Firm Growth and Promotion Opportunities

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Management Requires Planning Ahead

During WWI, DuPont increased workforce from 5,000 in 1914 to 85,000 in 1918

Post-war diversification into non-chemical industries in part to "**have a place to locate some managerial personnel**" (Chandler, 1962, p. 90)

Production Plans and Personnel Policies

Production plans affect personnel policies

Future production plans determine opportunities for current employees

Slow-growing firms constrained in their ability to promote workers (Bianchi et al., 2018)

The Firm-Growth Imperative

There's an "innate propensity of all organizations to expand... **to grow seems to offer opportunity for the realization of all kinds of active incentives**."(Barnard, '38)

Using promotions to motivate employees "creates a strong **organizational bias toward growth** to supply the new positions that such promotion-based systems require." (Jensen, '86)

Underlies the "[law-]**firm's growth imperative**." (Galanter & Palay, '94)

Firm growth has "implications for the firm's competitive advantage as **a result of the impact of firm growth on the firm's ability to motivate and incentivize its employees**." (Bennett and Levinthal, '17)

Our Contributions

Study how past production decisions affect future production decisions when workers are motivated via long-term, career-based incentives

Contribution 1: Fluctuations in growth opportunities lead firms to adopt **seniority-based personnel policies**

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Contribution 1: Fluctuations in growth opportunities lead firms to adopt **seniority-based personnel policies**

Contribution 2: Using promotion-based incentives leads to a time-inconsistent **opportunity-creation motive** for firm growth

Agenda

- The Model
- Preliminaries
- Allocating Opportunities Across Cohorts
- Optimal Production & Intertemporal Linkages

Model Sketch

1. Workers are motivated by their future prospects in the firm

2. Firm designs workers' careers, choosing pay and promotion policies

3. Firm plans production given a sequence of demand parameters

Model Ingredients

One firm, many identical workers interact repeatedly; common $\delta < 1$

Binary effort; shirking detected with noise

Two activities (1 and 2): activity 1 easier to do or monitor

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One firm, many identical workers interact repeatedly; common $\delta < 1$

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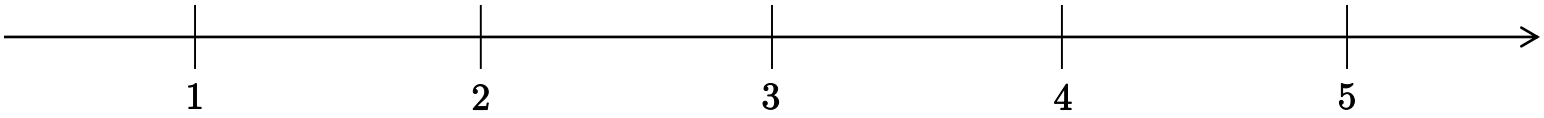
Two activities (1 and 2): activity 1 easier to do or monitor

Firm chooses production path

Firm chooses history-contingent wage & assignment policies

Workers protected by limited liability: wages must be nonnegative

Each Period



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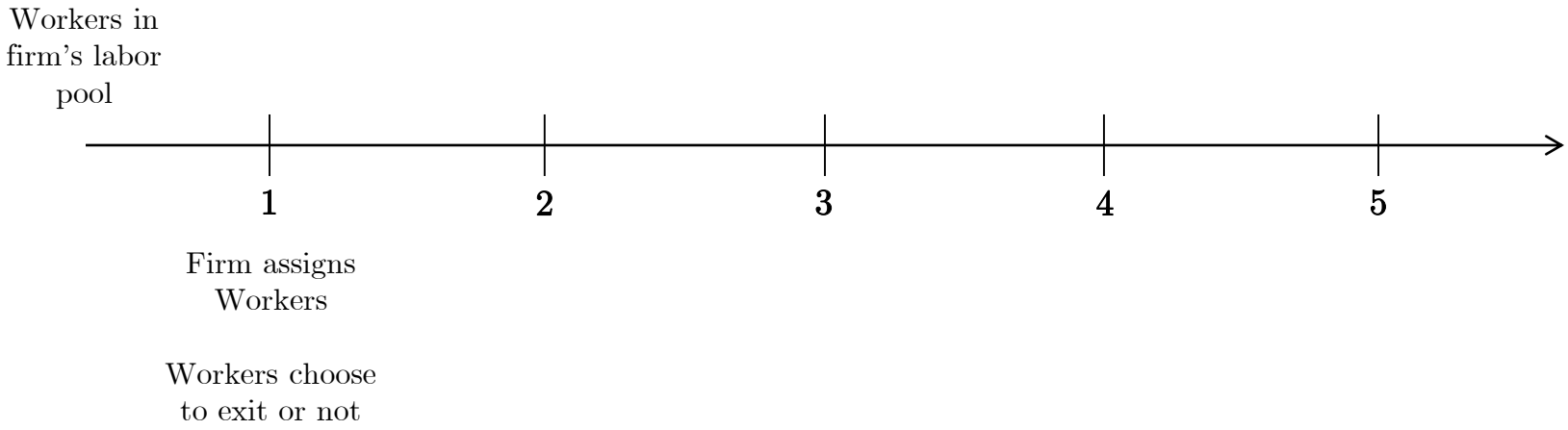
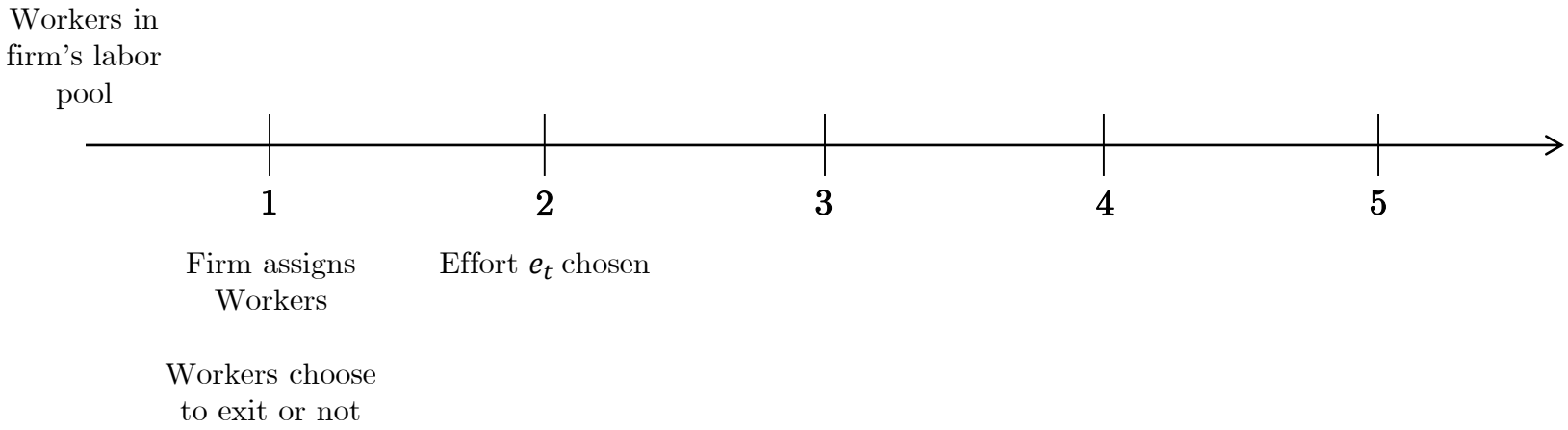


