Why do Larger Firms Pay Executives More for Performance?

Performance-based versus Market-based incentives

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Tinbergen Institute, Amsterdam

Introduction

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- Managerial labour market and contract incentives
- Apple Inc. 2016 Proxy Statement:

  "experienced personnel in the technology industry are in high demand, and competition for executive talent is intense ... (the contract incentives are designed) to attract and retain a talented executive team and align executives interests with those of shareholders ..."

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- How does the managerial labour market and pay incentives interact?
- Why do larger firms pay executives more for performance?
  (firm size premium in performance-based incentives)

Motivating Facts

- A typical executive compensation package:

fixed salary	+	performance-based pay (bonus, stocks, options, etc.)
30%		70%

- Performance-based incentives

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  1. delta increases in firm size,

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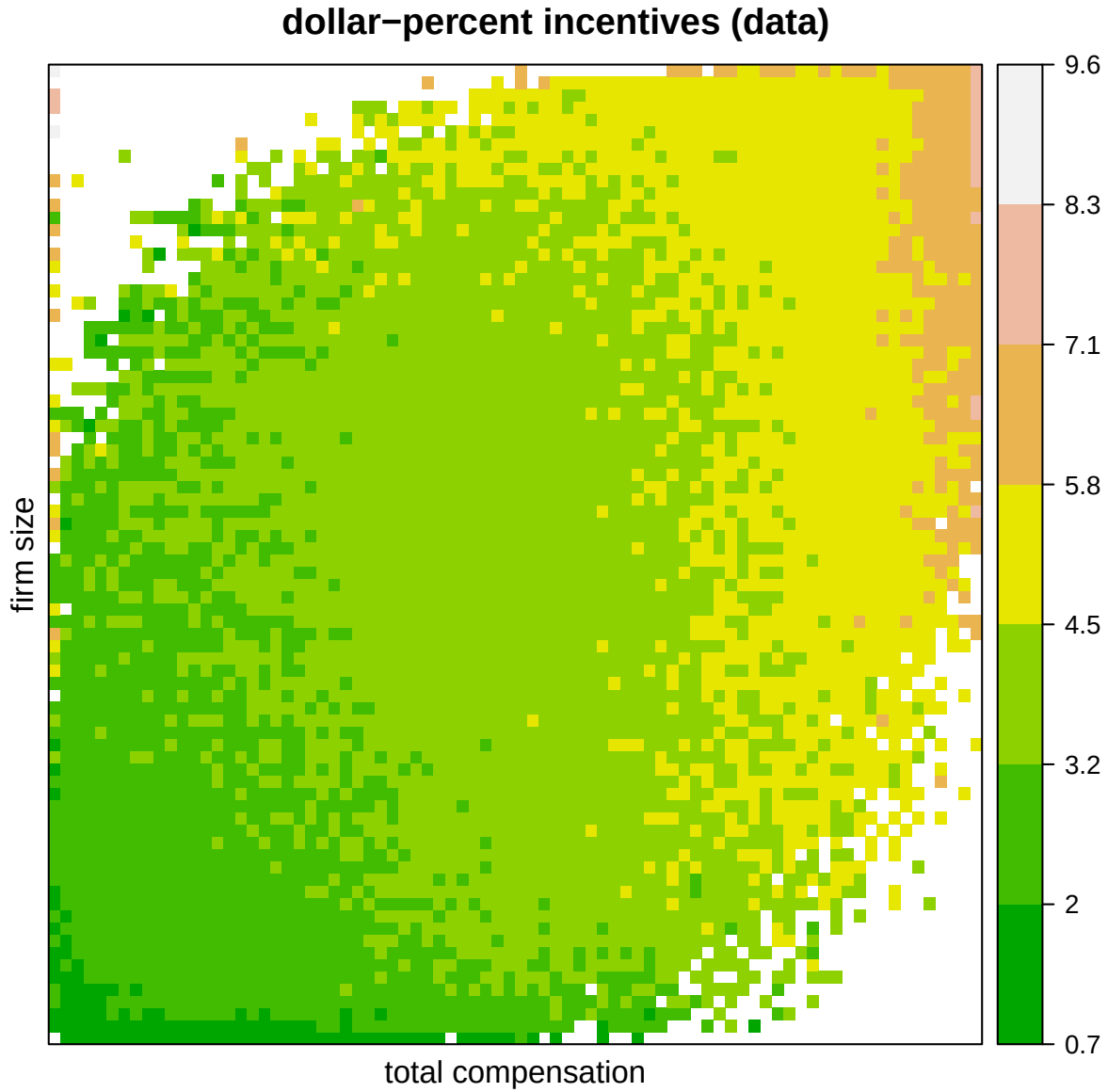
- Stylized facts:
  1. delta increases in firm size, controlling for total compensation [Size Premium in Performance-based Incentives]
  2. such firm size premium is larger in industries where the executive labour market is more active



Sample: top 5 to 8 executives in $S\&P1500$ firms from 1992 to 2015

Color (z): dollar-percent wealth-performance sensitivity

Table 1: Pay-for-performance Incentives Increase with Firm Size

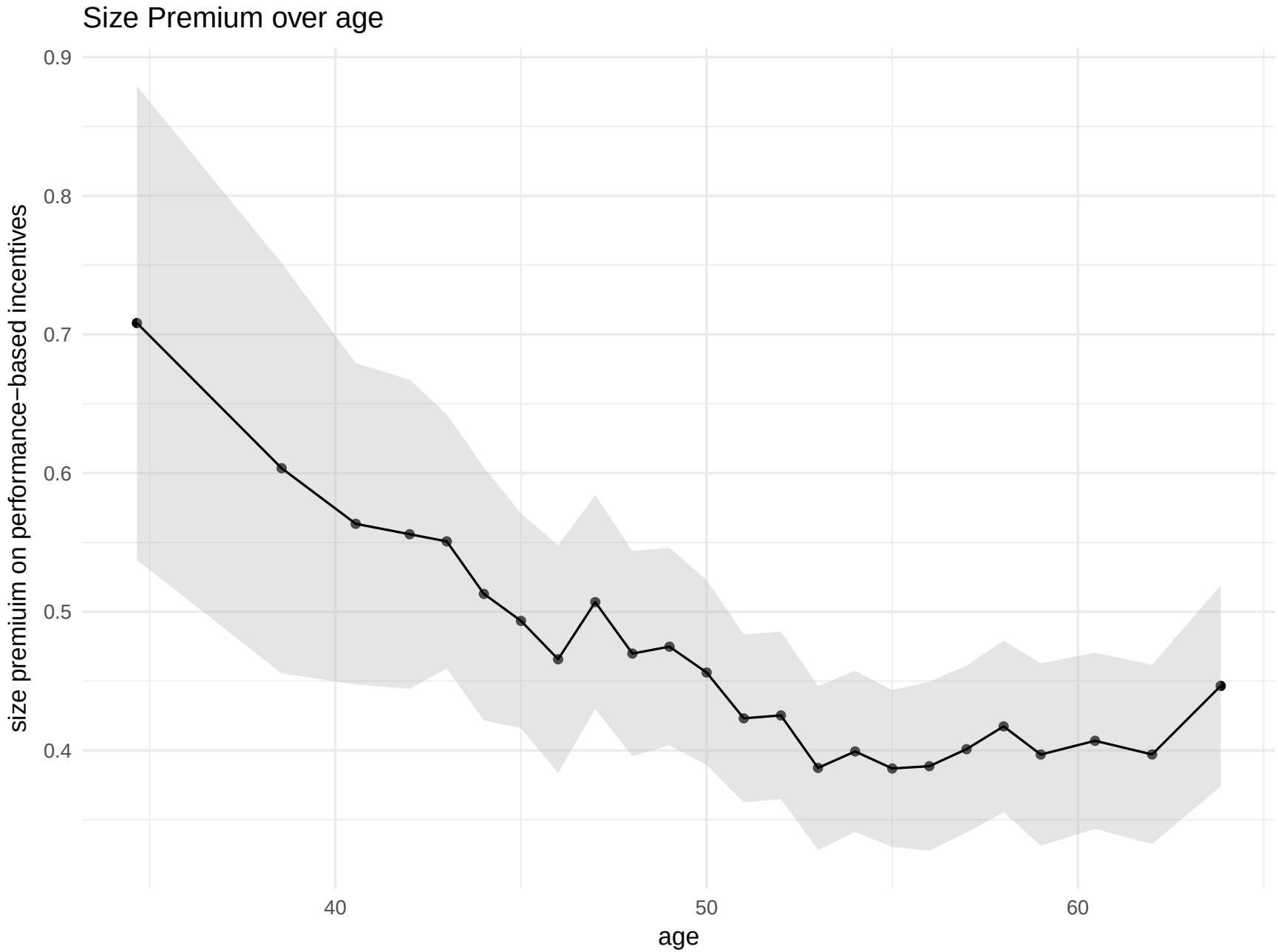
	log(*delta*)			
	(1)	(2)	(3)	(4)
log(Firm Size)	0.571***	0.295***	0.257***	0.253***
	(0.0153)	(0.0294)	(0.0252)	(0.0249)
log(tdc1)		0.682***		
		(0.0555)		
tdc1 Dummies (50)			Yes	
tdc1 Dummies (100)				Yes
Age dummies	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes
Year × Industry FEs	Yes	Yes	Yes	Yes
Observations	129458	129184	129185	129185
adj. R-sq	0.392	0.491	0.502	0.505

Note: The standard error (clustered at the firm level) are shown in parentheses, and we denote symbols of significance by * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dependent variable is the log of delta. The independent variable is the log of firm size. The key control variable is total compensation.

Table 2: Firm Size Premium Increases with Market Competition

	log(*delta*)		
	(1)	(2)	(3)
log(Firm Size)	0.348***	0.386***	0.257***
	(0.00708)	(0.0189)	(0.0483)
log(tdc1)	0.653***	0.596***	0.653***
	(0.00445)	(0.0319)	(0.0269)
log(Firm Size) × External CEO	0.0434*		
	(0.0204)		
GAI		-0.428	
		(0.255)	
log(Firm Size) ×GAI		0.0702*	
		(0.0325)	
Size Heterogeneity (sd/mean)			-2.652***
			(0.784)
log(Firm Size) × Size Heter.			0.218*
			(0.0993)
Age dummies	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes
Observations	126533	77230	126533
adj. R-sq	0.505	0.512	0.506

Note: External CEO is measured by the percentage of new CEOs who are not insiders at the industry level (Gremers and Grinstein, 2014). GAI is the industry-year average of the general ability index composed by Cláudia, Ferreira and Matos (2013) .Size-Heterogeneity is the standard deviation of firm size within each industry-year group divided by the corresponding mean.


Size Premium over age
size premiuim on performance−based incentives
0.9
0.8
0.7
0.6
0.5
0.4
40
50
60
age

Research Questions:

- How does the labour market shape contract incentives?
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Main Story:

- Dynamic moral hazard problem + Frictional labour market
- Performance-based incentives + Market-based incentives
- Market-based incentives decrease with firm size, so larger firms need to provide more performance-based incentives.

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- Taking effort today improves managerial skills which are persistent and are appreciated in the labour market.

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- **Job ladder effect**
  executives in larger firms are less likely to receive competitive outside offers

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Why do market-based incentives decrease in firm size?

- **Job ladder effect**
  executives in larger firms are less likely to receive competitive outside offers
- **Wealth effect**
  executives in larger firms have a higher certainty equivalence level of wealth in the future, subjectively they are less sensitive to wealth variation (diminishing marginal utility)

What do I do?

1. Model
2. Reduced-form Evidence
3. Structural Estimation using SMM
4. Quantitative Analyses
   - regulations on executive compensation
   - spillover effect of corporate governance on executive compensation

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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, Infinite Periods

Executives:

- risk averse, $u(w) - c(e)$, $e \in \{0, 1\}$, $c(1) = c$, $c(0) = 0$
- effort e stochastically increases individual productivity $z \in \mathcal{Z}$
- z is persistent, follows a Discrete Markov Chain process
  - $\Gamma(z, z')$ if $e = 1$, $\Gamma^s(z, z')$ if $e = 0$
  - likelihood ratio $g(z, z') = \Gamma^s/\Gamma$ decreases in z'
- die with $\delta \in (0, 1)$, the match breaks up, the job disappears

Firms:

- firm size $s \in \mathcal{S}$, exogenous and permanent
- production (cash flow) $y(s, z) = \alpha sz$

Set Up: Search Market

Search Market:

- on the job search
- with $\lambda \in (0,1)$ sample an outside firm s' from $F(s')$

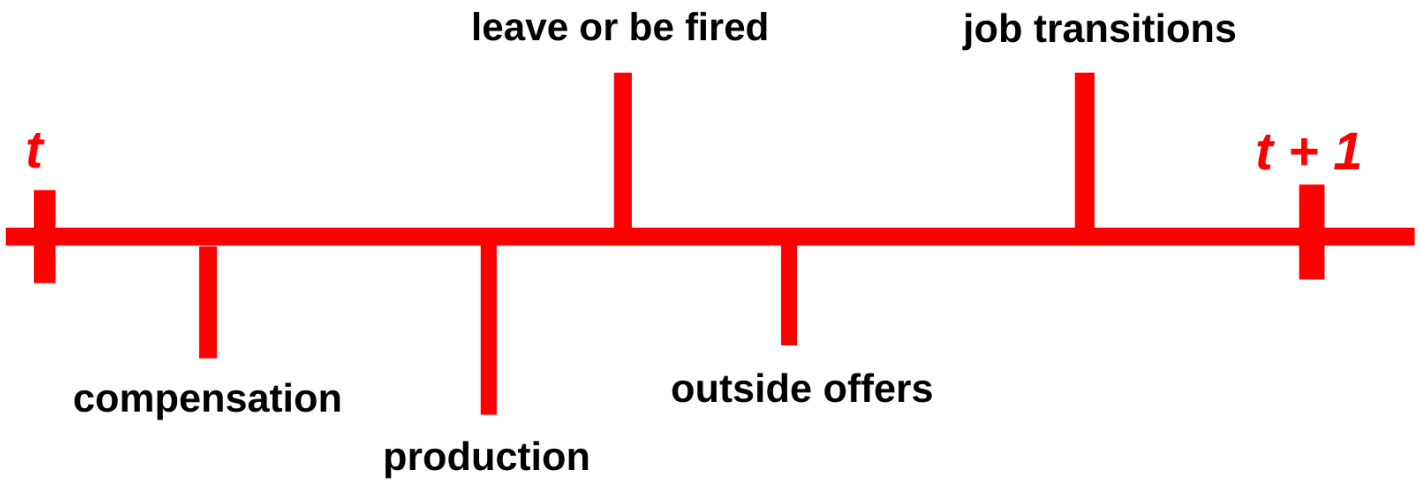
Sequential Auction:

- Bertrand competition between current firm s and outside firm s'
- Each firm has a **bidding frontier**, $\overline{W}(z,s)$, defined by

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

- $\overline{W}(z,s)$ increases in z and s
- $s' > s$ leads to job turnovers

Timing


leave or be fired
job transitions
t
t + 1
compensation
production
outside offers

Contracting Problem

Firms maximize profits

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

subject to

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

$$\tilde{\beta} \sum_{z' \in \mathbb{Z}} \sum_{s' \in \mathbb{S}} W(z',s') \tilde{F}(s') (1 - g(z,z')) \Gamma(z,z') \geq c, \quad \text{(IC)}$$

