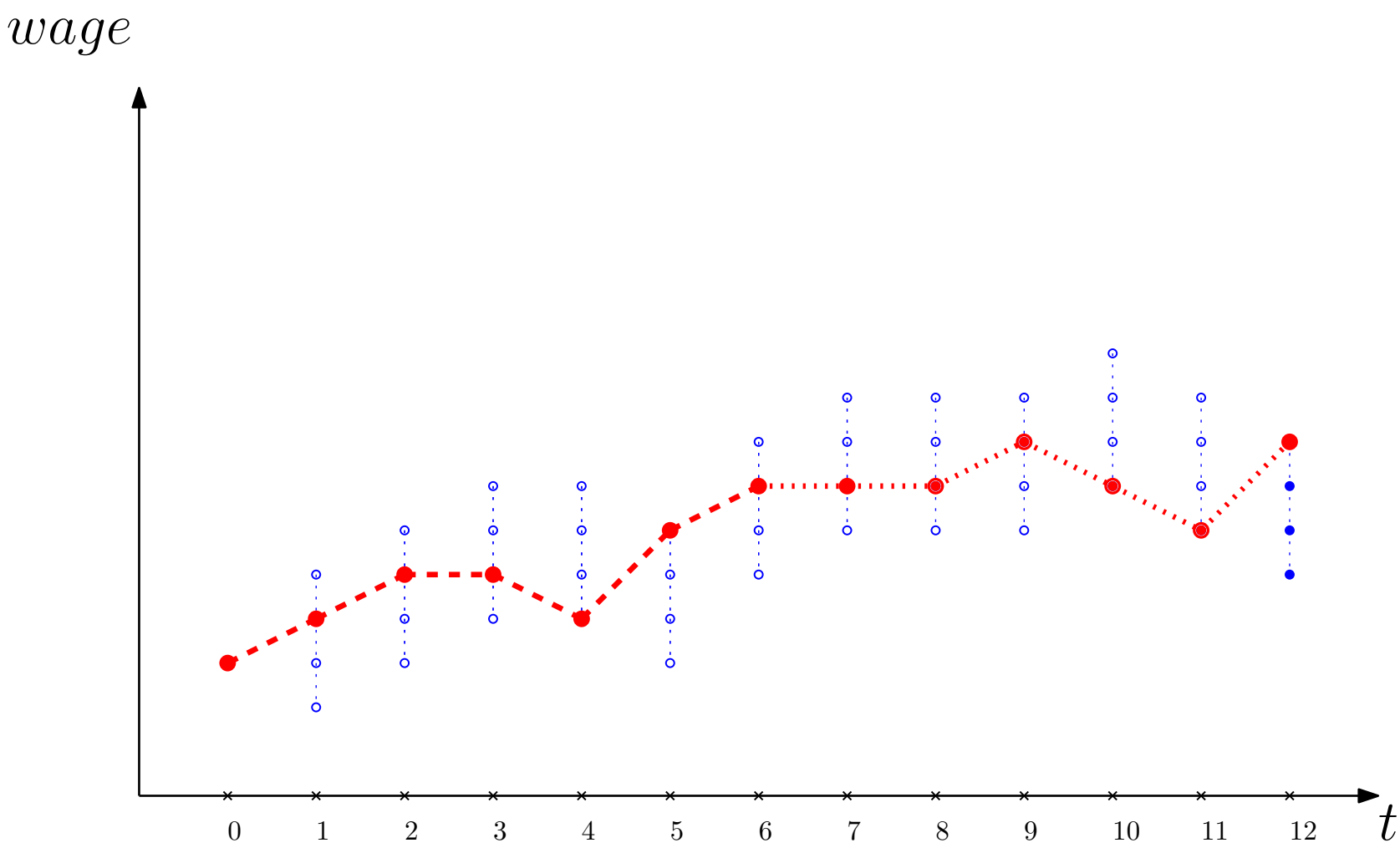
Thanks you for your attention.