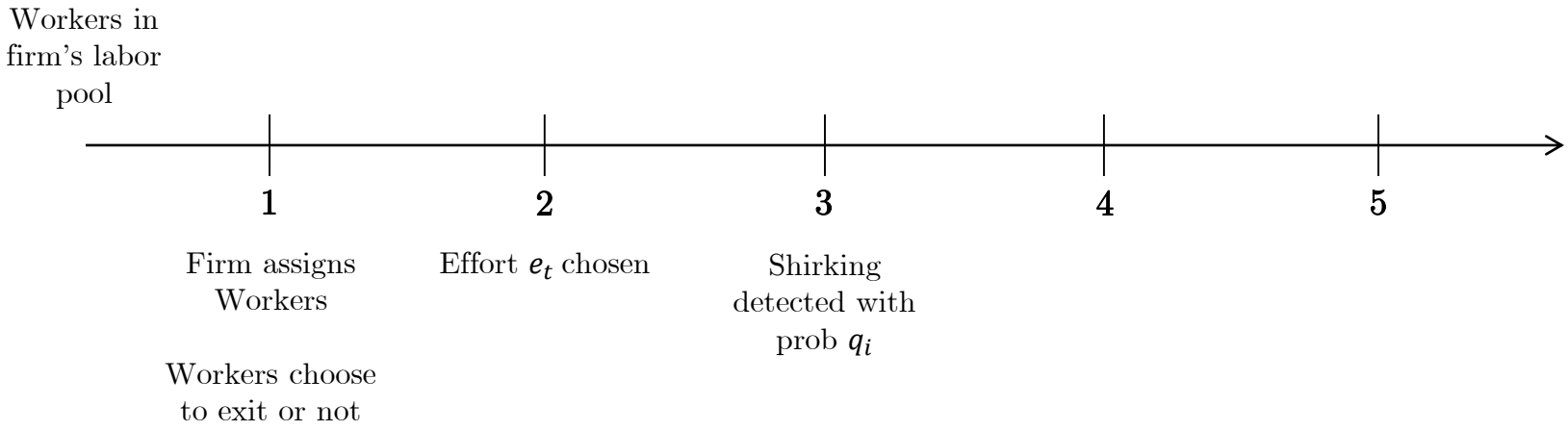
1: Firm assigns each worker to activity $i \in \{0,1,2\}$, and each worker decides whether to stay or leave the labor pool and get 0

Each Period



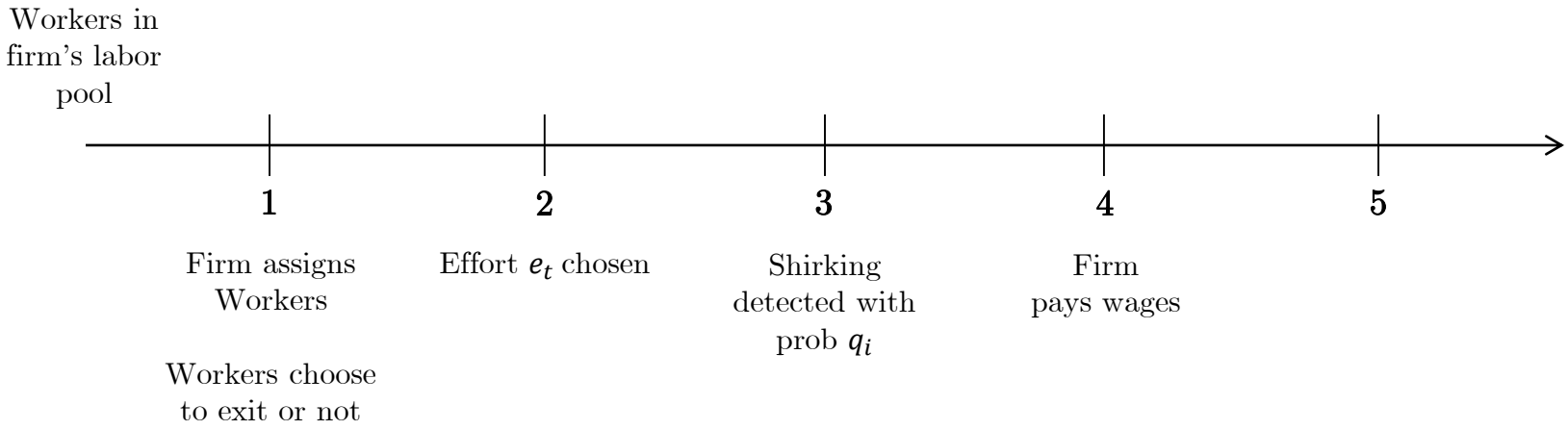
2: Each worker assigned to activity 1 or 2 chooses to work or shirk. Worker assigned to activity i chooses effort $e_t \in \{0,1\}$ at cost $c_i e_t$

Each Period



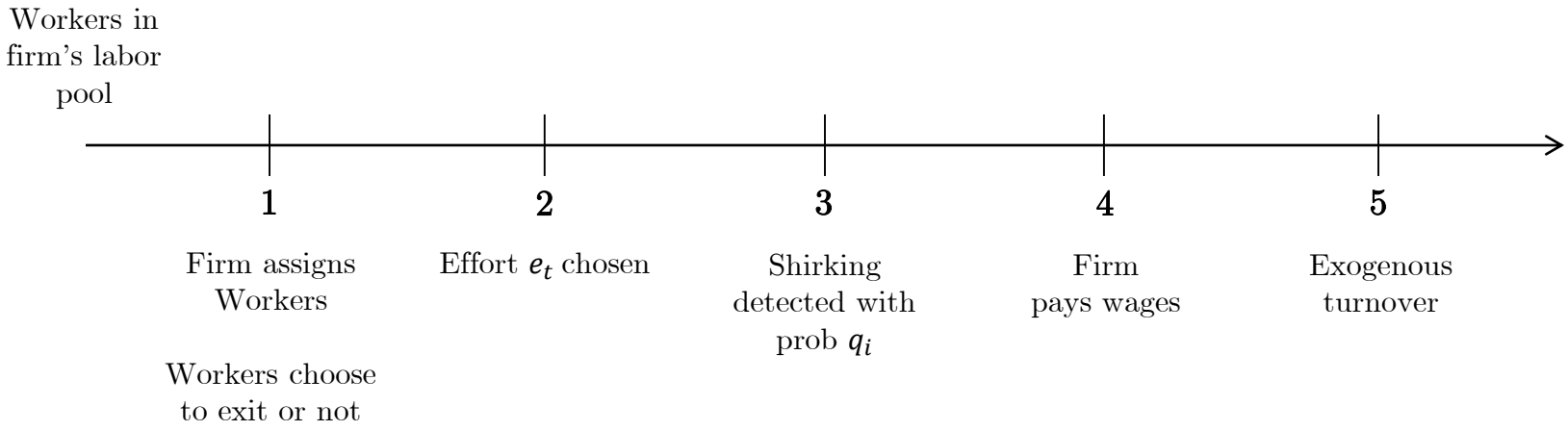
3: A signal $y_t \in \{0,1\}$ is realized for each worker. If $e_t = 1$, then $\Pr[y_t = 1] = 1$ and if $e_t = 0$, then $\Pr[y_t = 1] = 1 - q_i$.