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

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

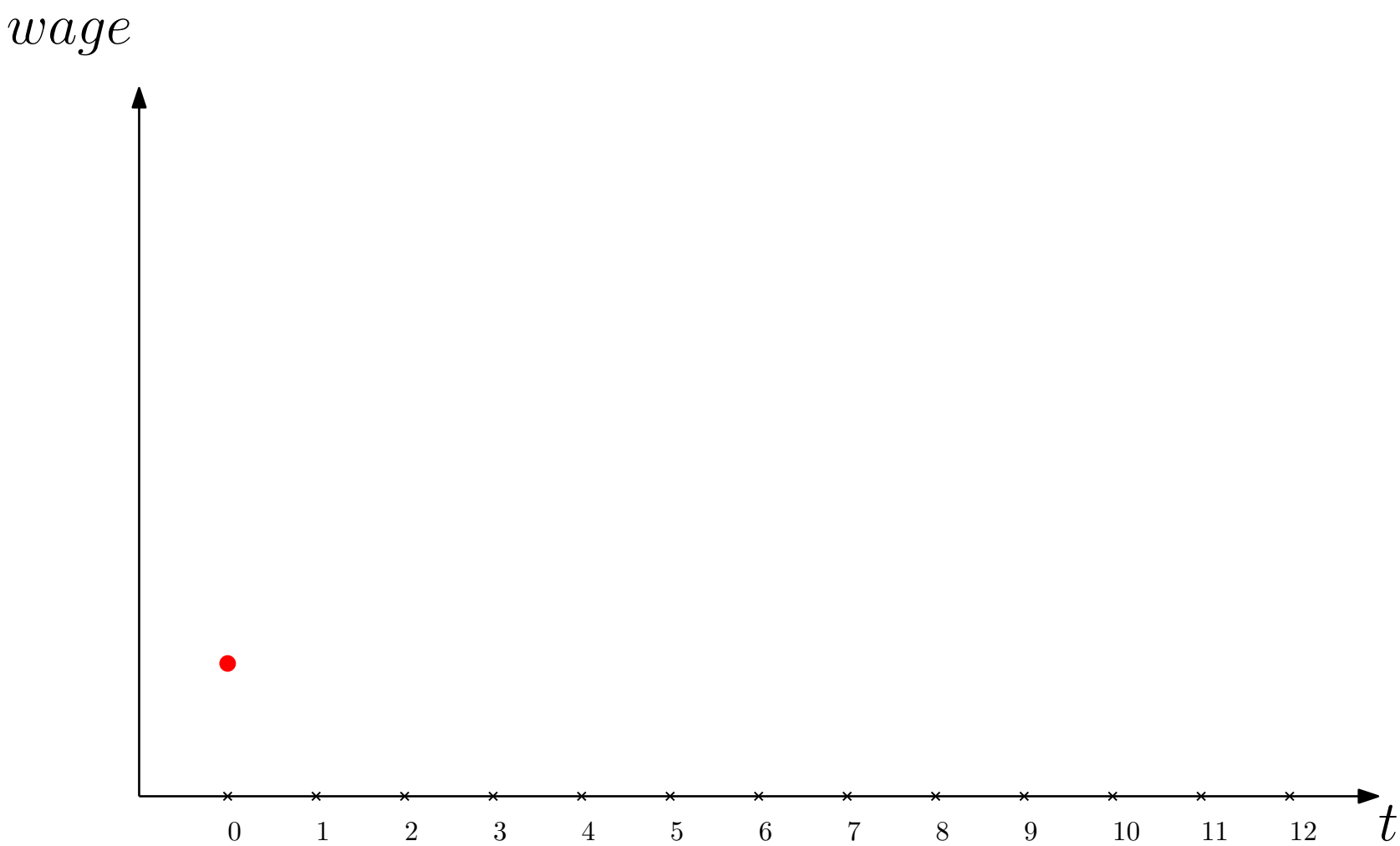
The Equilibrium

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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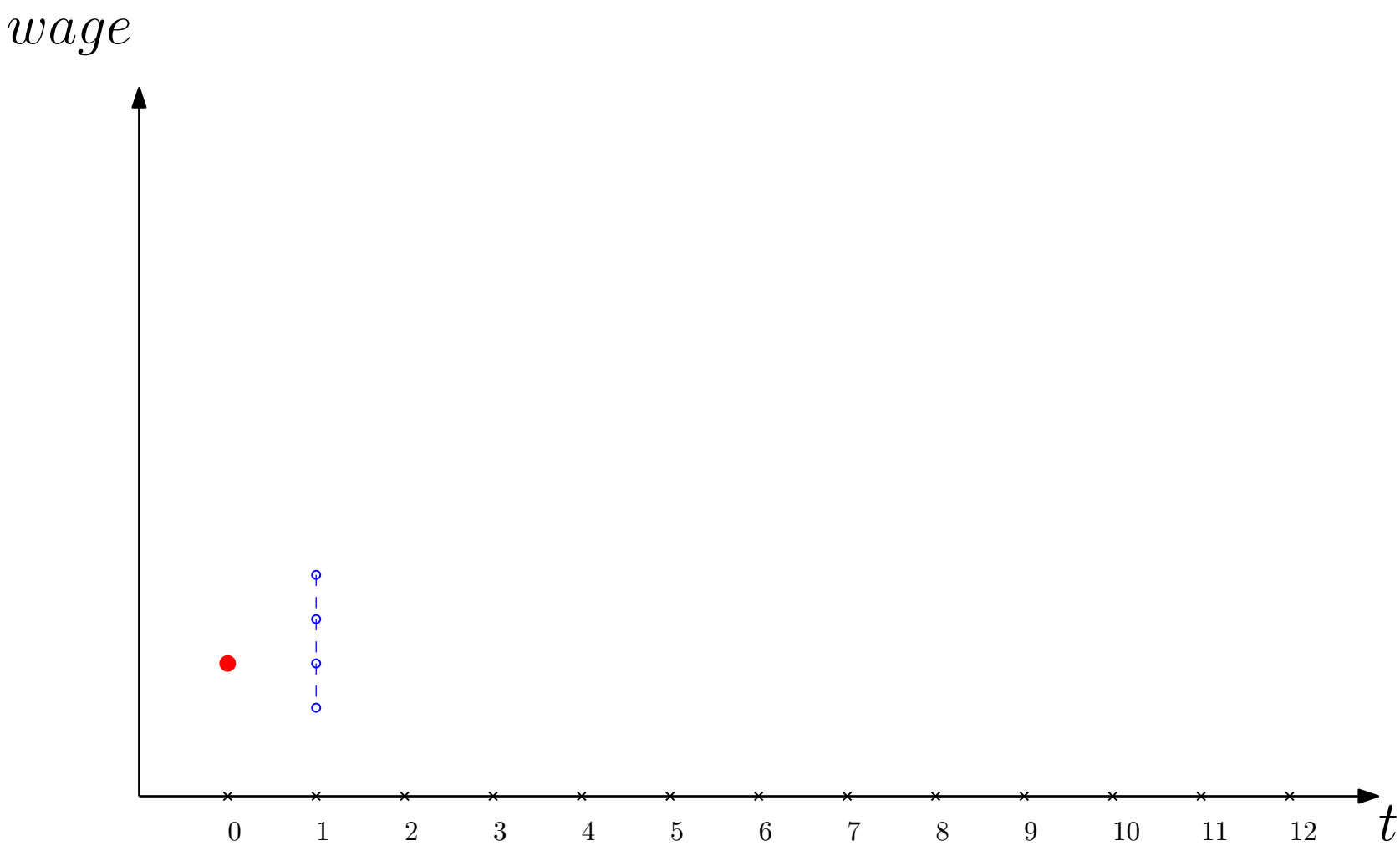

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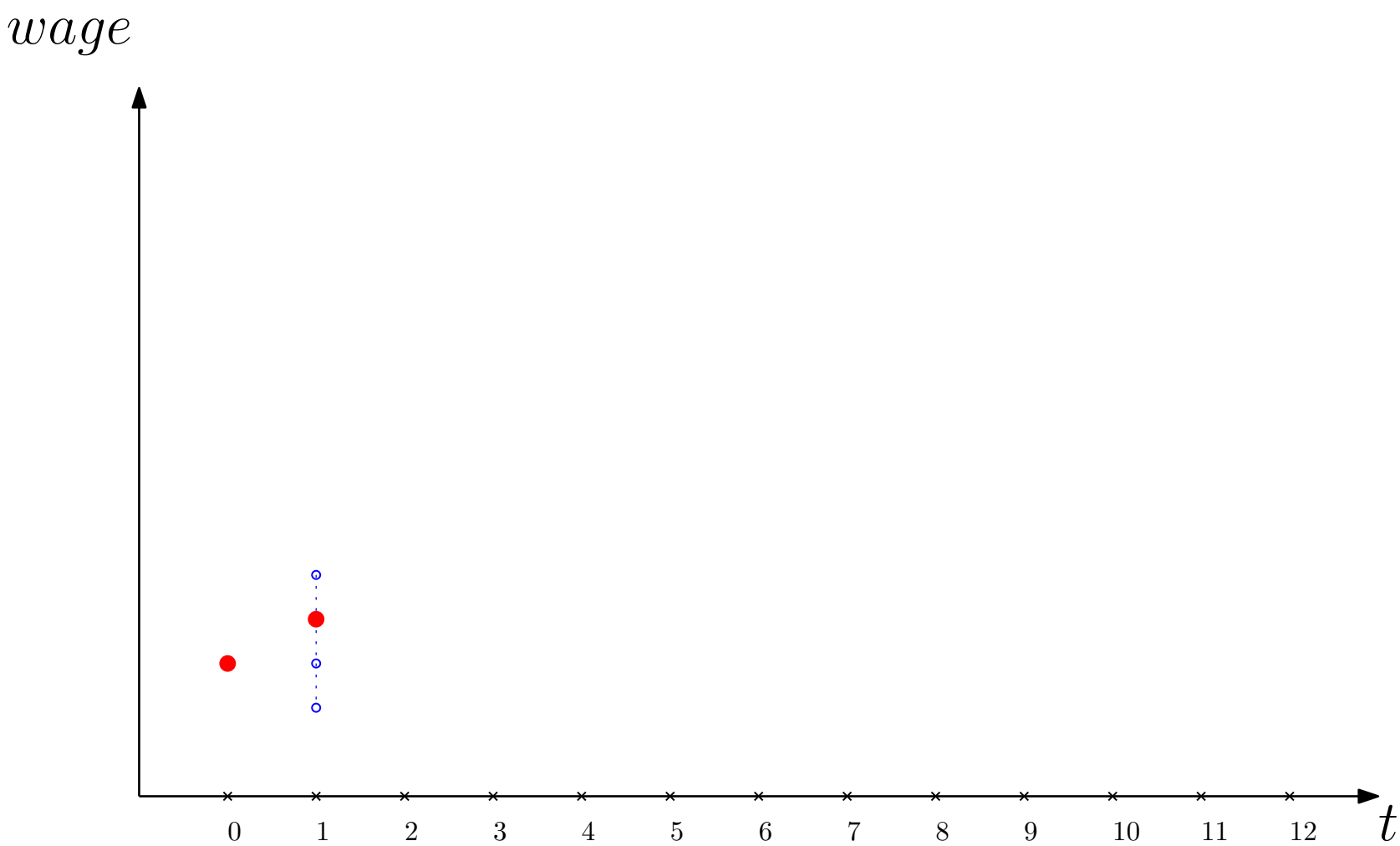

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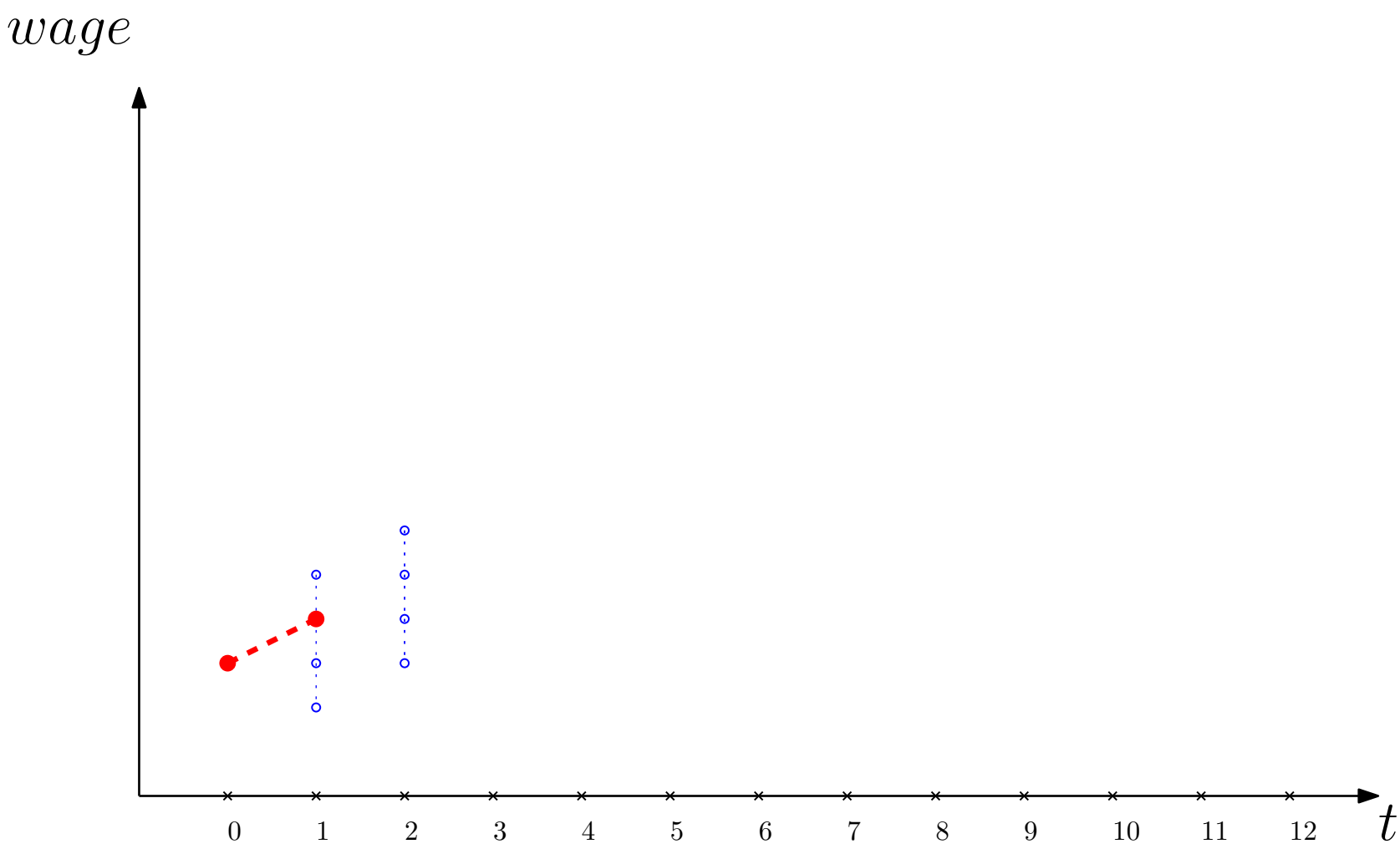

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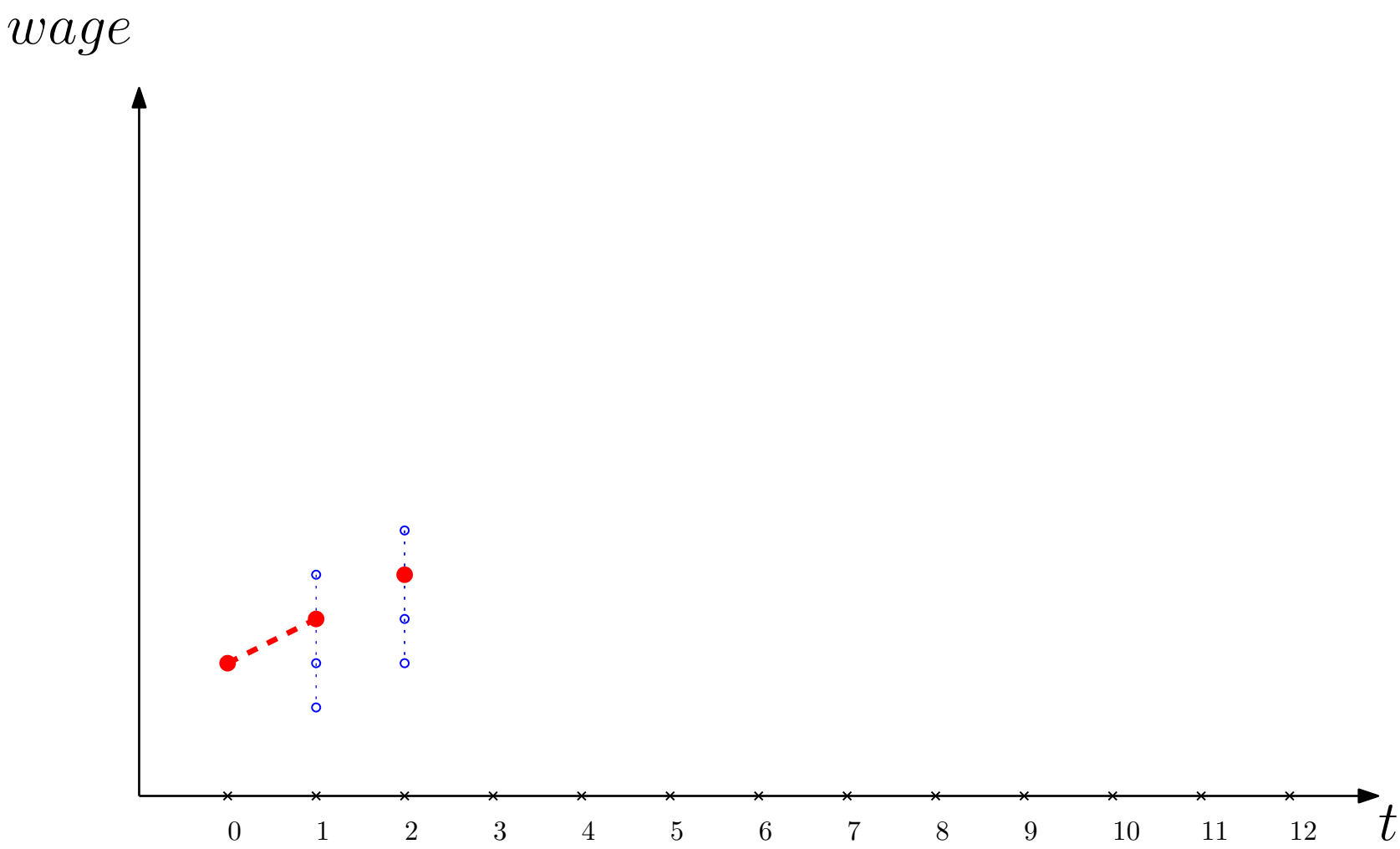

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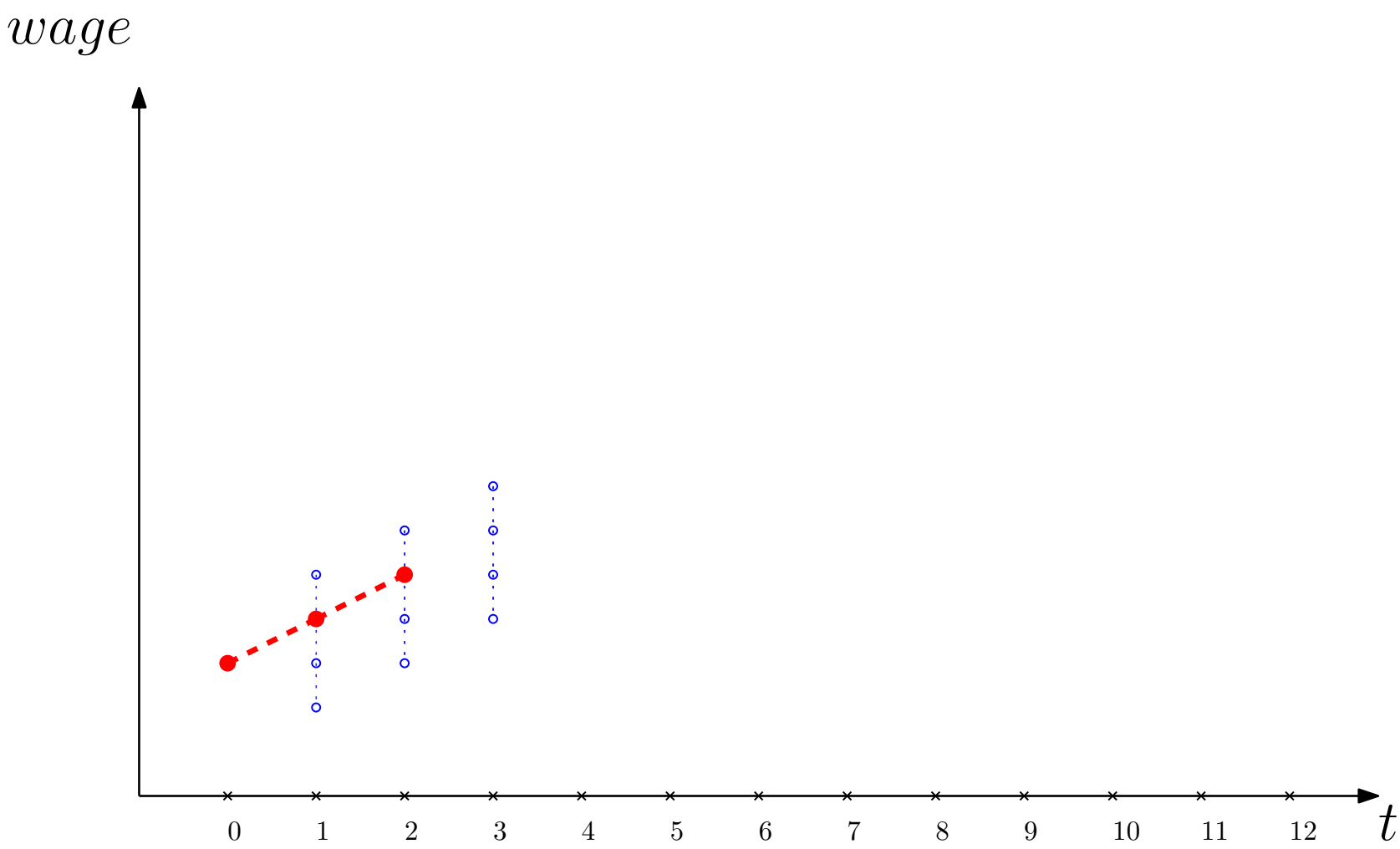