http://bohuecon.github.io

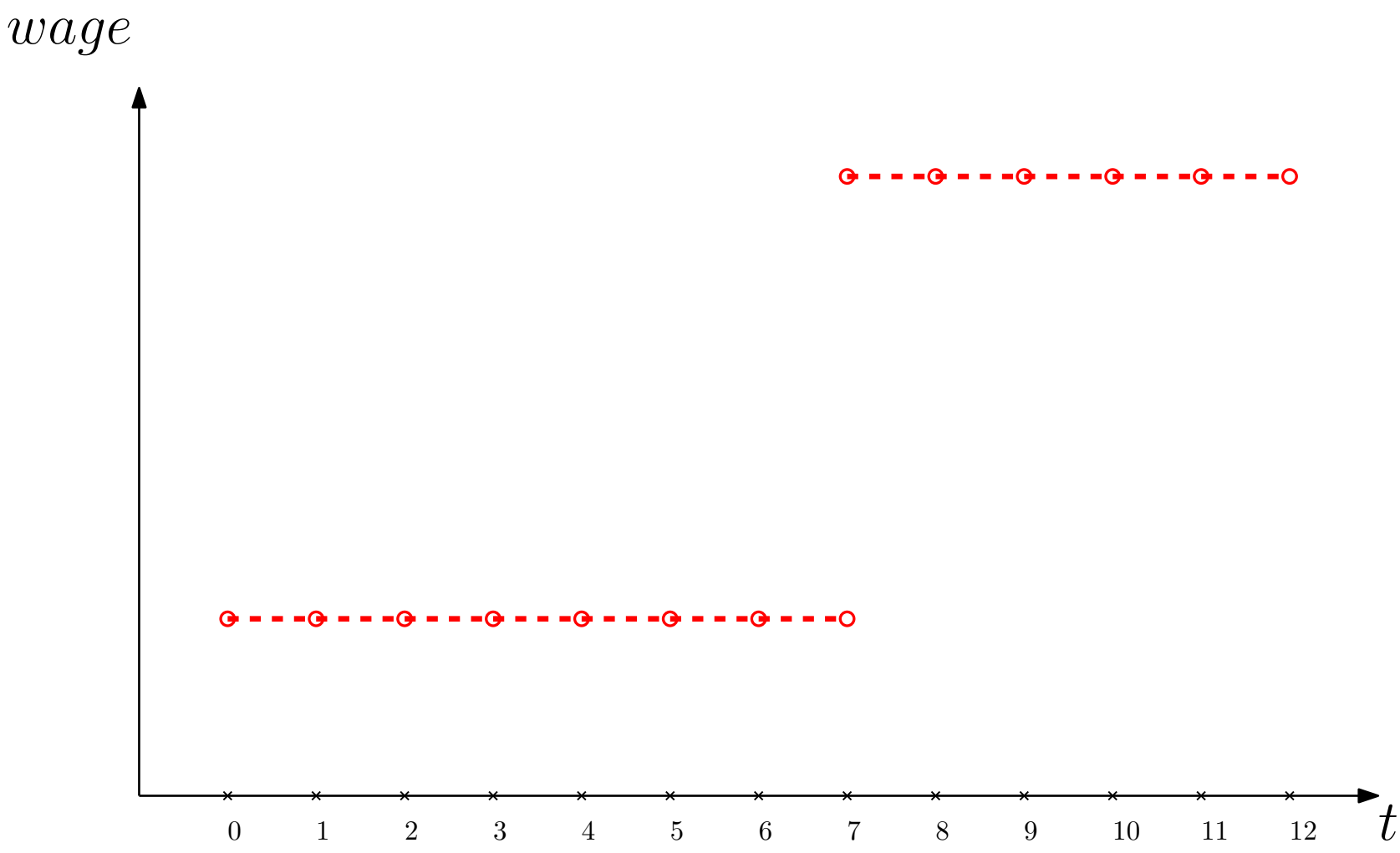
No Moral Hazard, Full Commitment



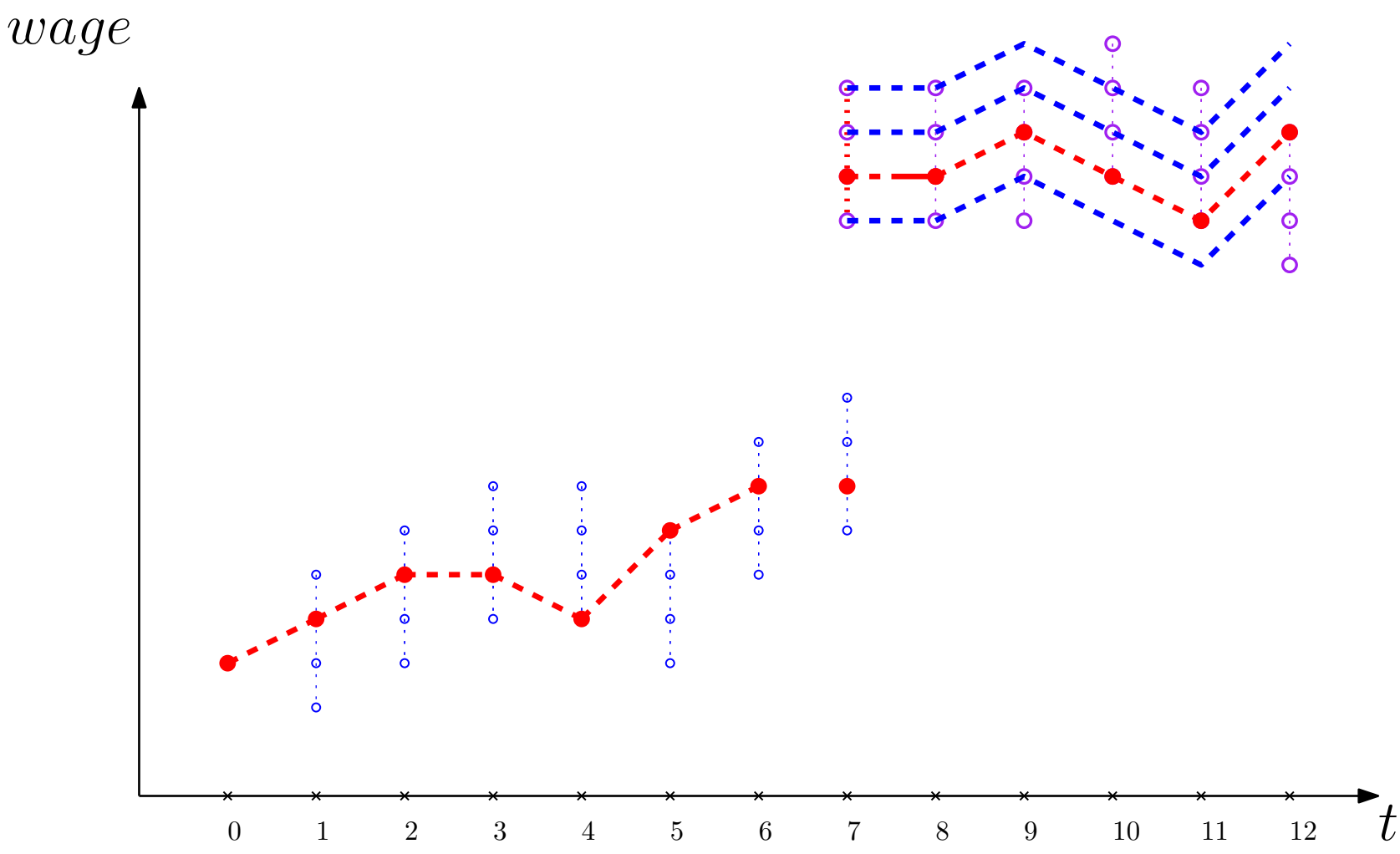
Only Moral Hazard



Only Limited Commitment



Optimal Contract



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

References

Edmans, Alex, Xavier Gabaix, and Dirk Jenter (2017), "Executive compensation: A survey of theory and evidence." Technical report, National Bureau of Economic Research.