Each Period



4: The firm pays wages $W_t \geq 0$ to each worker

Each Period



5: Each worker leaves the relationship with probability d and receives 0 in all future periods

Contracts

Firm commits to LT contracts specifying wages and assignments based on **history** $h^t = (0, \ldots, 0, A_\tau, \ldots, A_t)$, where $A_s \in \{0,1,2\}$. Worker is a **cohort-τ worker** if τ is first time at which $A_\tau \in \{1,2\}$.

Wage policies map histories to nonnegative payments $\mathrm{W_t} = w(h^t) \geq 0$

Assignment policies specify probability $p_i(h^t)$ agent with history h^t will be assigned to activity i

Payoffs

Worker's payoff in period t if assigned to i and choose e_t:

$$w(h^t) - c_i e_t$$

Firm's payoff in period t:

$$\underbrace{\theta_t f\left(N_{1,t}, N_{2,t}\right)}_{\substack{\text{period-}t \\ \text{revenues}}} - \sum_{h^t \in \mathcal{H}^t} w(h^t) \underbrace{\ell(h^t)}_{\substack{\text{mass of workers} \\ \text{w/history } h^t}}$$

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The Program: Objective & Constraints

$$\max_{N,v,w,p} \sum_{t=1}^{T} \delta^{t-1} \left[\theta_t f\left(N_{1,t}, N_{2,t}\right) - \sum_{h^t \in \mathcal{H}^t} w(h^t)\ell(h^t) \right]$$

subject to

$$v(h^t) = w(h^t) - c(h^t) + \delta(1-d)\sum_{i\in\{1,2\}} p_i(h^t)v(h^t i) \qquad (PK)$$

$$v(h^t) \geq (1-q(h^t))(w(h^t) + \delta(1-d)\sum_{i\in\{1,2\}} p_i(h^t)v(h^t i)) \qquad (IC)$$

$$v(h^t) \geq 0 \qquad (IR)$$

$$\sum_{h^t|A_t=i} \ell(h^t) = N_{i,t} \text{ for } i \in \{1,2\}$$

$$\ell(h^t i) = (1-d)p_i(h^t)\ell(h^t) \text{ for } i \in \{1,2\} \qquad (Flow)$$

Motivation Requires Rents

Motivation: each worker must prefer to work and get value v than shirk, save on effort costs, and maybe get v (or 0 if caught)

- Activity 1 requires $v \geq R_1 = \frac{1-q_1}{q_1} c_1$.
- Activity 2 requires $v \geq R_2 = \frac{1-q_2}{q_2} c_2 > R_1$.

Minimize Rents Paid to New Hires

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Dynamic motivation—rent-extraction trade-off: firm wants to maximize total surplus minus rents paid to new hires

- **Guiding principle**: don't pay excess rents to new hires

Internal Labor Markets

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Allocating Opportunities

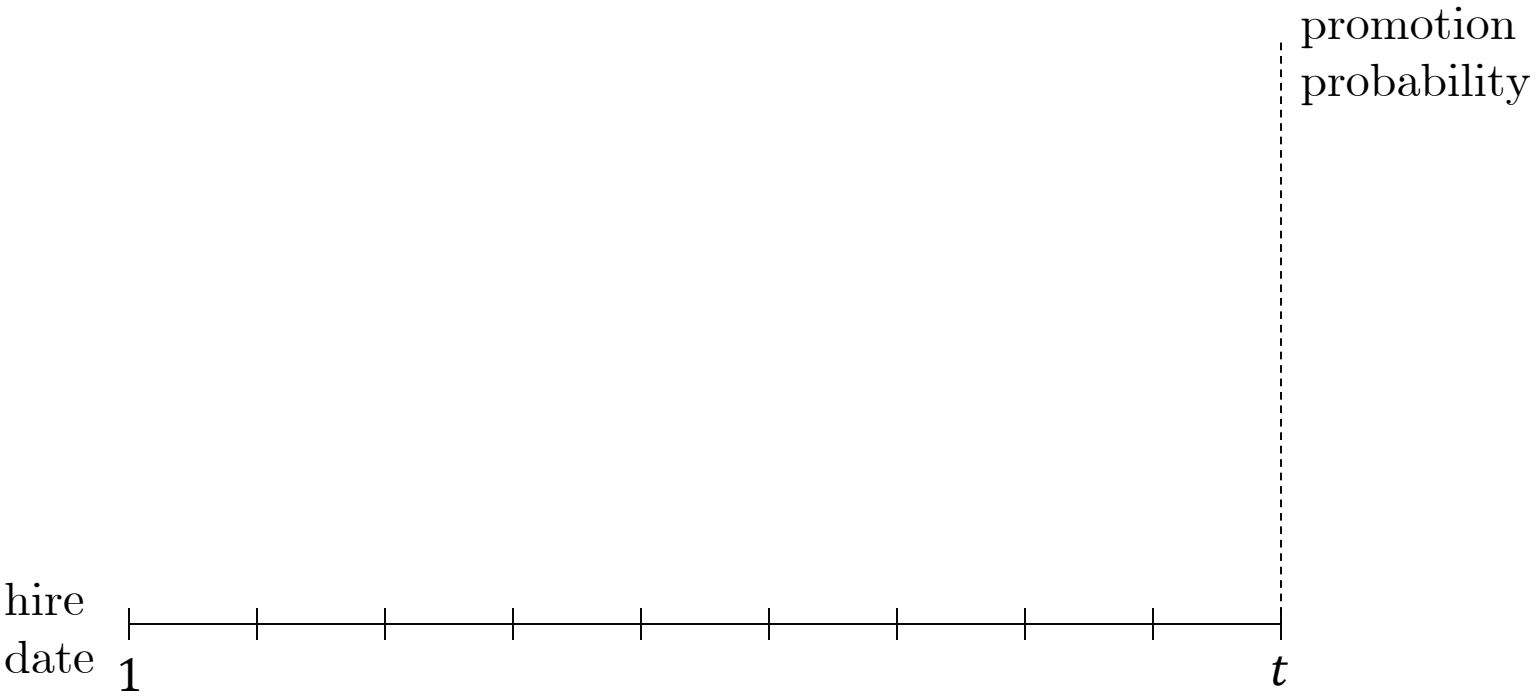
Proposition

If the firm never has to downsize, there is an optimal personnel policy with the following properties:

1. *Earlier cohorts earn more and are promoted with higher probability*
2. *Modified FIFO promotion rules*

We'll talk a bit later about what extra happens when the firm might have to downsize.