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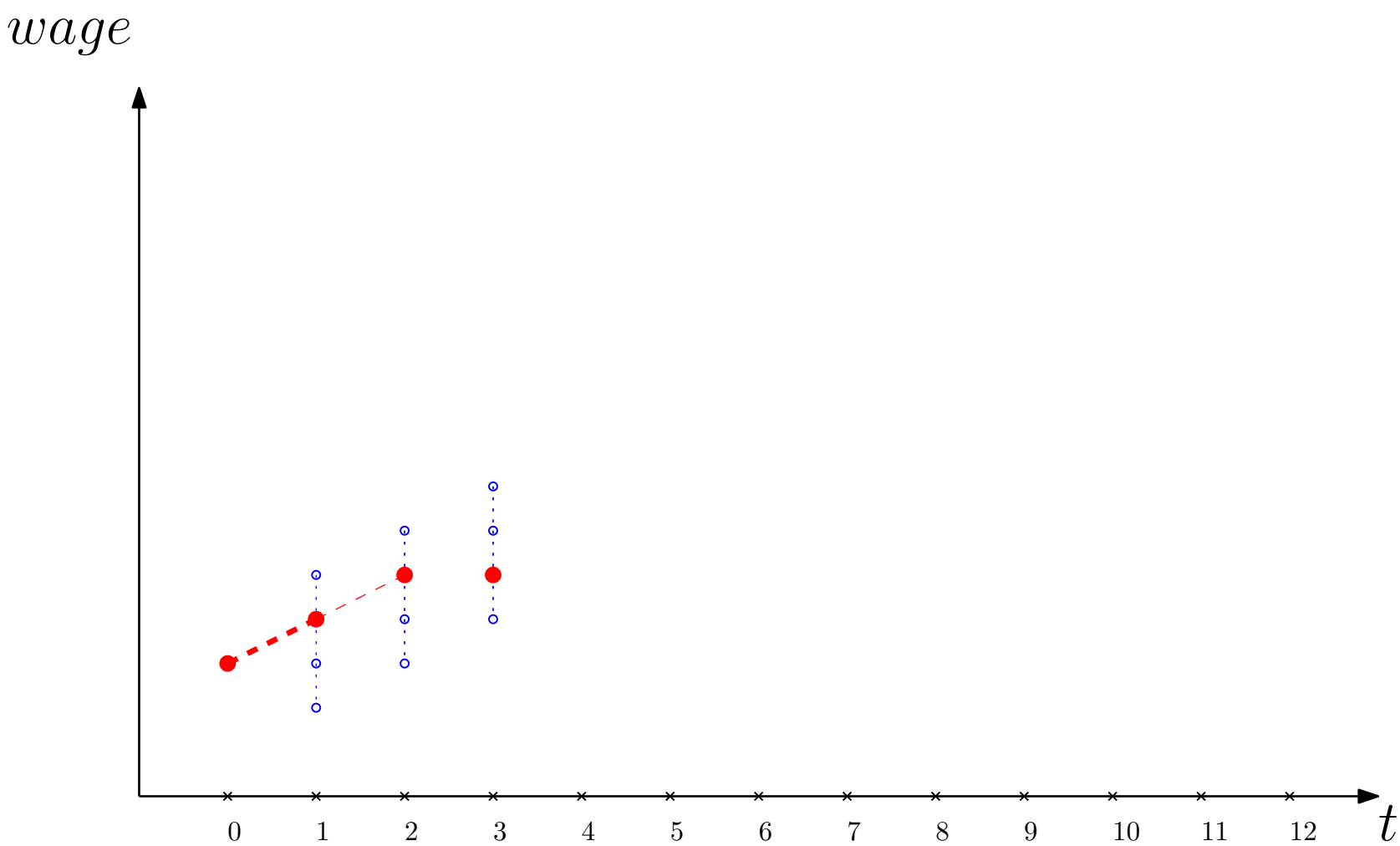

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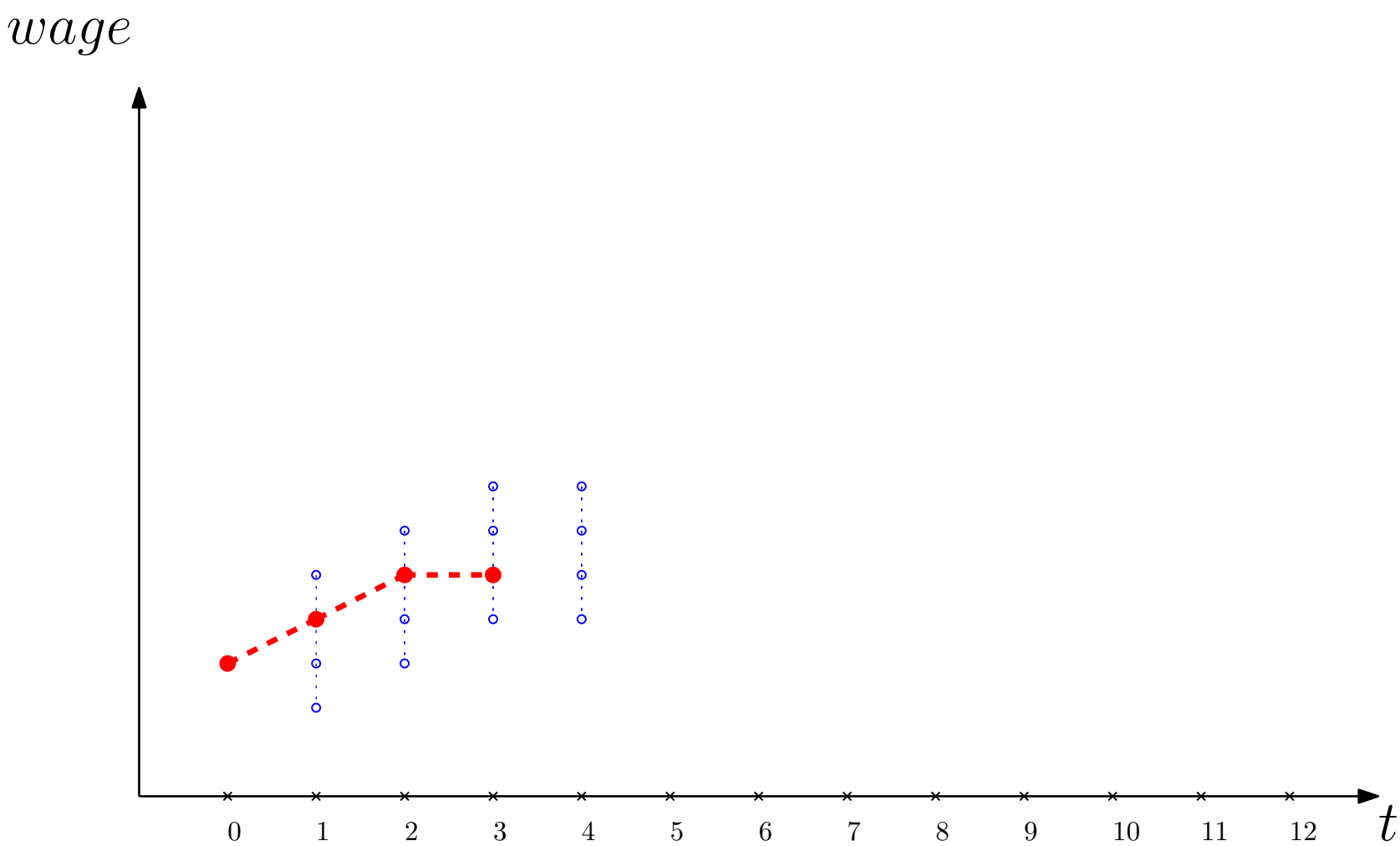

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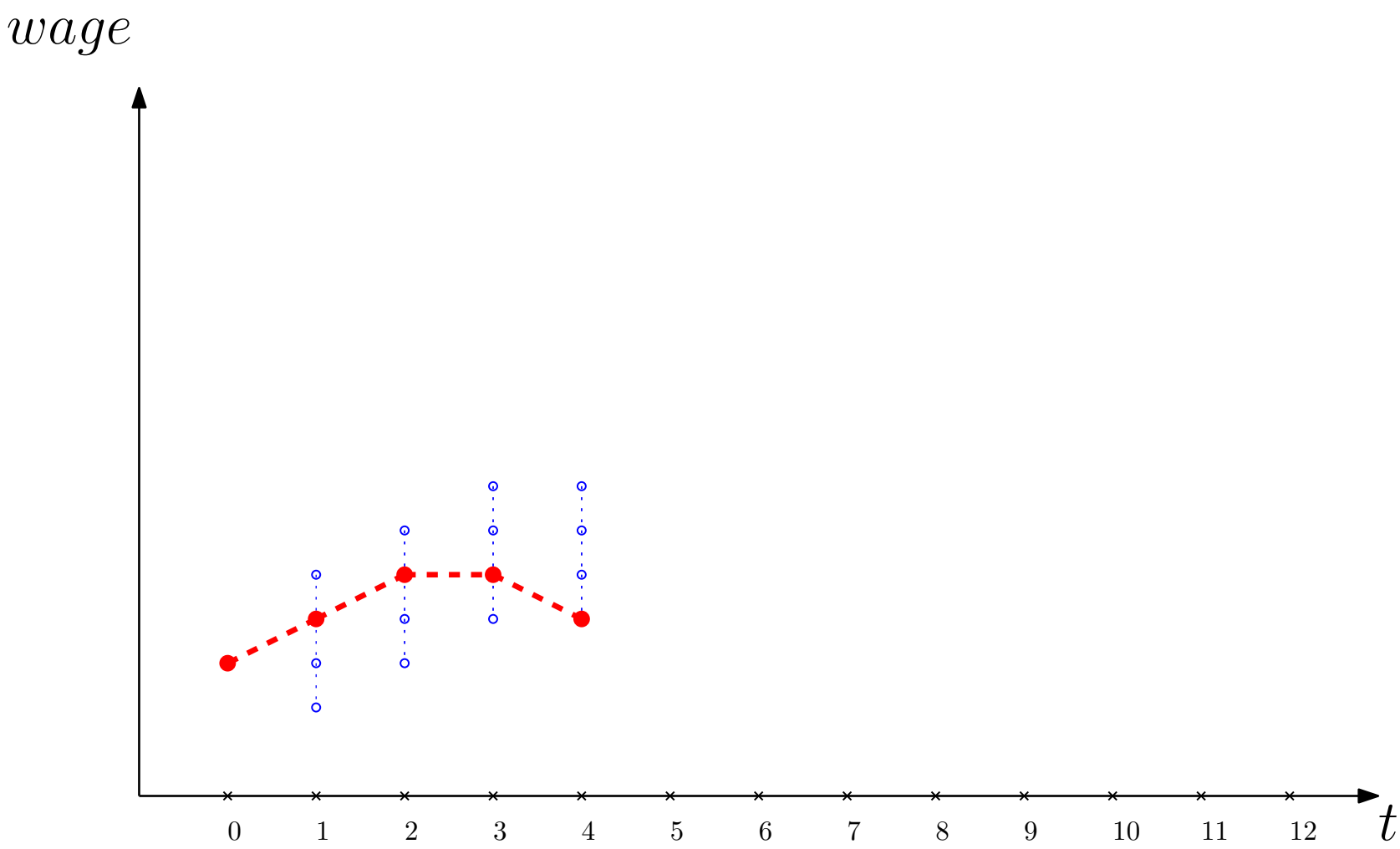

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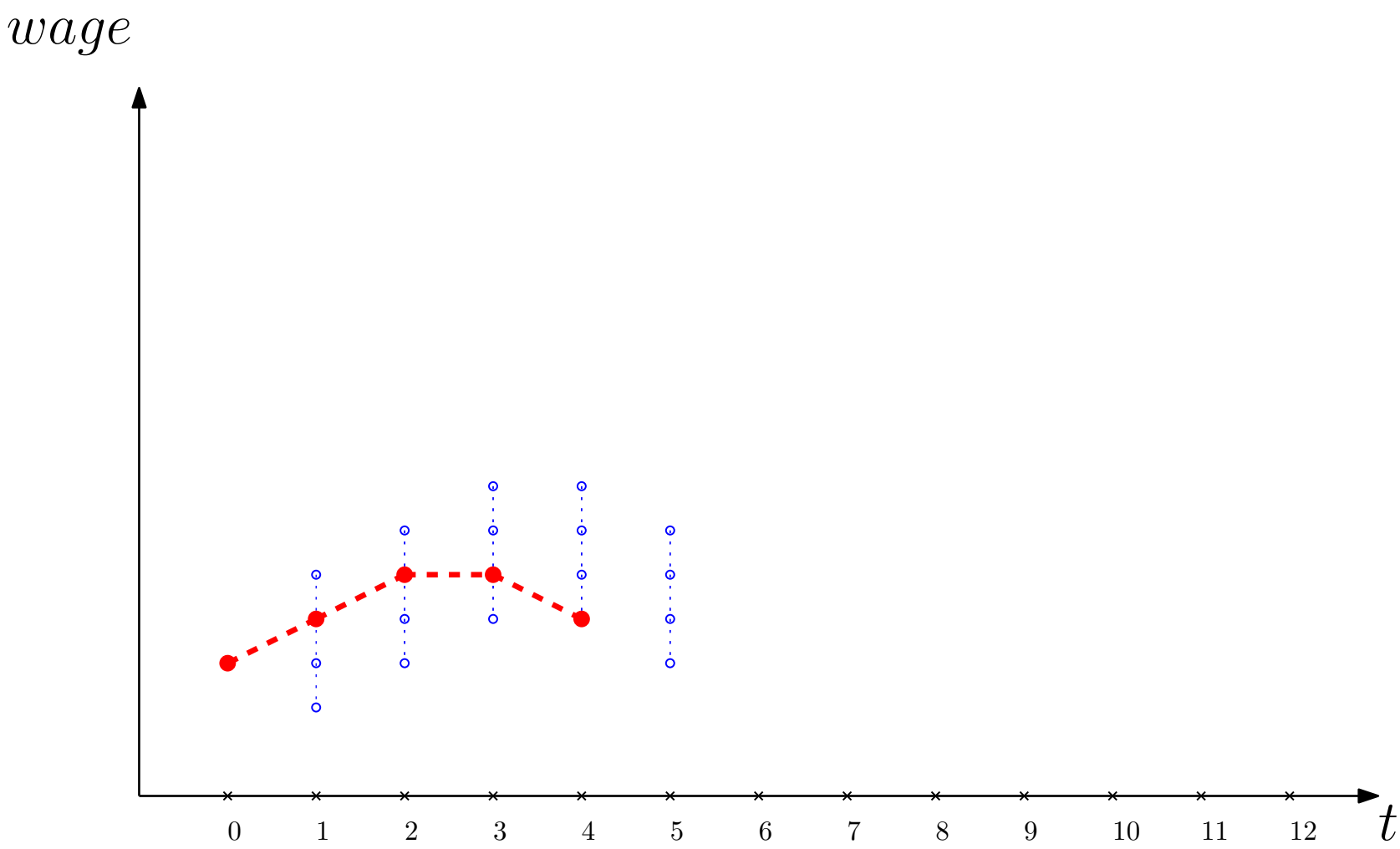

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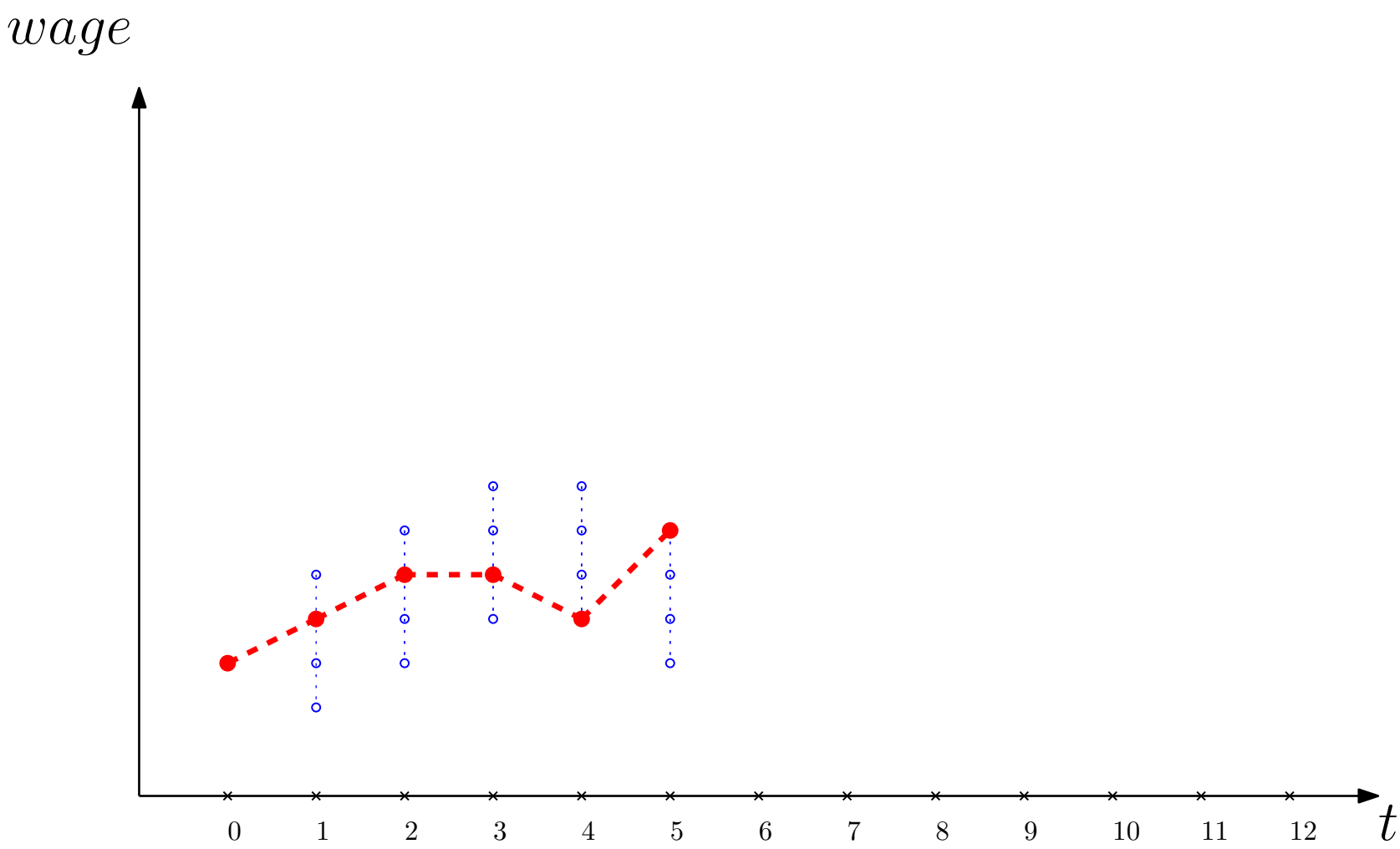