Modified First-In-First-Out Promotions



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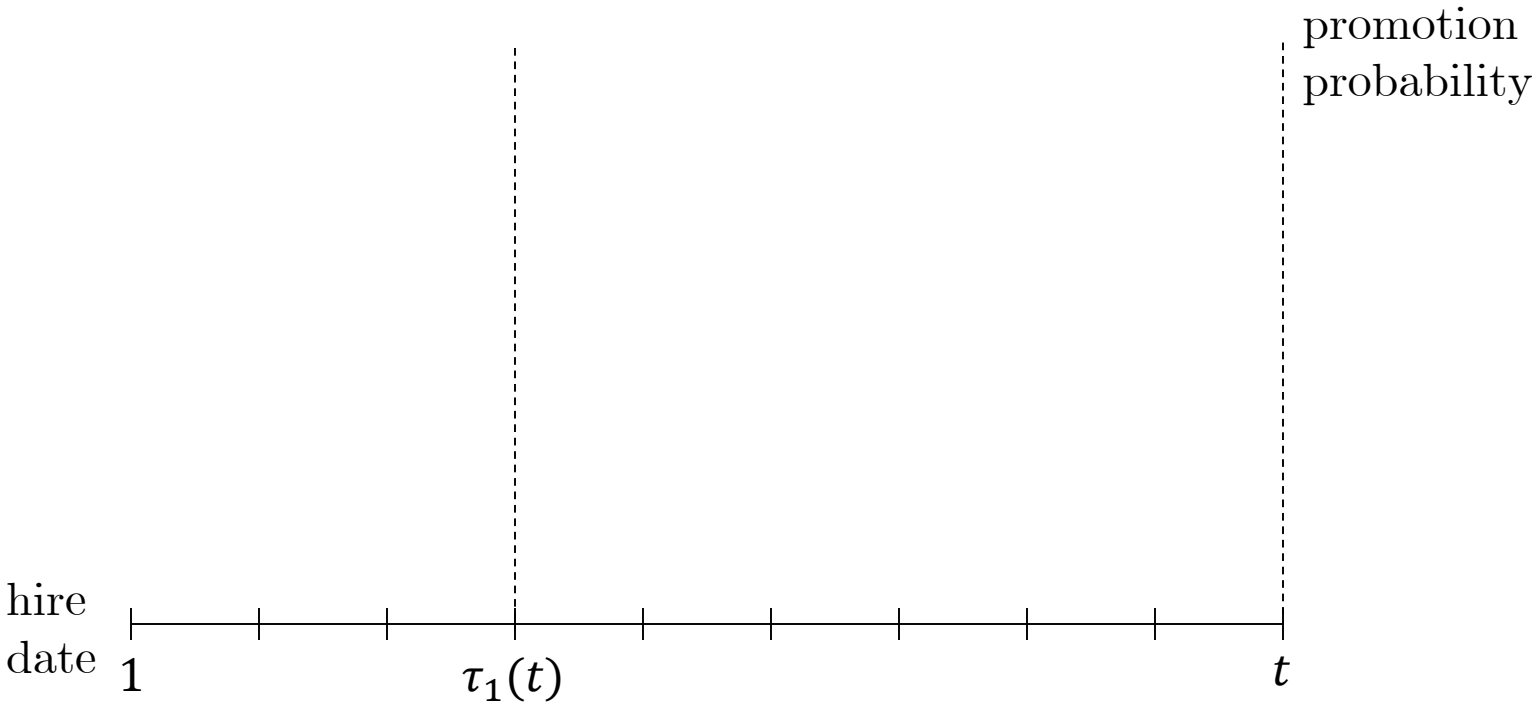

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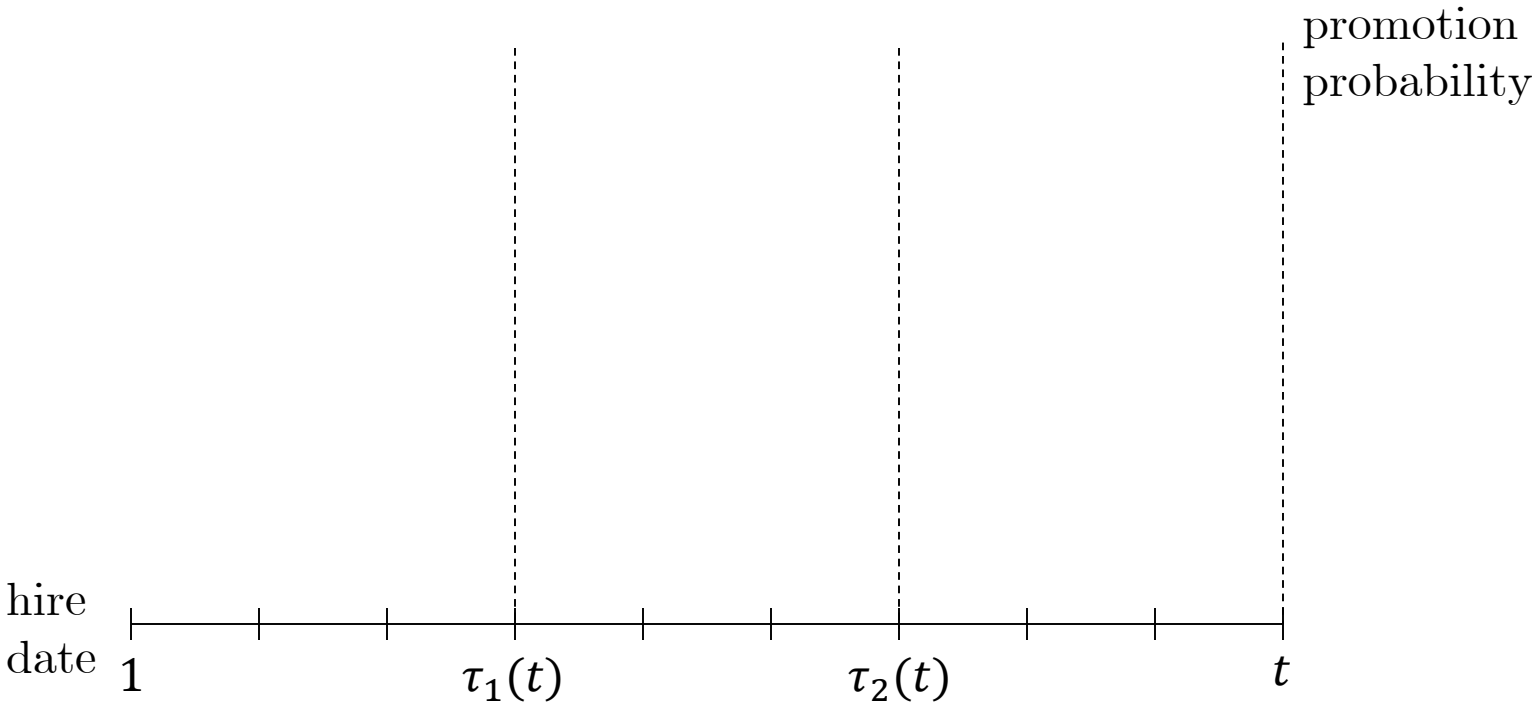

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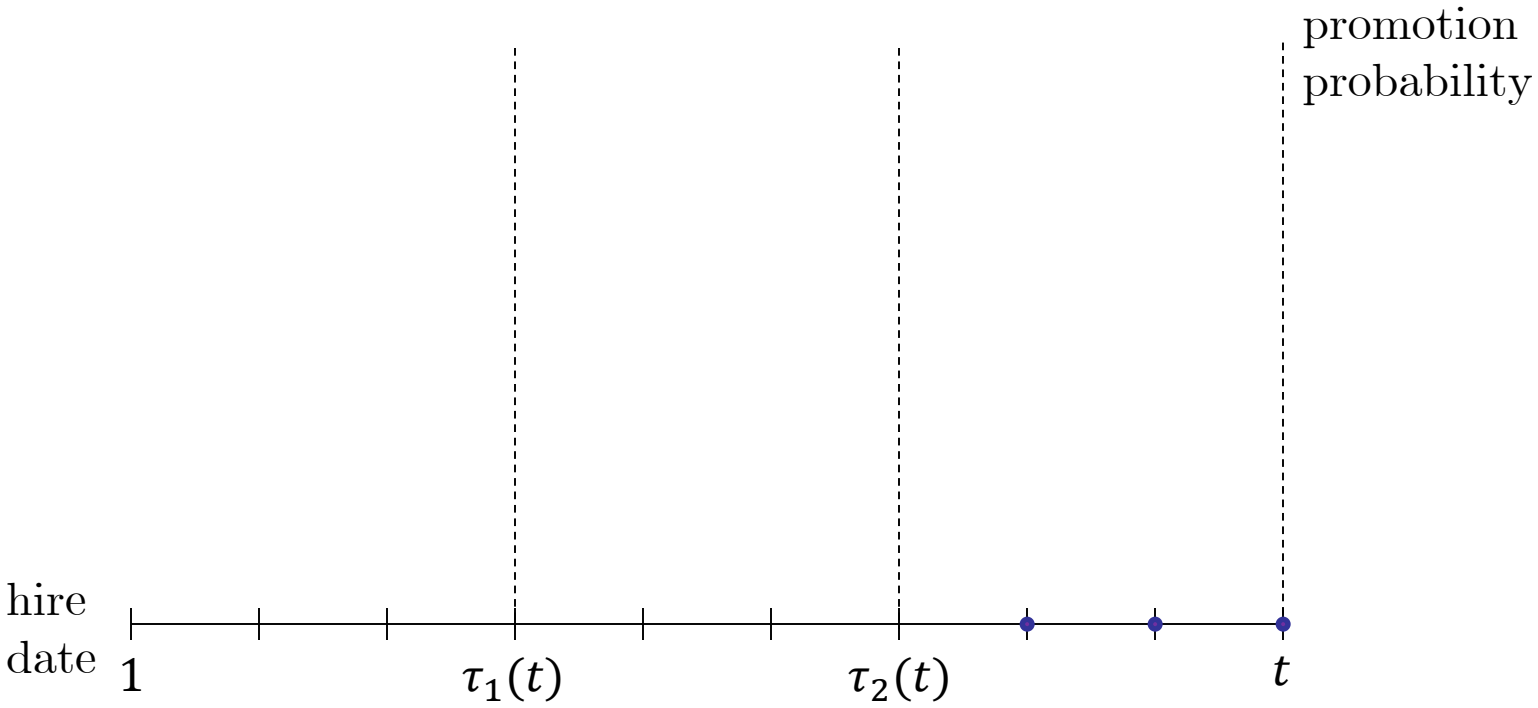

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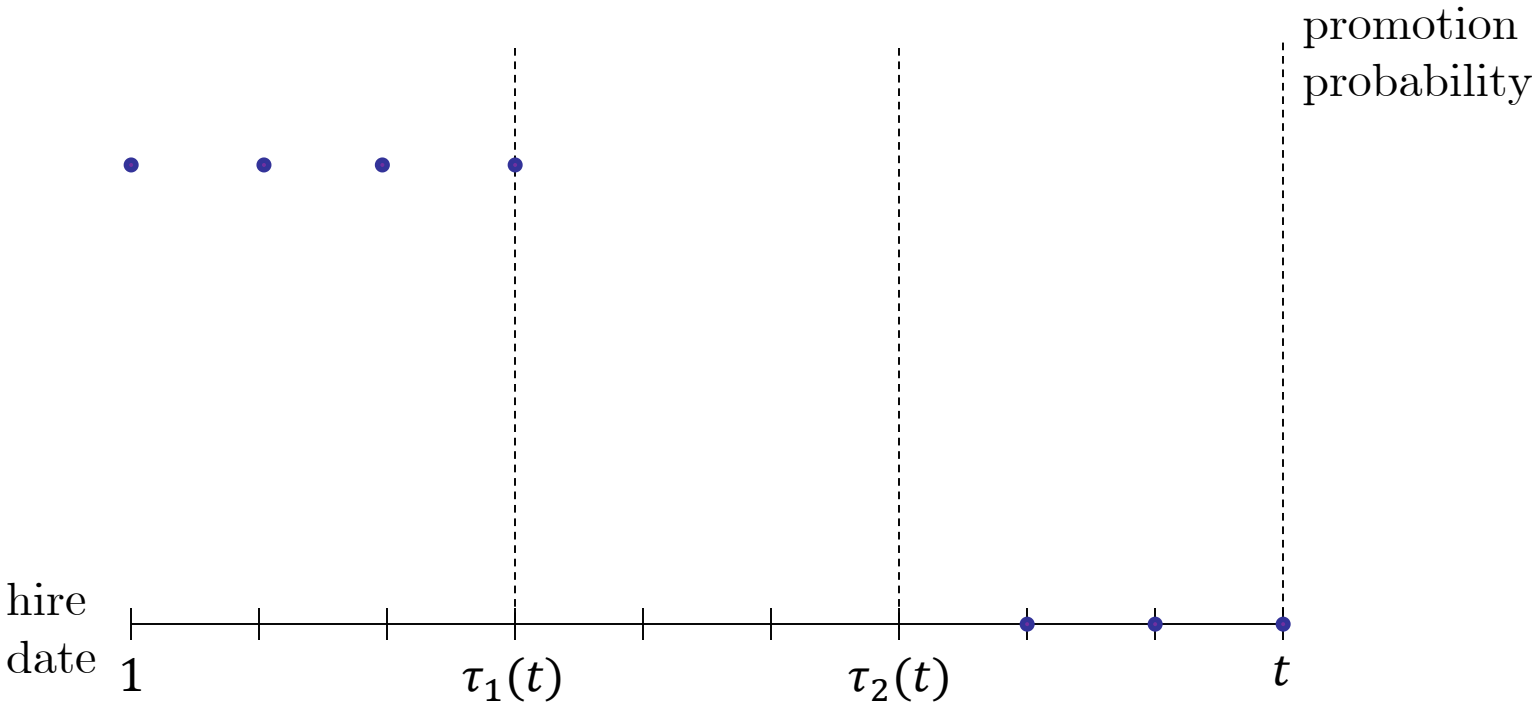