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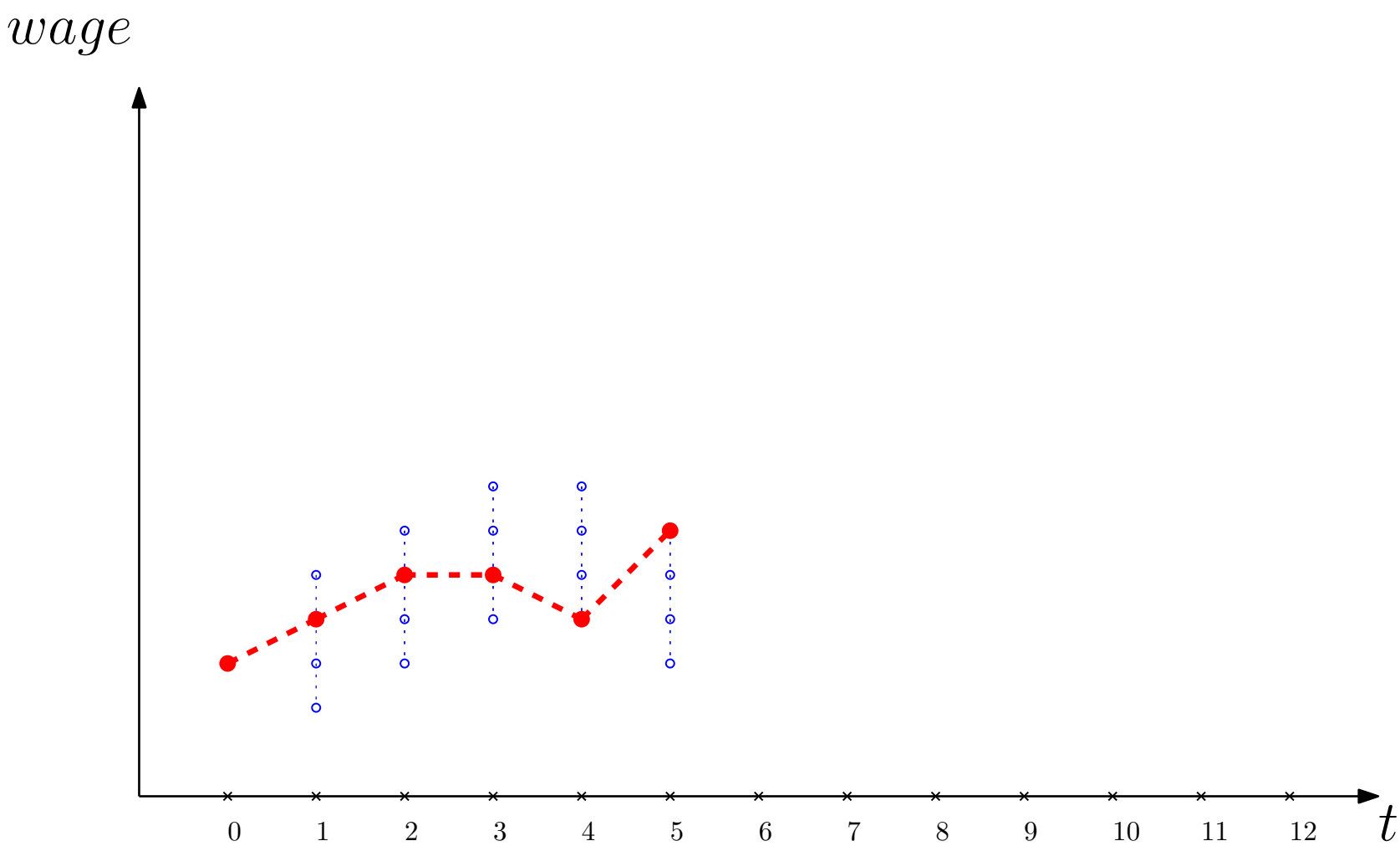

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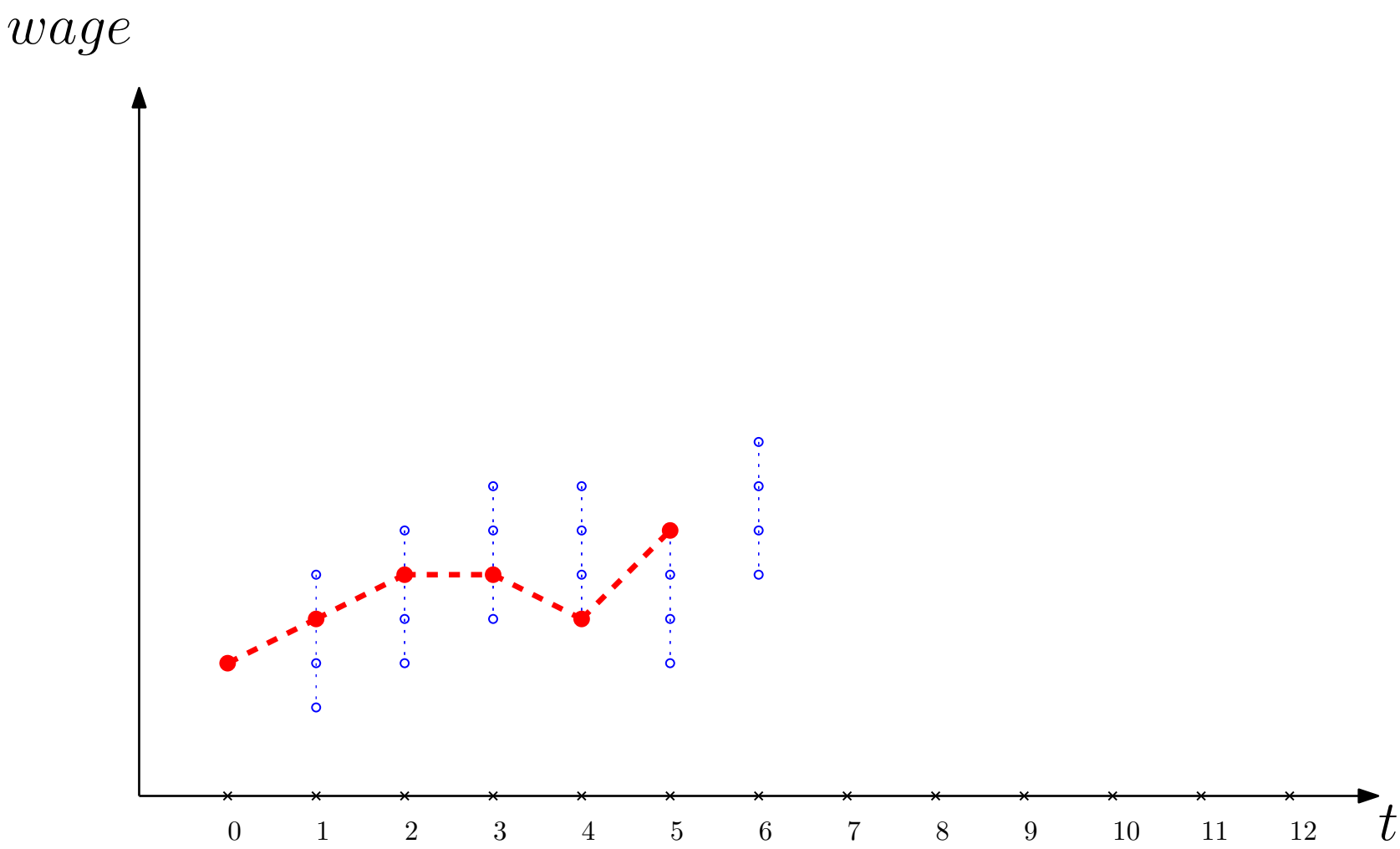

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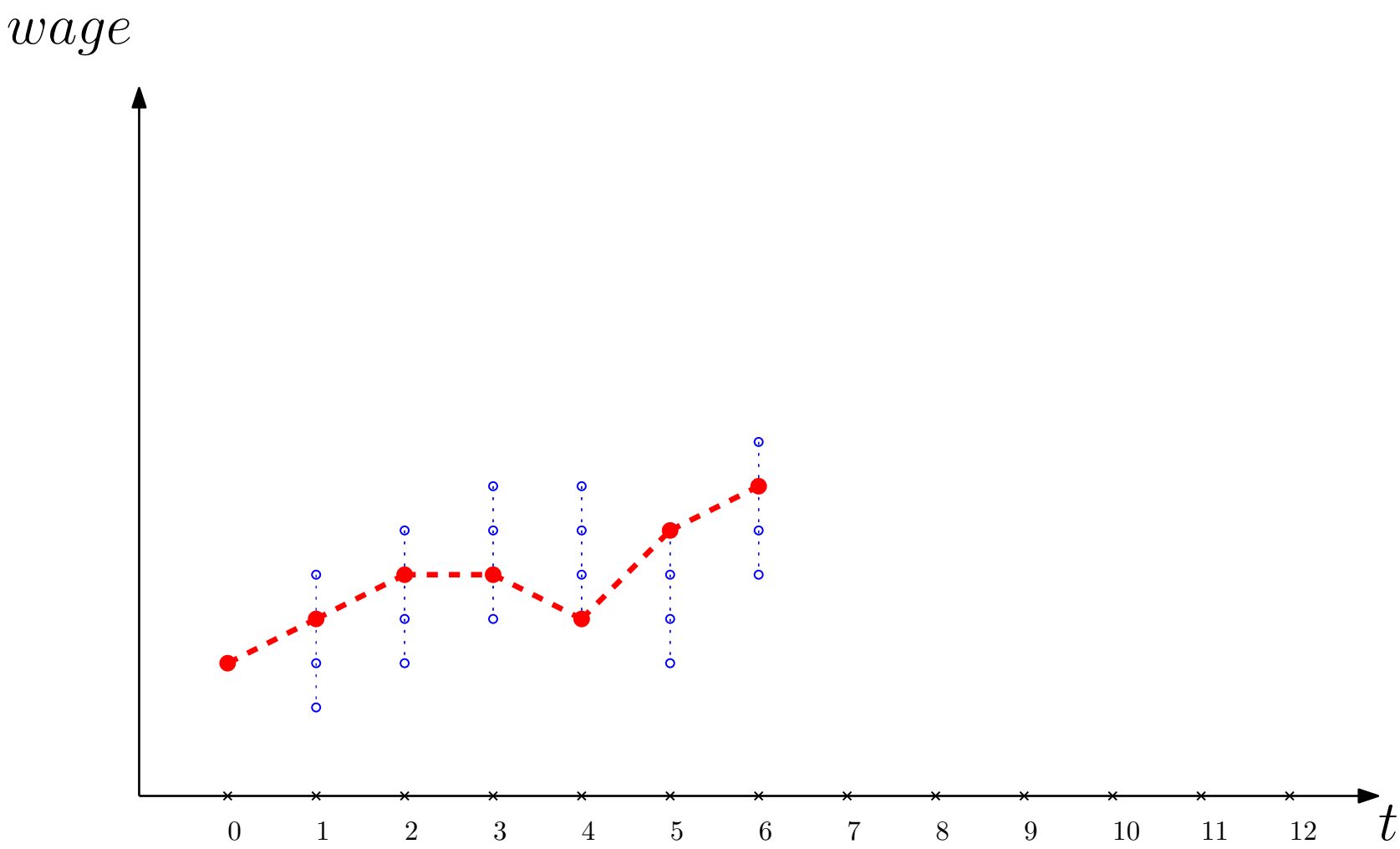

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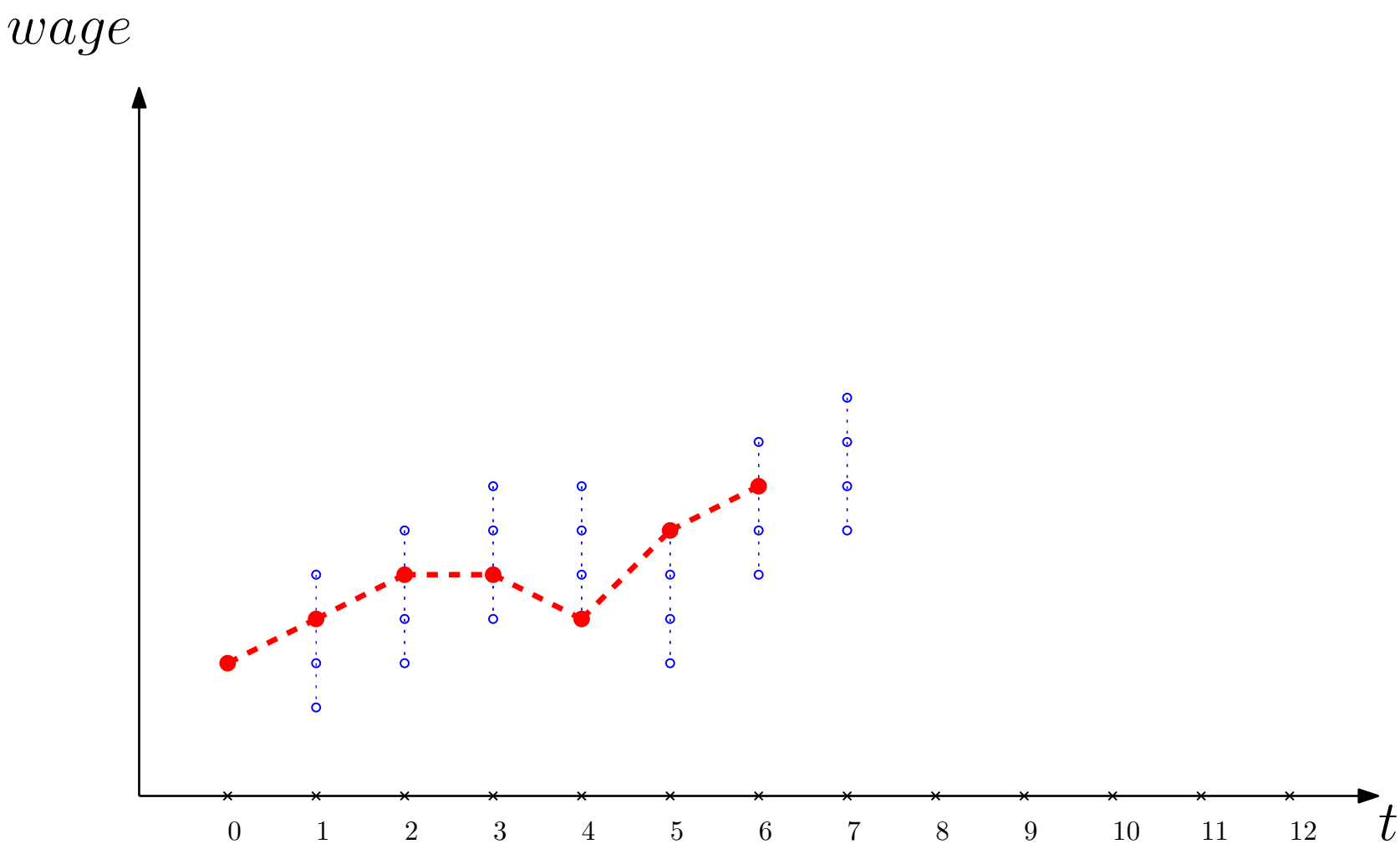

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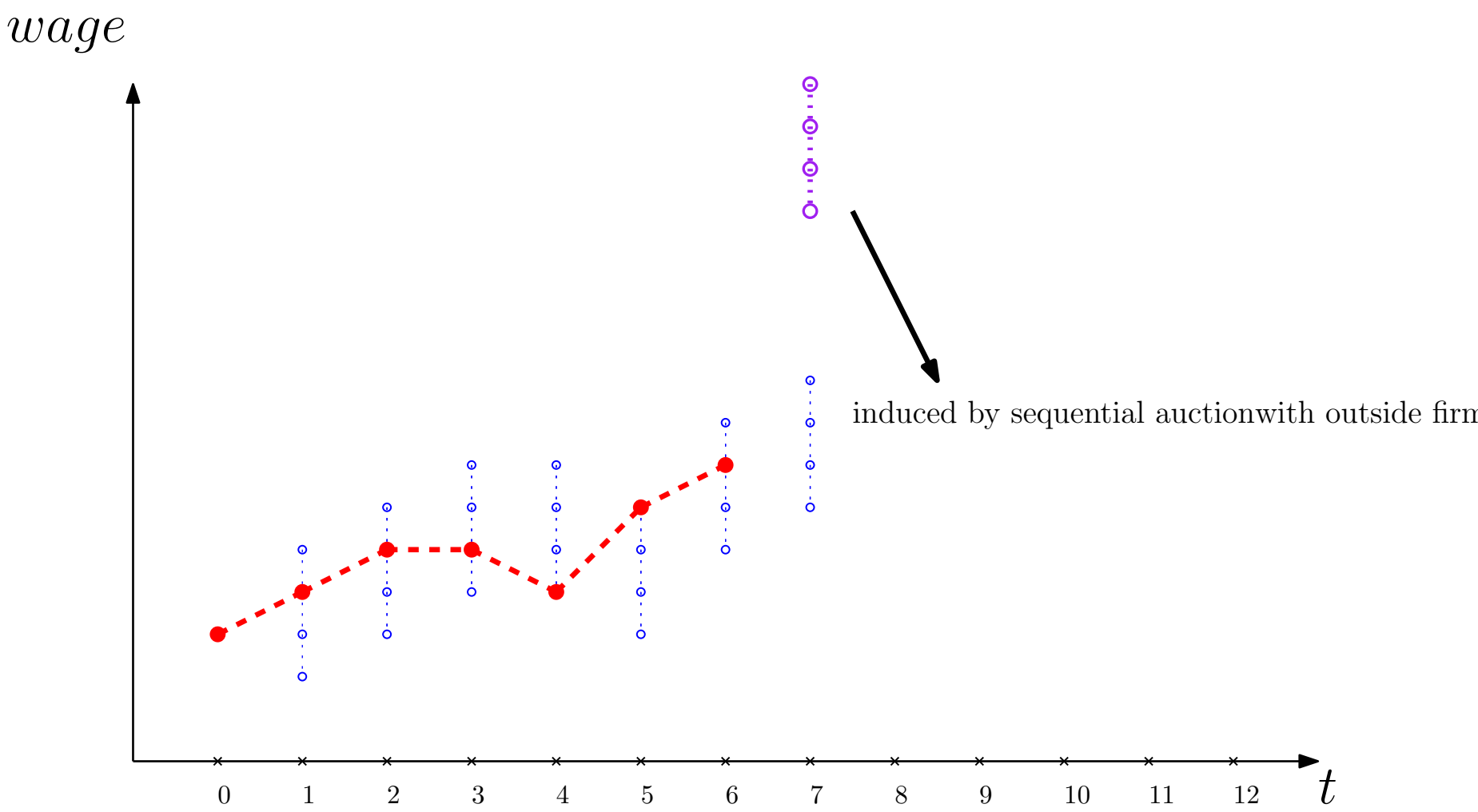

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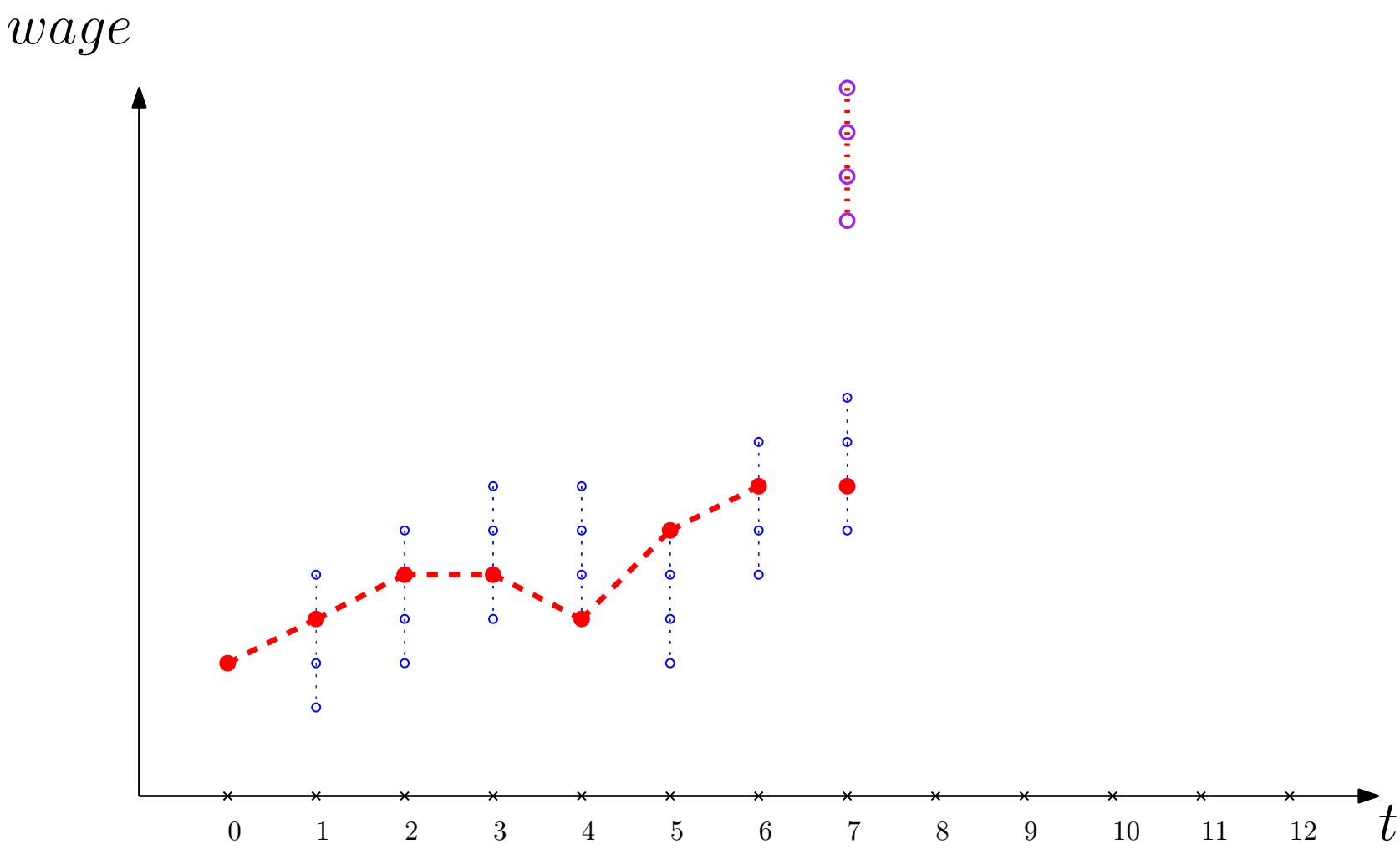

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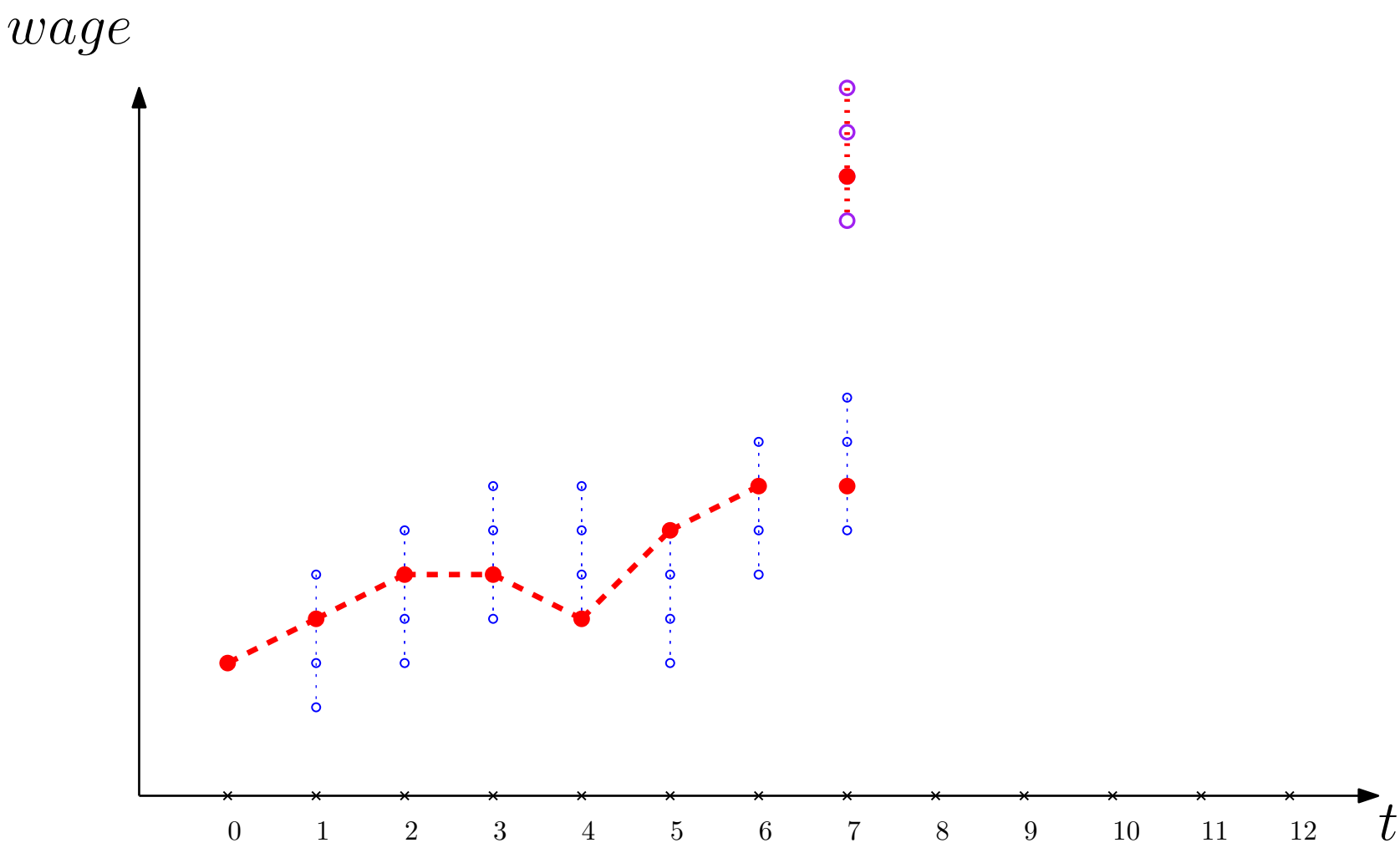

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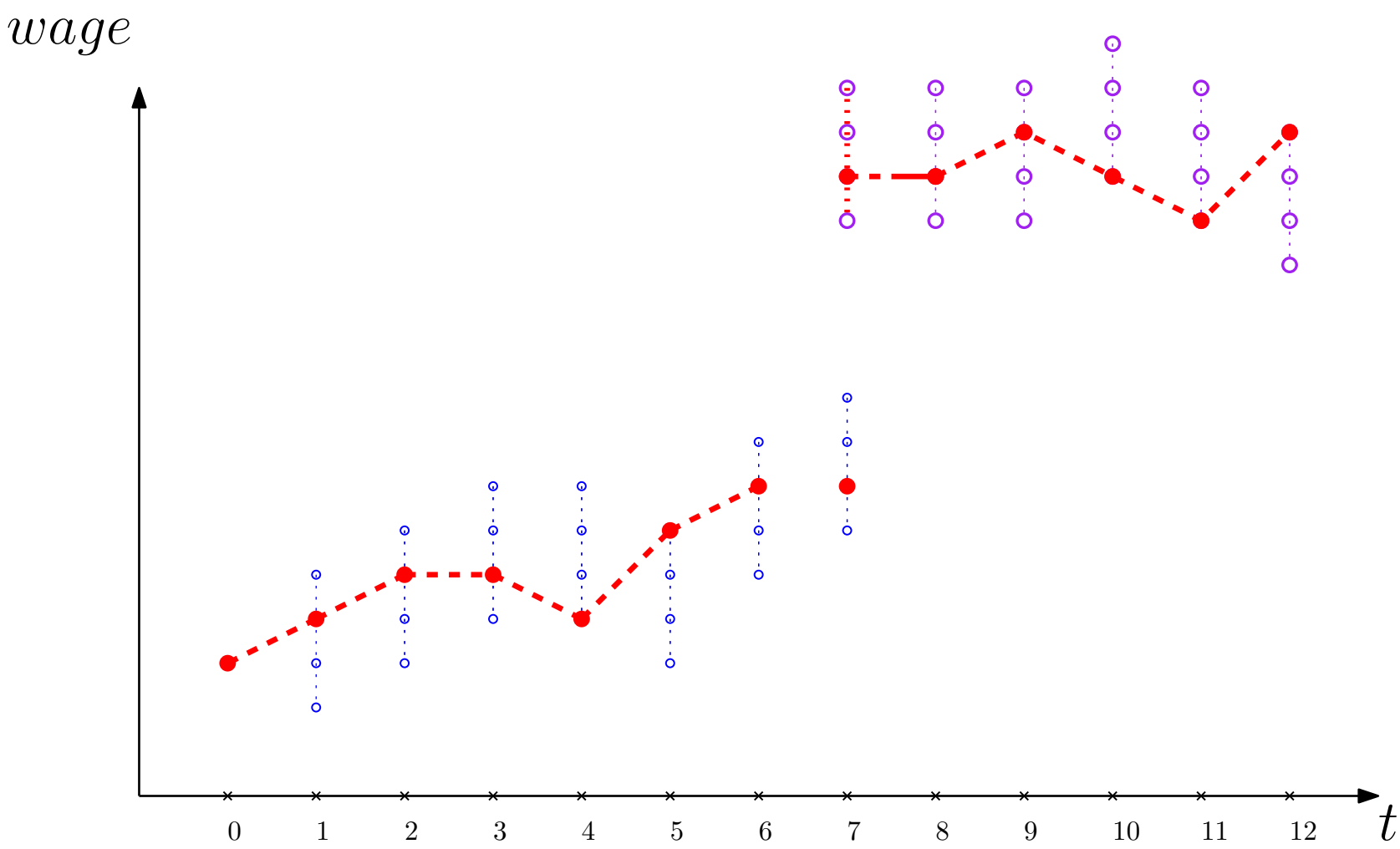

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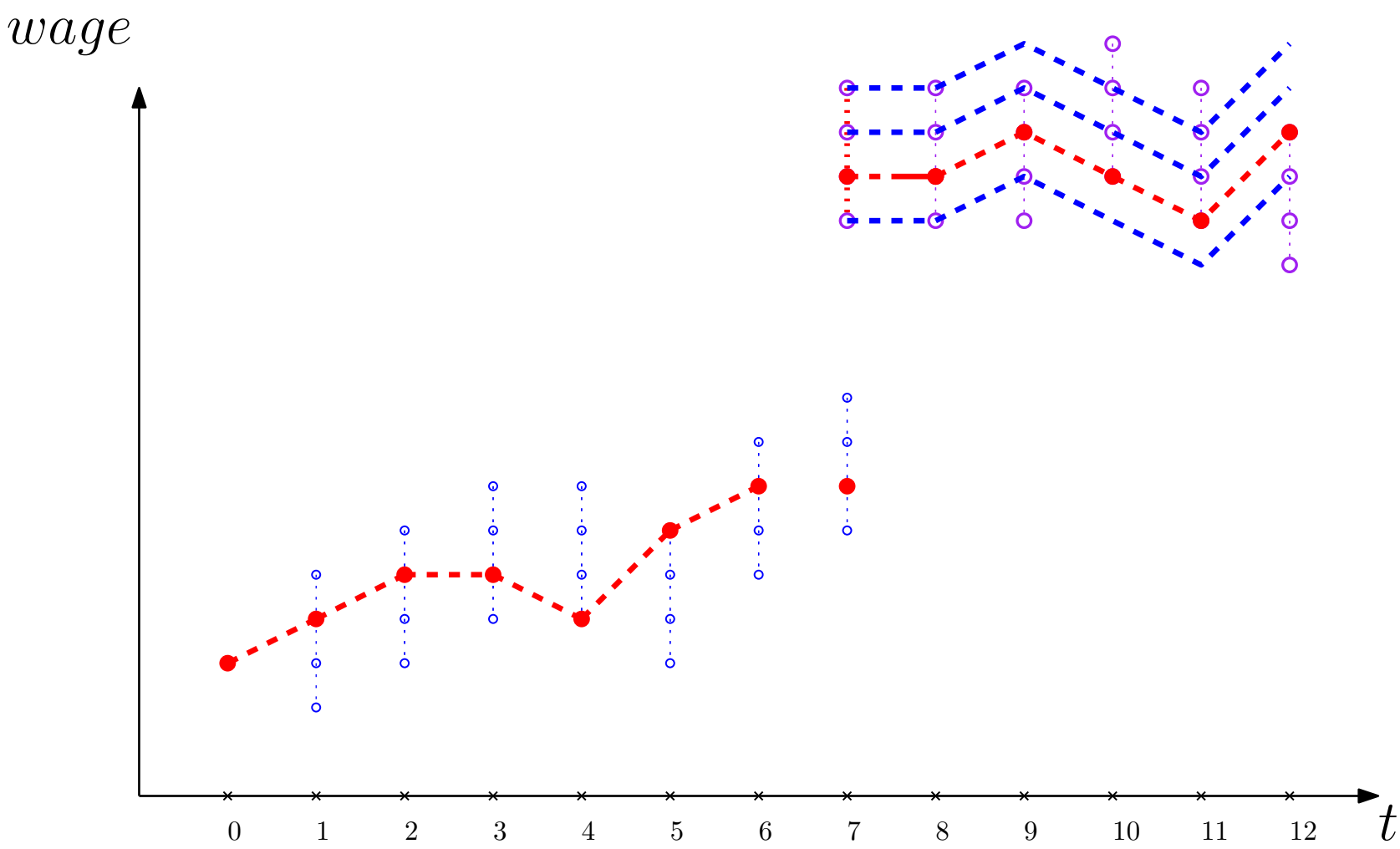

Why do Market-based Incentives Decrease in Firm Size?