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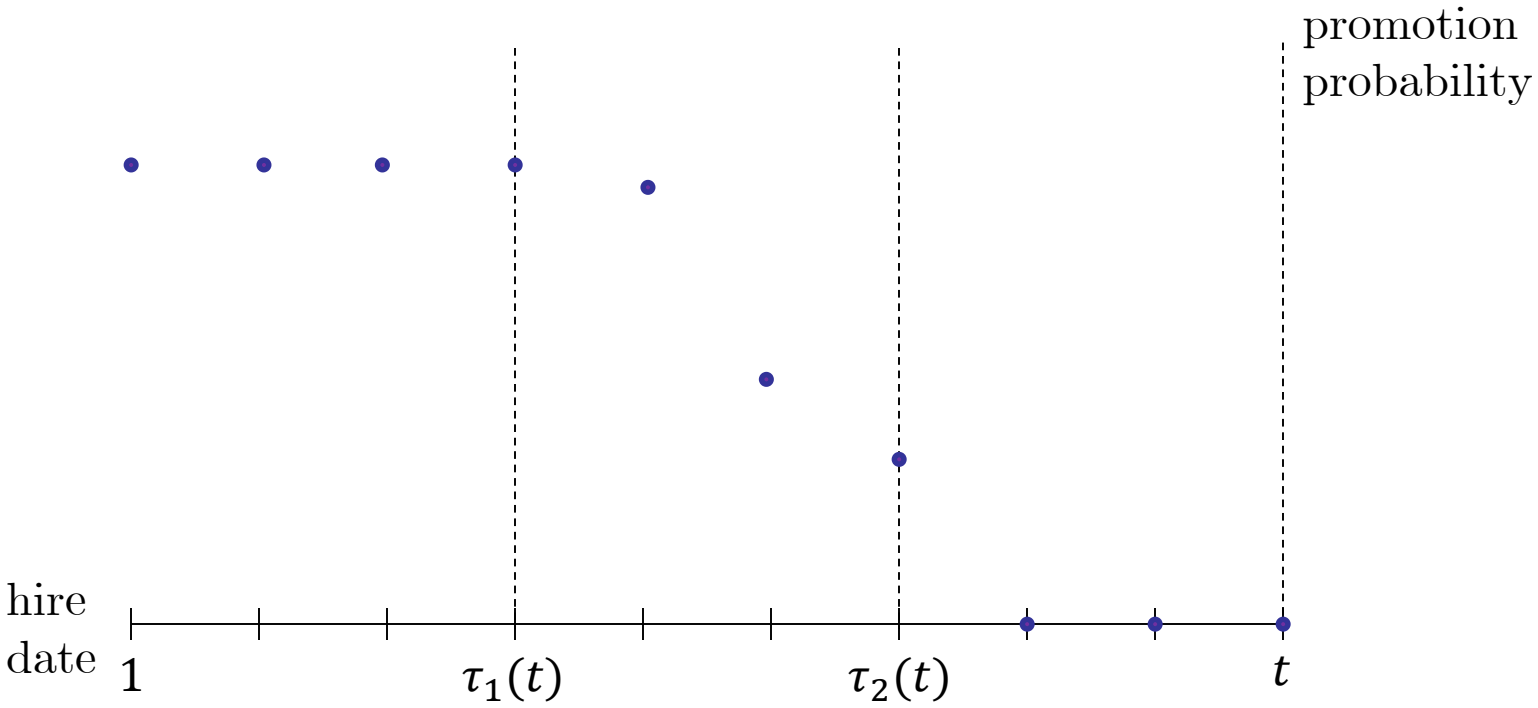
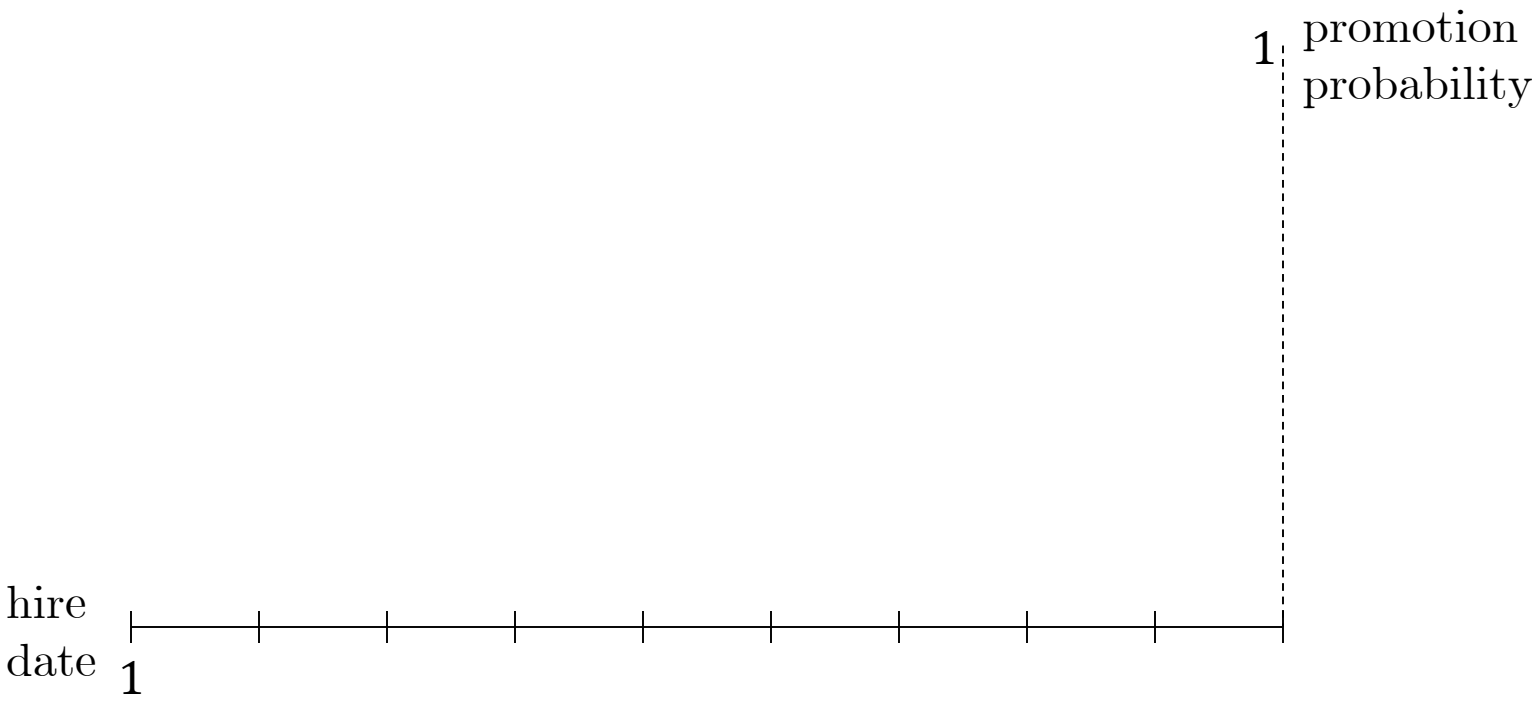


Why not First-In-First-Out?



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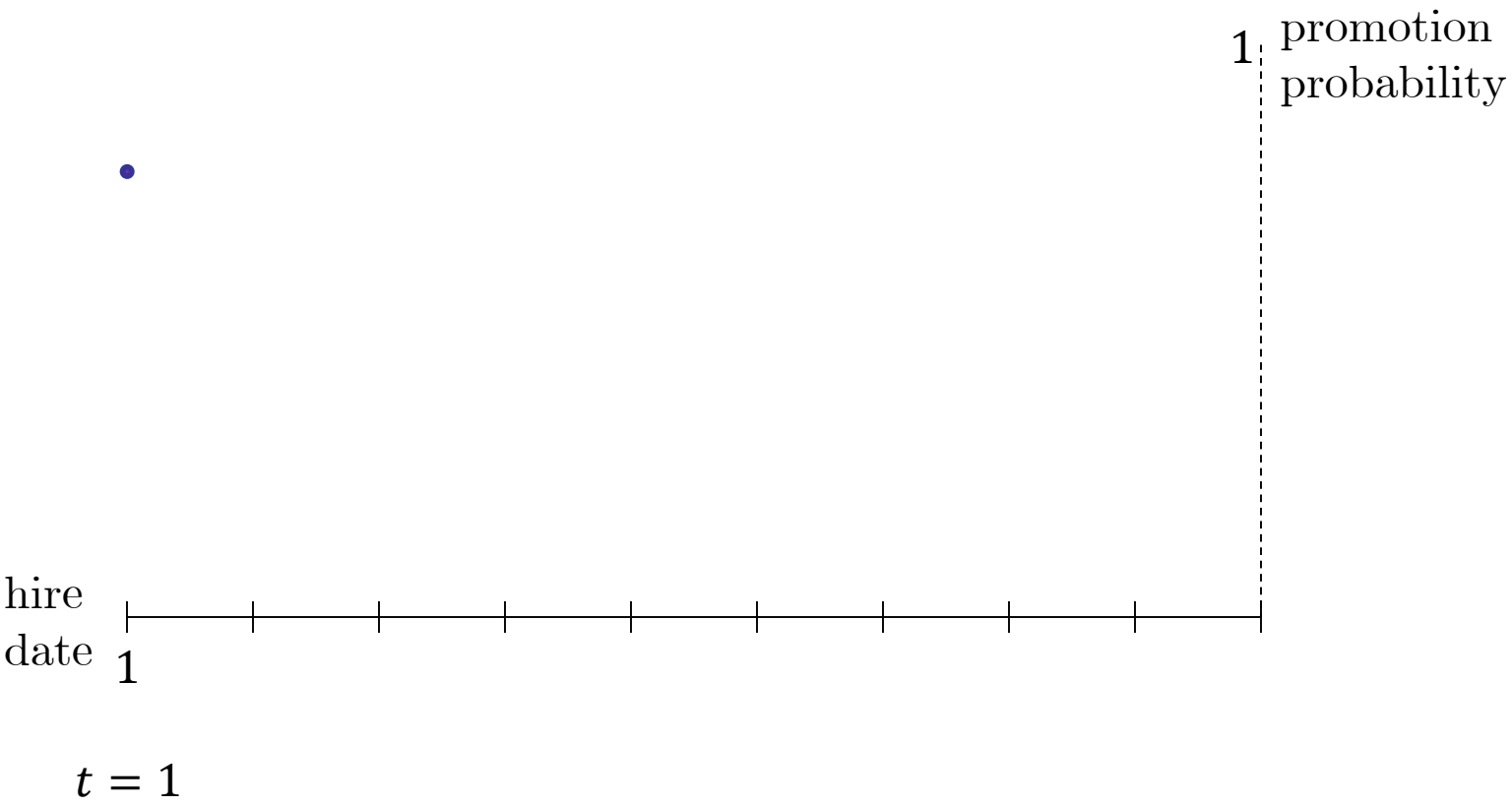