Incentive Compatibility Constraint

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

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$$\mathcal{I}[W(z')] \equiv \tilde{\beta}\left\{ \sum_{z'} W(z')\Gamma_{e=1}(z,z') - \sum_{z'} W(z')\Gamma_{e=0}(z,z') \right\}.$$

Incentive Compatibility Constraint

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The incentive compatibility constraint is

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

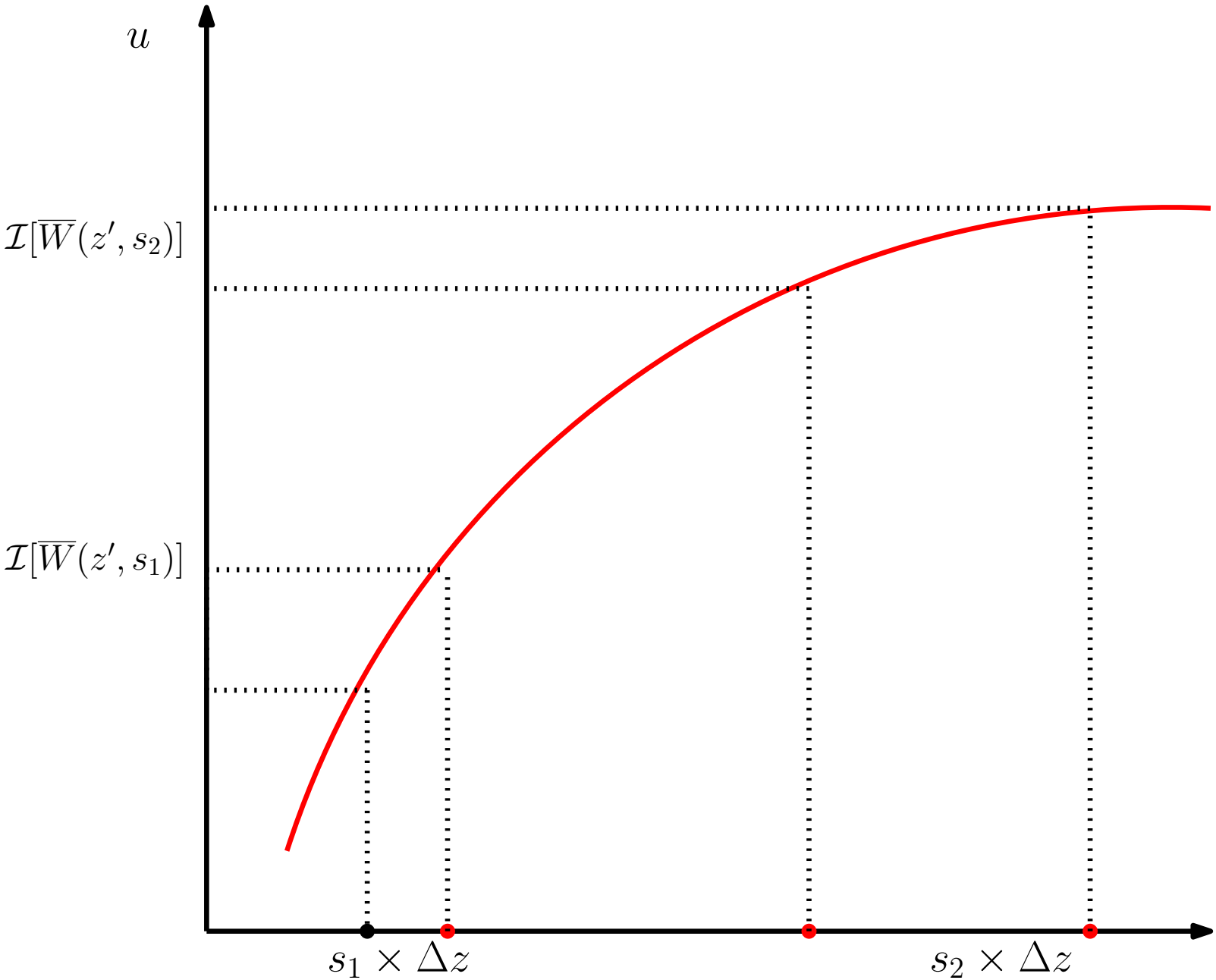
Sets of outside firms s':

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

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

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

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



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

Proposition

$\mathcal{I}[\overline{W}(z', s)]$ decrease in firm size s iff

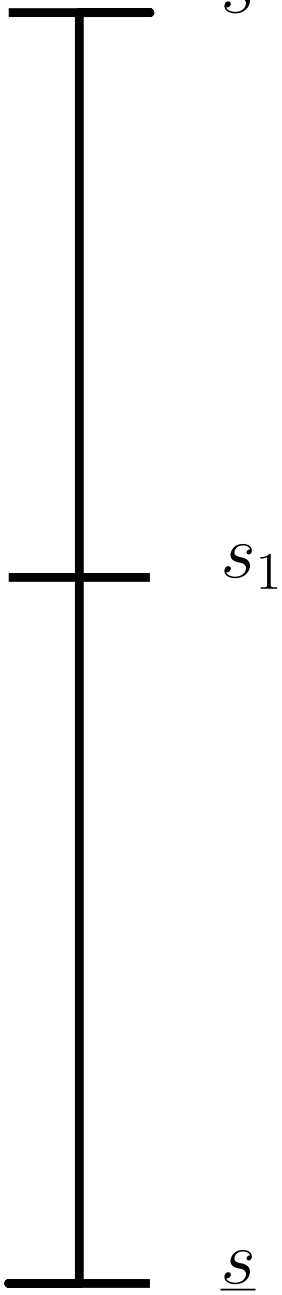
$$-\frac{wu''(w)}{u'(w)} > 1.$$

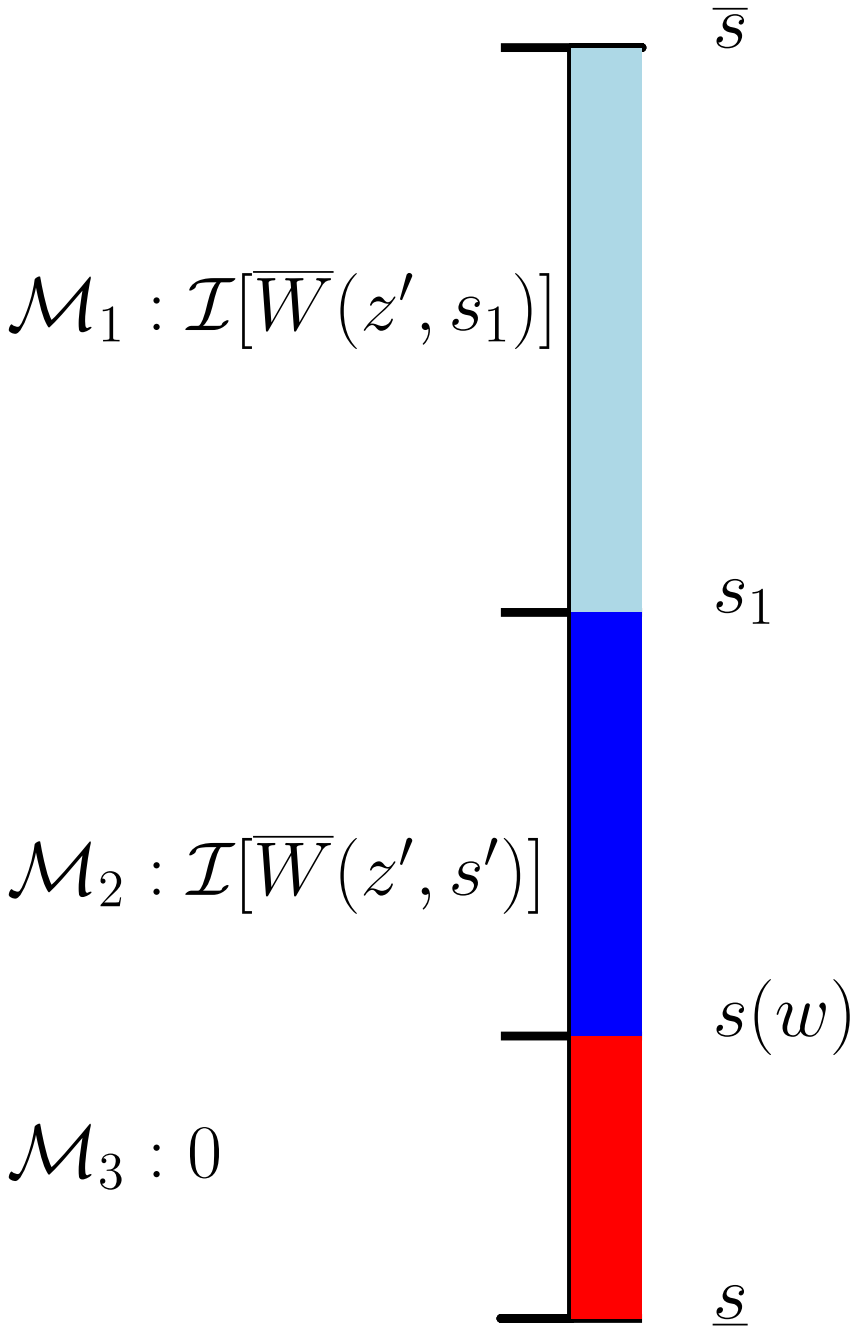
Intuition [wealth effect]

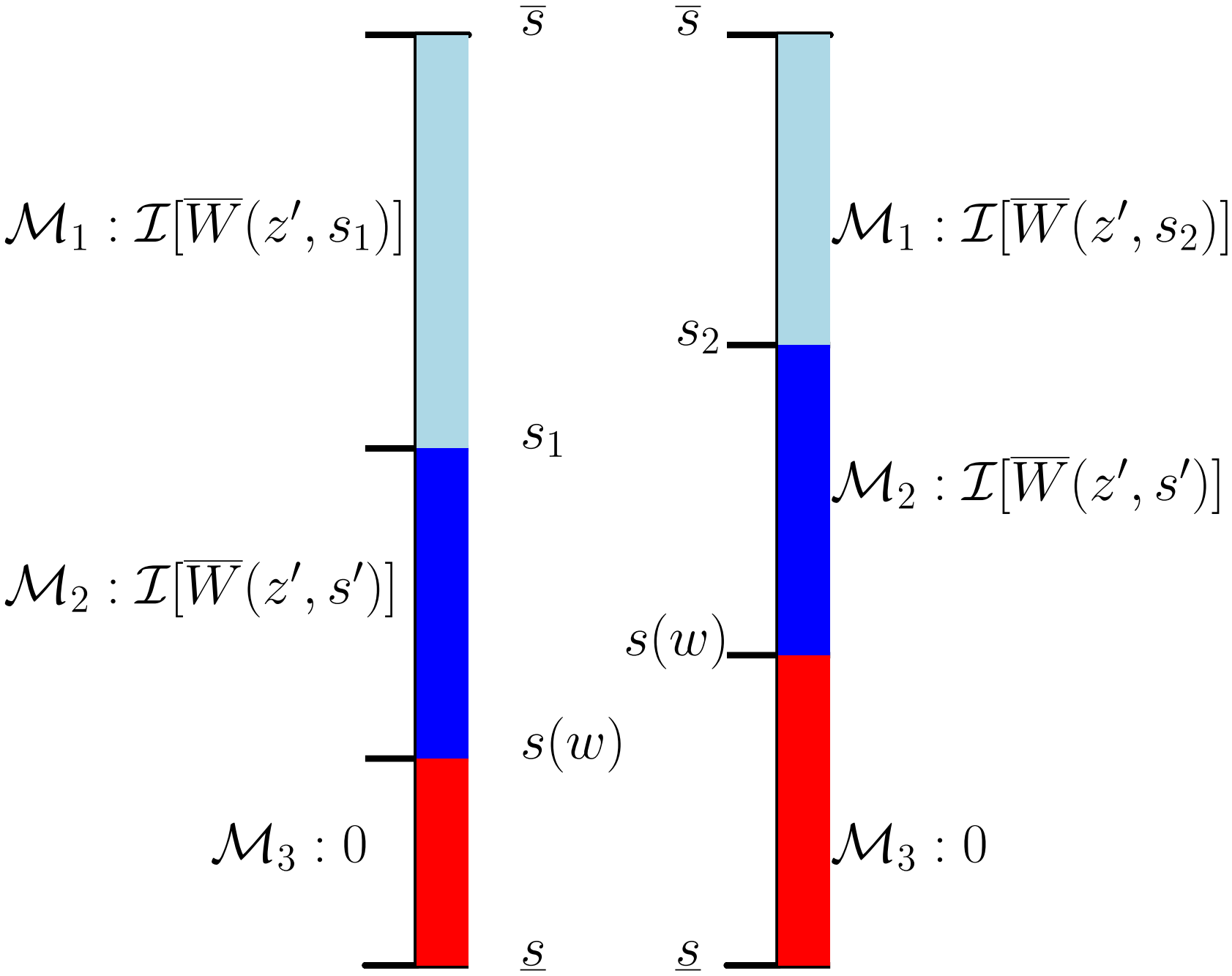
- Higher s leads to higher certainty equivalence of $\overline{W}(z', s)$
- Higher certainty equivalence leads to lower marginal utility of extra wealth

Why do market-based incentives decrease in s?

- Consider two executives with the same total compensation w.
- They work in different firms $s_1 < s_2$.
- Let's compare their market-based incentives.


$\overline{s}$
s_1
$\underline{s}$


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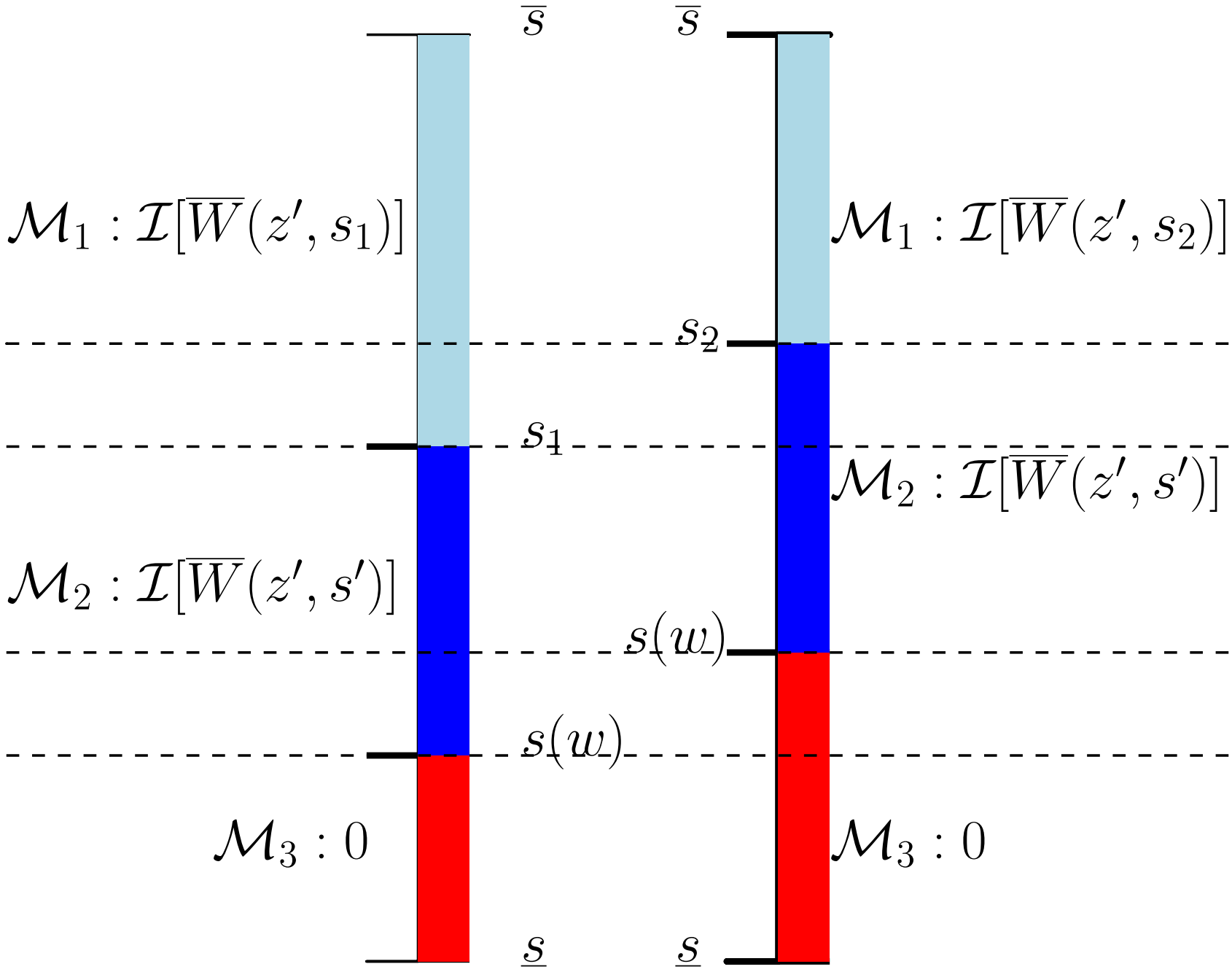
$\underline{s}$
$\underline{s}$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s_2
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$s(w)$
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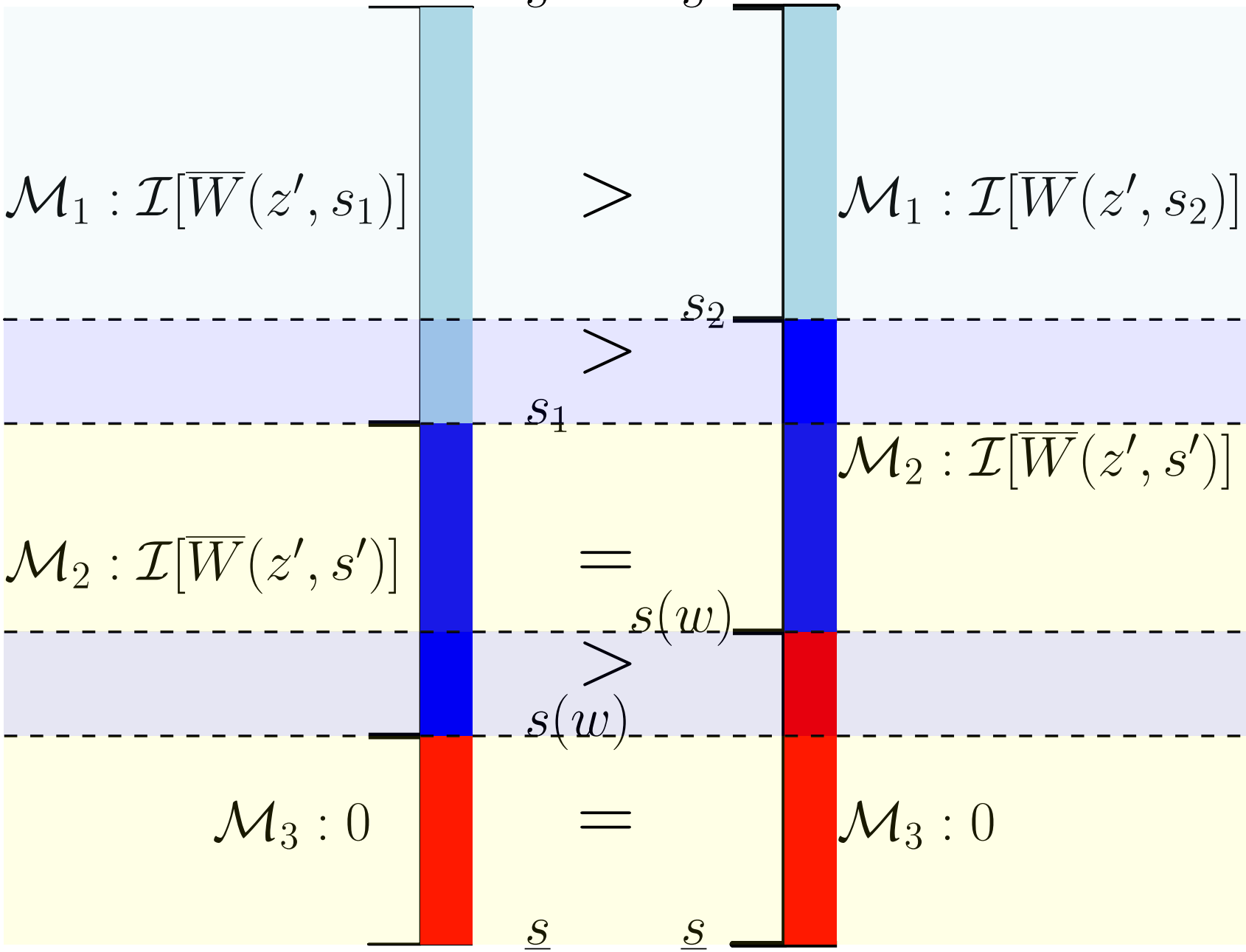
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s_2
$>$
s_1
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$=$
$s(w)$
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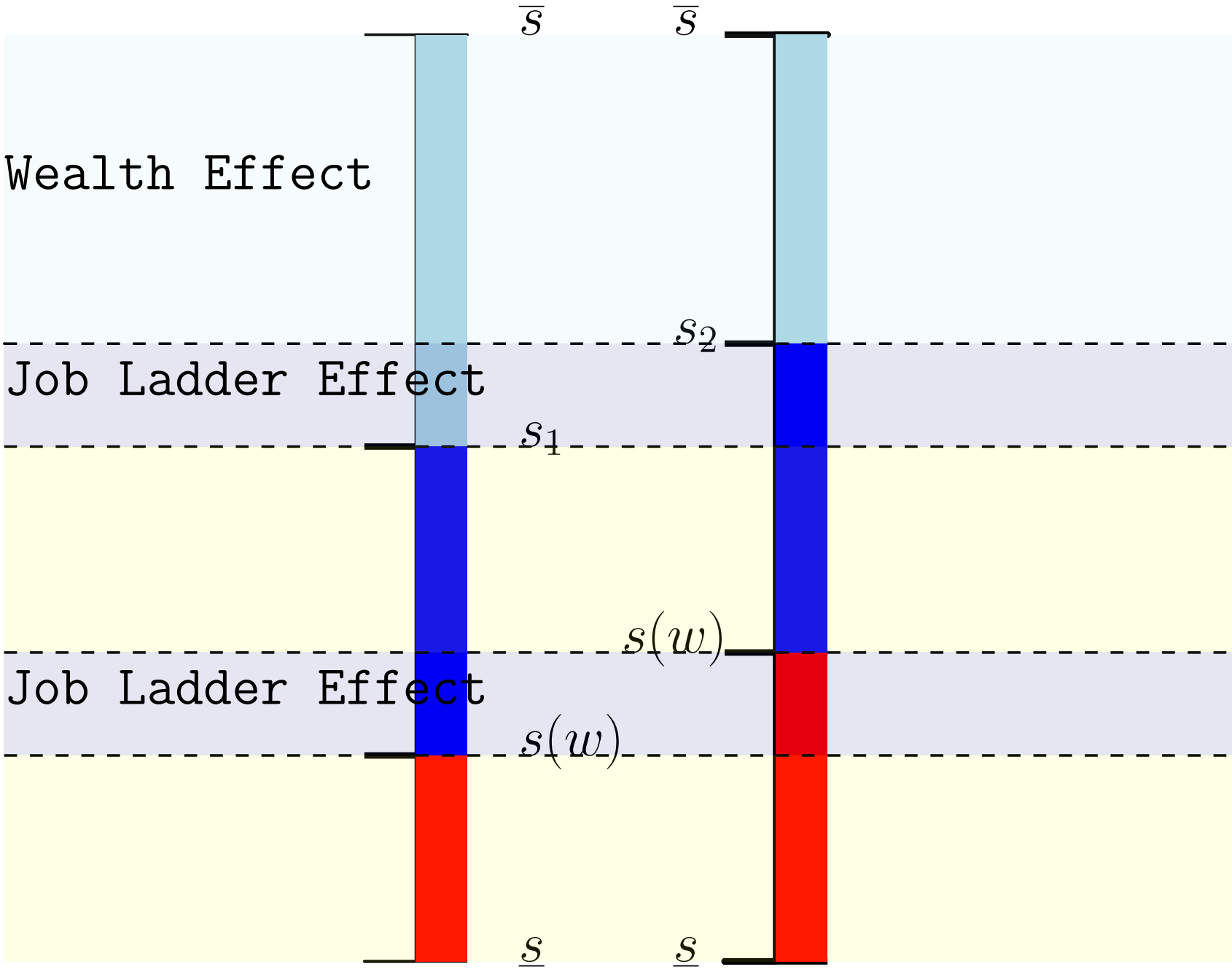
$\underline{s}$
$\underline{s}$


$\overline{s}$
$\overline{s}$
Wealth Effect
s_2
Job Ladder Effect
s_1
$s(w)$
Job Ladder Effect
$s(w)$
$\underline{s}$
$\underline{s}$

Incentive Compatibility Constraint

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

$$\mathcal{I}[W(z')] \equiv \tilde{\beta}\left\{ \sum_{z'} W(z')\Gamma_{e=1}(z,z') - \sum_{z'} W(z')\Gamma_{e=0}(z,z') \right\}.$$

The incentive compatibility constraint is

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

Firm size premium in incentive pay

- Keep c constant, market-based Incentives decrease in s, thus performance-based Incentives increase in s

Examine Direct Evidence

Key implications of the model

1. The managerial labour market is active.

2. Managers climb job ladders towards larger firms.

3. Managers in larger firms tend to have less job-to-job transitions. [Job ladder effect]

4. Controlling for initial compensation, executives in larger firms tend to experience higher compensation growth. [Wealth effect]

Job-to-Job transitions

Job-to-Job (JJ): leaves the current firm, and starts to work in another firm within 90/180 days

Year	JJ Rate (90 days)	JJ Rate (180 days)
2006	0.0481116	0.0584544
2007	0.0439572	0.0534421
2008	0.0417629	0.0513116
2009	0.0390869	0.0479955
2010	0.0377093	0.0460241
2011	0.0373968	0.0445605
2012	0.0371108	0.0465753
2013	0.0329913	0.0406546
2014	0.038031	0.0485502
2015	0.0565262	0.0651887
2016	0.0463576	0.049301

Key implications of the model

1. The managerial labour market is active.

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Climb the Job Ladder

Table 3: Firm Size Changes Among Job-to-Job Transitions

Panel A: All executives

Total obs.	Firm Size Decrease obs. (%)	Firm Size Increase obs. (%)
1910	681 (35%)	1229 (65%)

Panel B: Across age groups

Age Groups	Firm Size Decrease obs. (%)	Firm Size Increase obs. (%)	All obs.
[26, 40)	33 (35%)	61 (65%)	94
[40, 50)	259 (37%)	448 (63%)	707
[50, 60)	236 (37%)	394 (63%)	630
[60, 65)	29 (36%)	51 (64%)	80
[65, 70)	8 (25%)	23 (75%)	31
[70, 86)	1 (20%)	4 (80%)	5

Key implications of the model

1. The managerial labour market is active.

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

	Job-to-Job Transition		
	(1)	(2)	(3)
log(Firm Size)	0.917****	0.915****	0.972*
	(0.0109)	(0.0110)	(0.0139)
Age	0.985****	0.970***	0.967***
	(0.00273)	(0.0105)	(0.0112)
log(Firm Size) × Age		1.002	1.003
		(0.00151)	(0.00161)
log(tdc1)			0.830****
			(0.0150)
Market-Book Ratio	0.942****	0.943****	0.939****
	(0.0150)	(0.0150)	(0.0157)
Market Value Leverage	1.033**	1.033**	1.035**
	(0.0139)	(0.0139)	(0.0142)
Profitability	0.913****	0.910****	0.905****
	(0.0197)	(0.0198)	(0.0199)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	154635	154635	118119
chi2	496.1	498.3	491.4

Key implications of the model

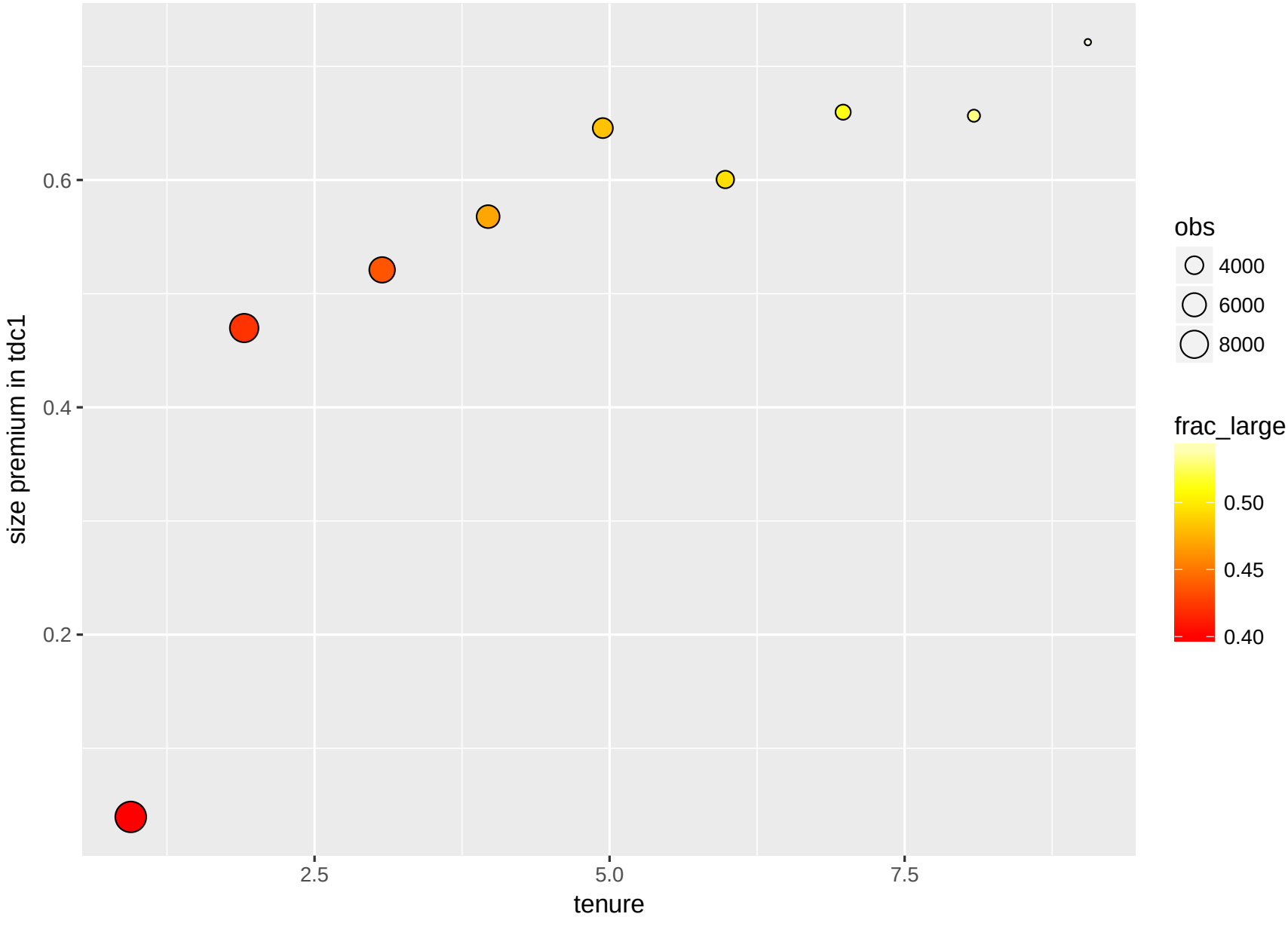
1. The managerial labour market is active.

2. Managers climb job ladders towards larger firms.

3. Managers in larger firms tend to have less job-to-job transitions. [Job ladder effect]

4. Controlling for initial compensation, executives in larger firms tend to experience higher compensation growth. [Wealth effect]

Starting years: 1994 to 2005

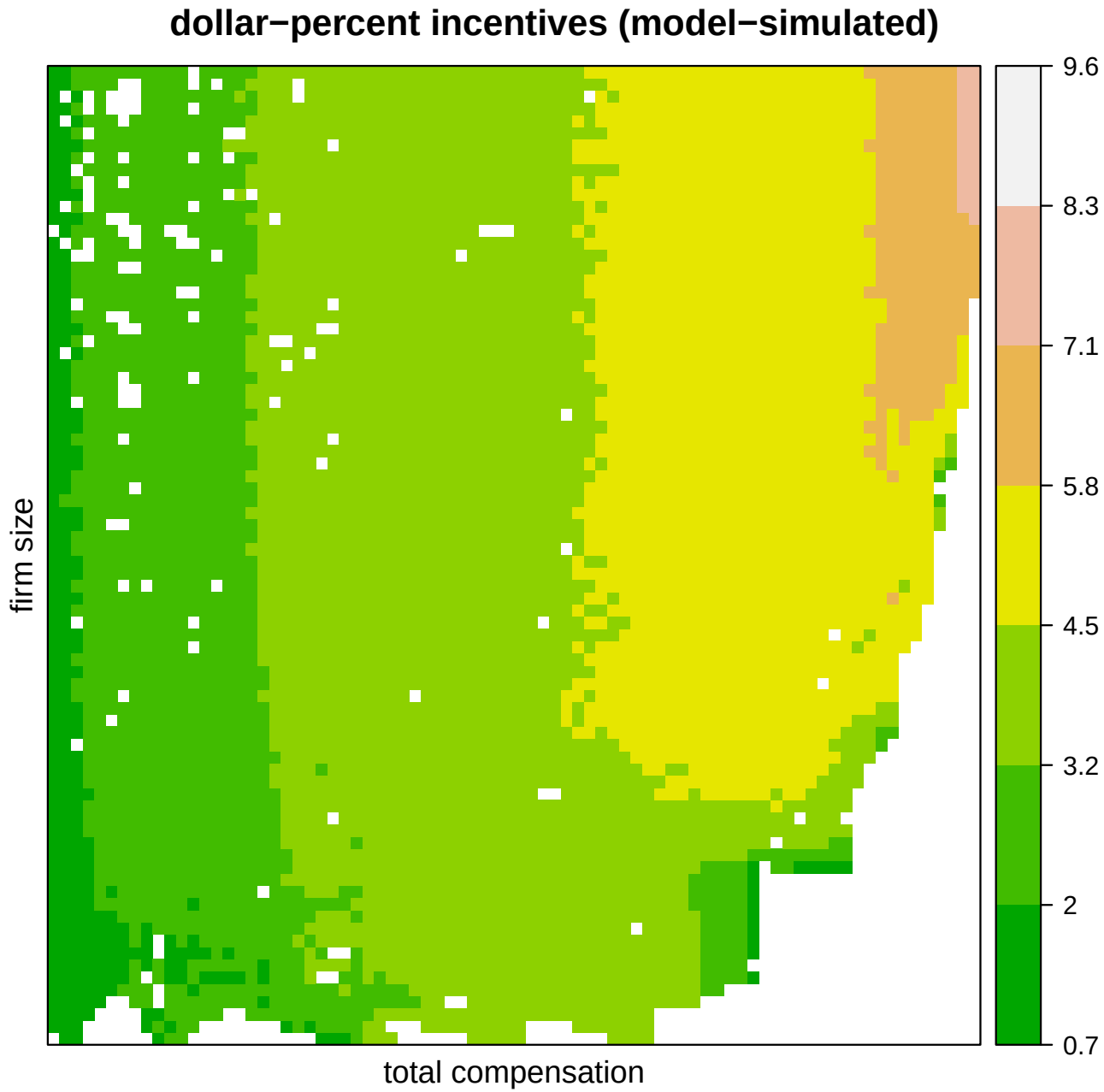


Estimation

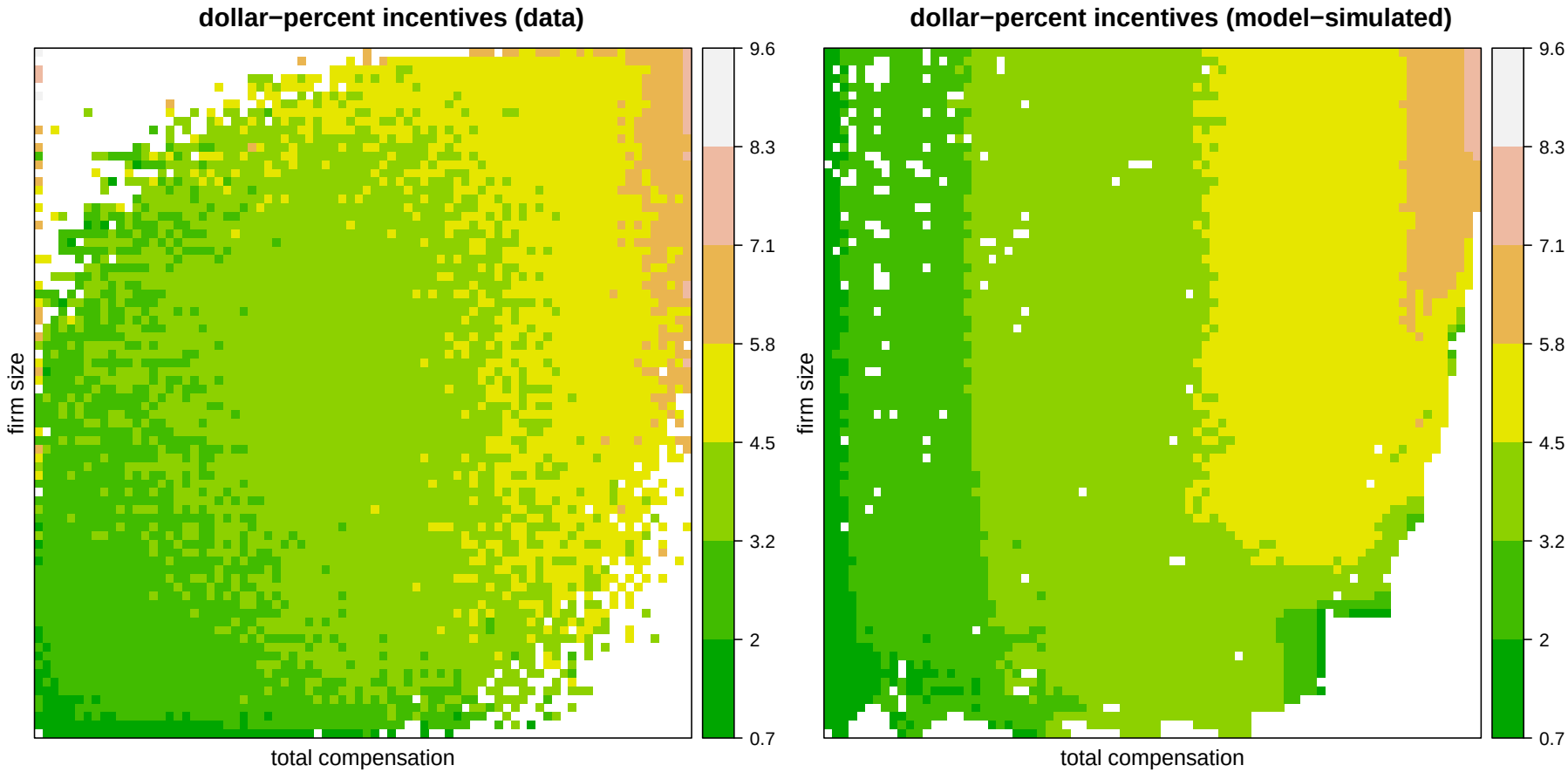
Moments and Estimation

Moments	Target	Model	Estimates	Standard Error
Exit Rate	0.0691	0.0691	$\delta = 0.0691$	0.0012
EE Rate	0.0523	0.055	$\lambda_1 = 0.2759$	0.0017
$\hat{\rho}_z$	0.8111	0.5499	$\rho_z = 0.7$	0.0036
Mean(z)	0.1284	0.1763	$\mu_z^w = 0.06$	0.0006
Var(z)	0.0141	0.0141	$\sigma_z = 0.12$	0.0014
Mean(log(wage))	7.17714	6.5241	$\mu_s = 1.7847$	0.228385
Mean(log(size))	7.44379	8.7934	$\sigma_s = 1.3982$	0.0314657
$\beta_{wage-size}$	0.370295	0.3196		
Mean(log(delta))	4.01842	3.8080		
$\beta_{delta-size}$	0.297673	0.2941	$c = 1.91385$	0.0259
$\beta_{delta-wage}$	0.717209	2.1228	$\sigma = 2.50748$	0.0046
Mean($delta > 0$)	0.994725	0.9844		

Model Predictions



Model Predictions v.s. Data



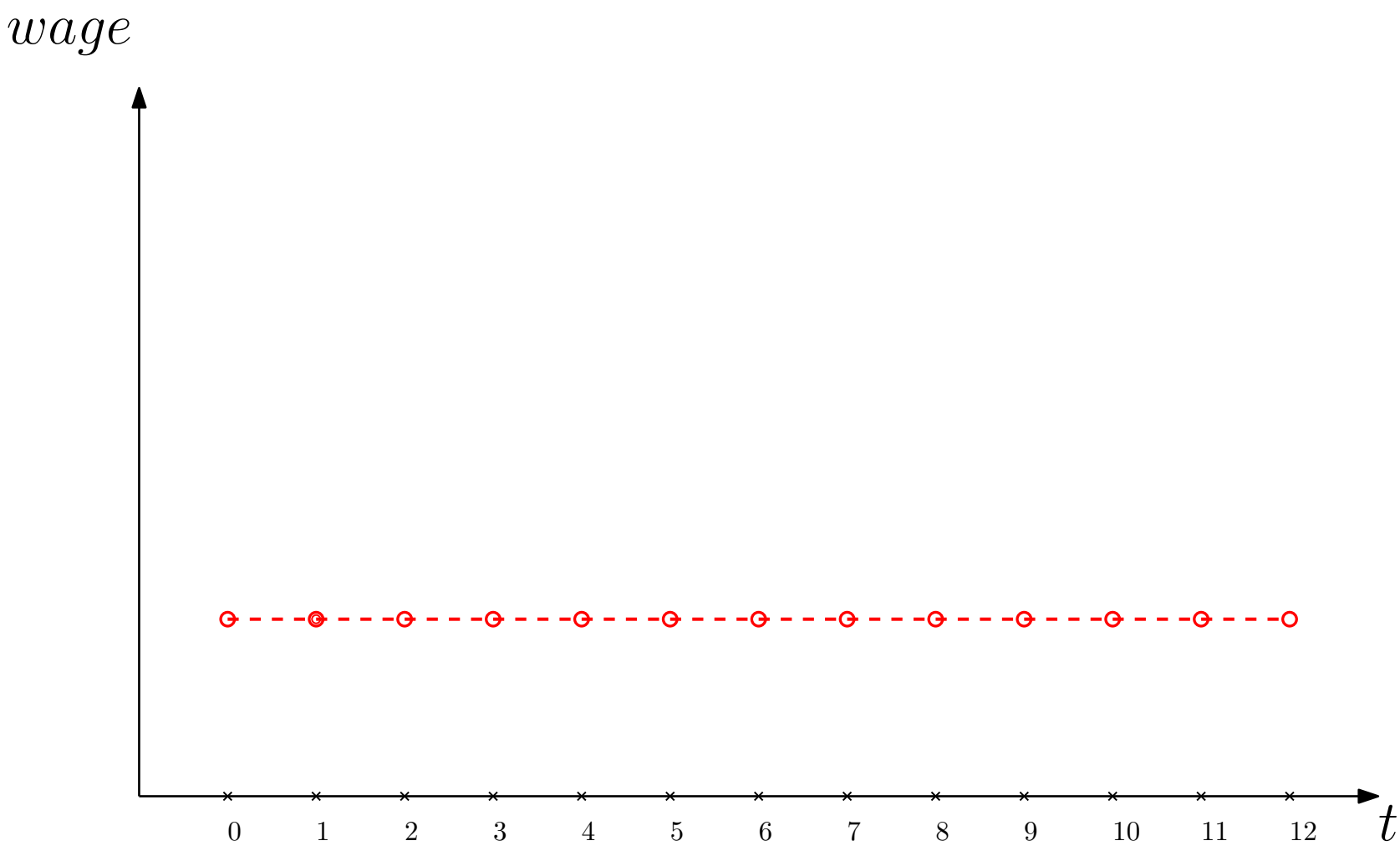
Conclusion

Summary

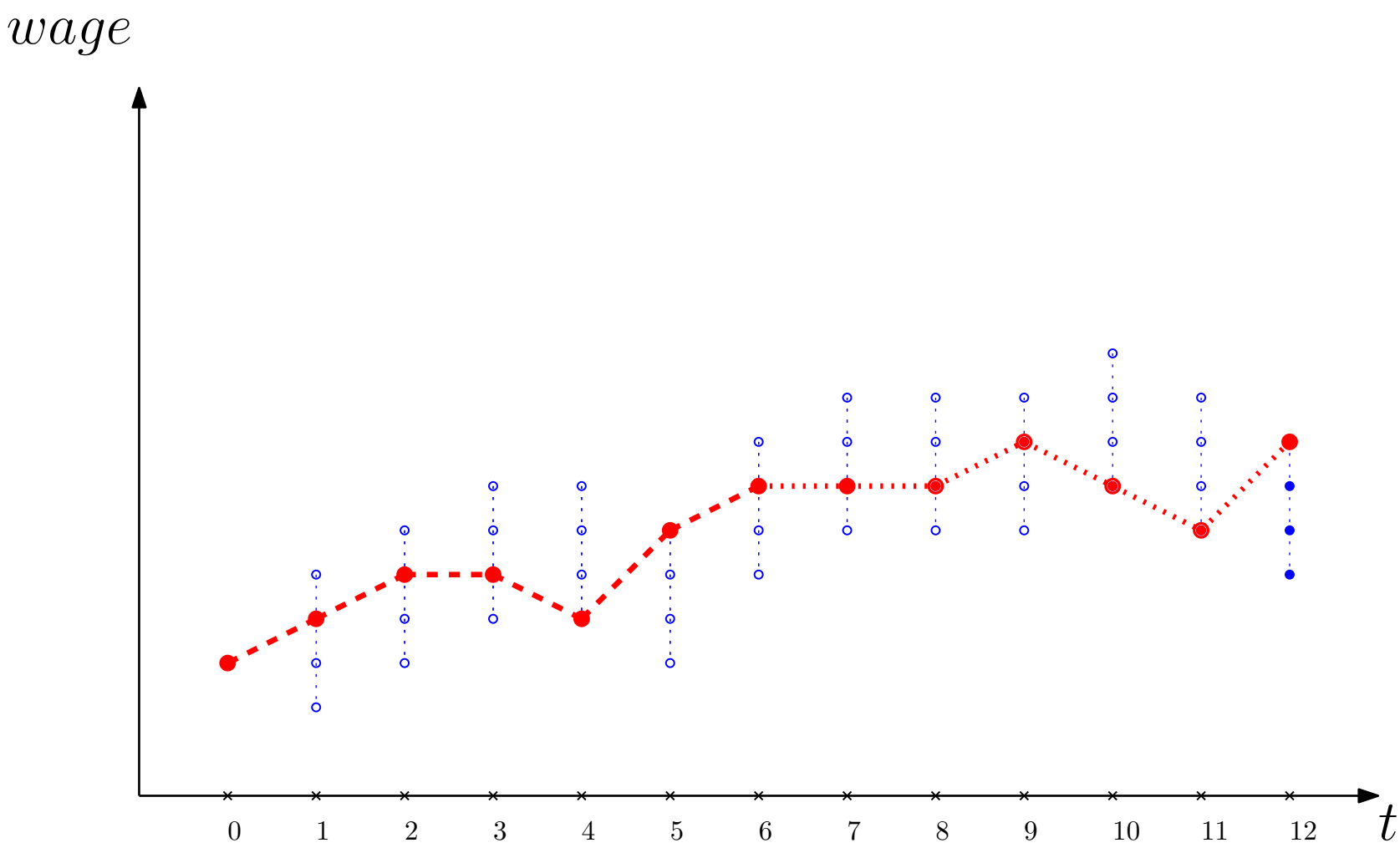
- Executives are motivated by performance-based incentives and market-based incentives.
- Market-based incentives are smaller in larger firms, so larger firms need more performance-based pay.
- The key mechanism of the model is supported by several reduced-form evidence
- The model can fit the size premium very well and generate the reasonable `delta` over firm size and total compensation.

Questions?

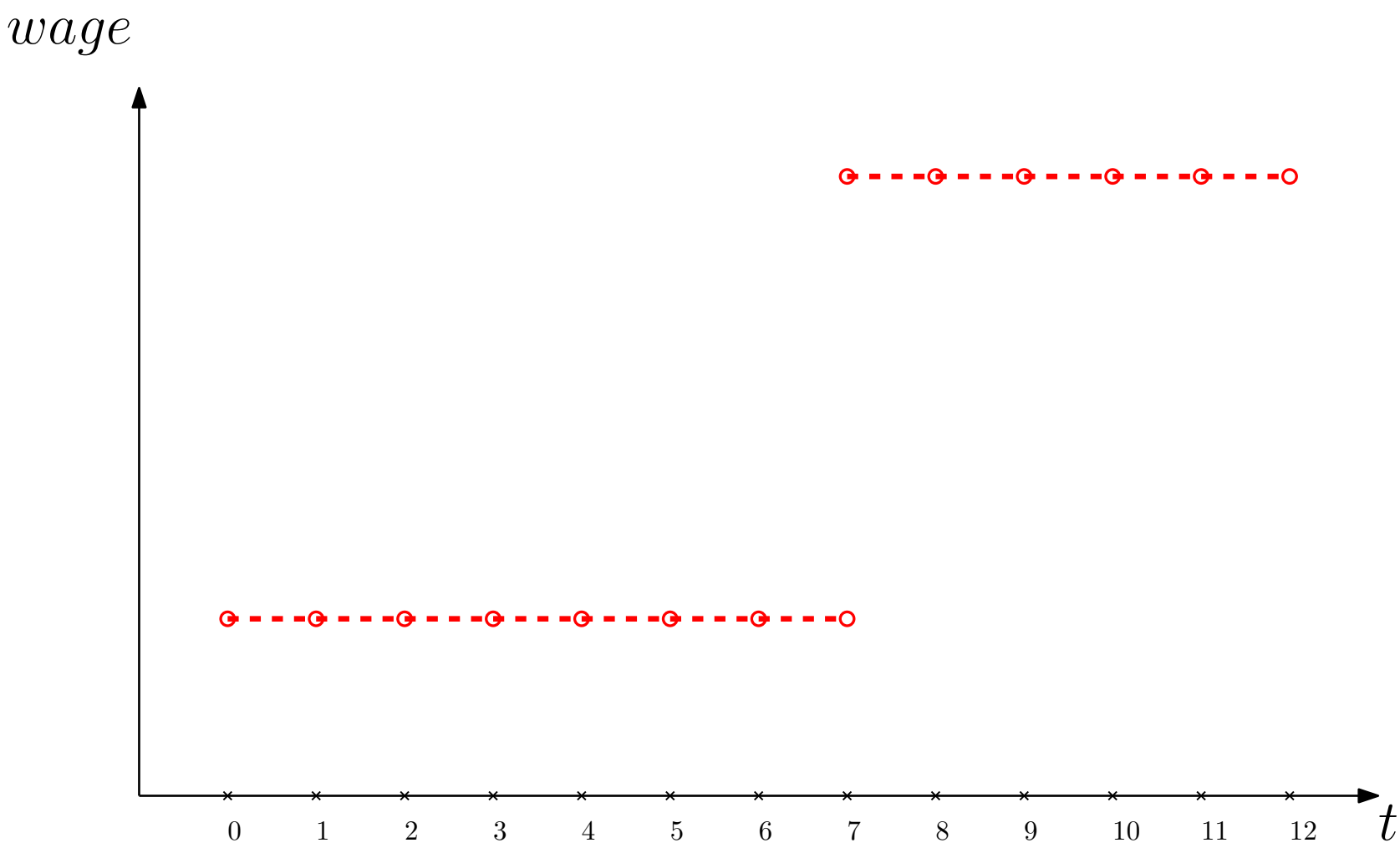
No Moral Hazard, Full Commitment



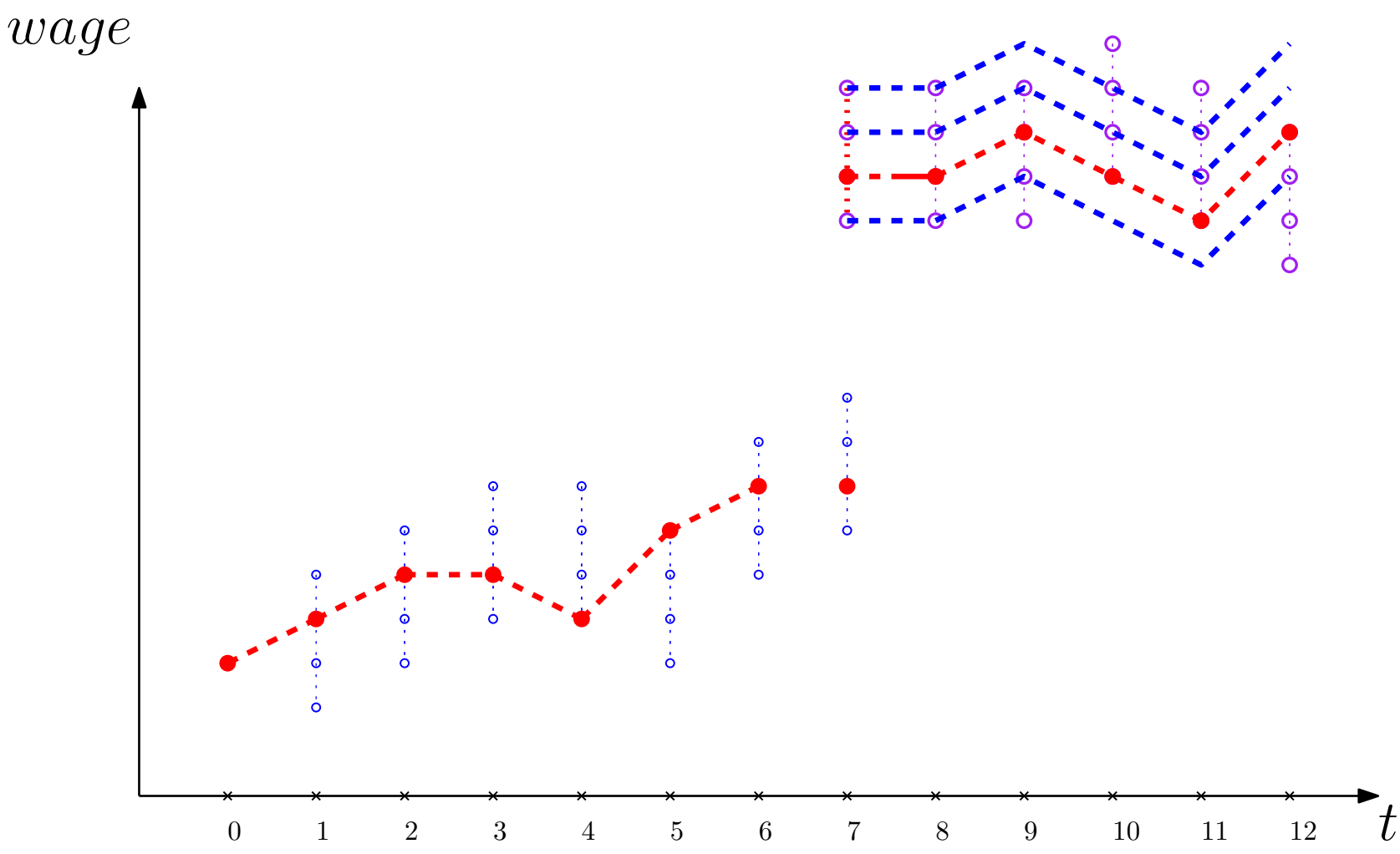
Only Moral Hazard



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