$t = 1$

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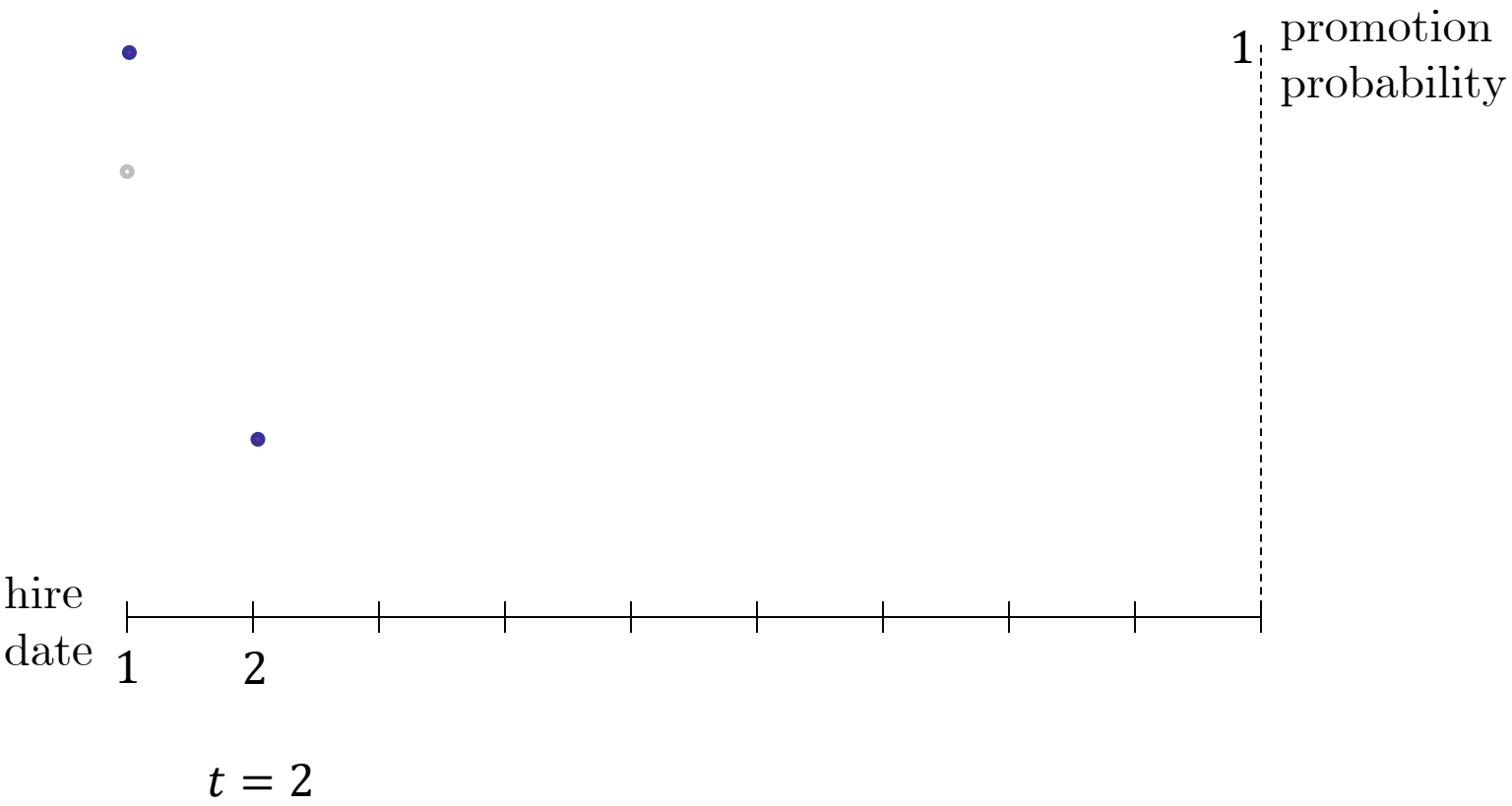

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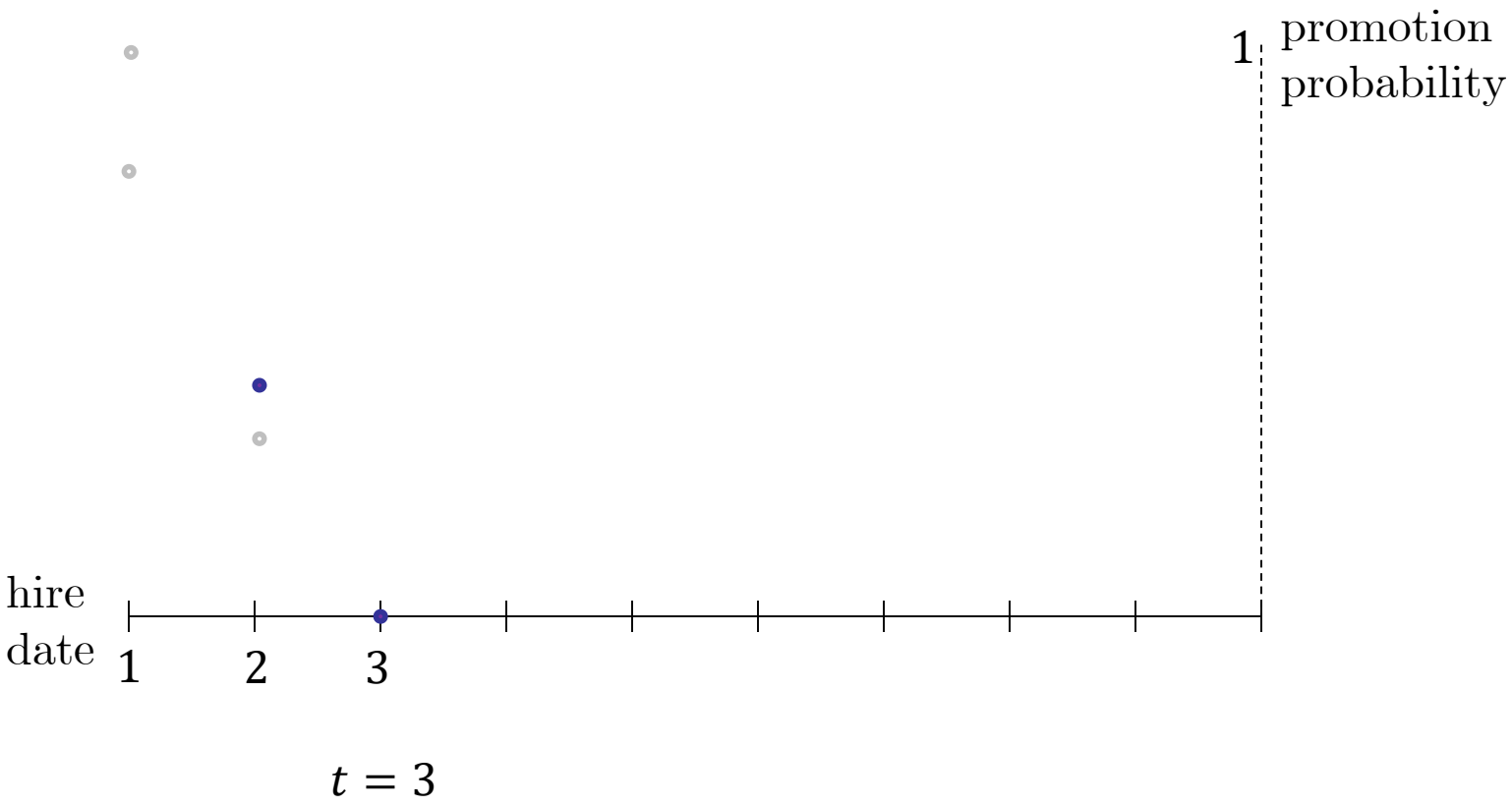

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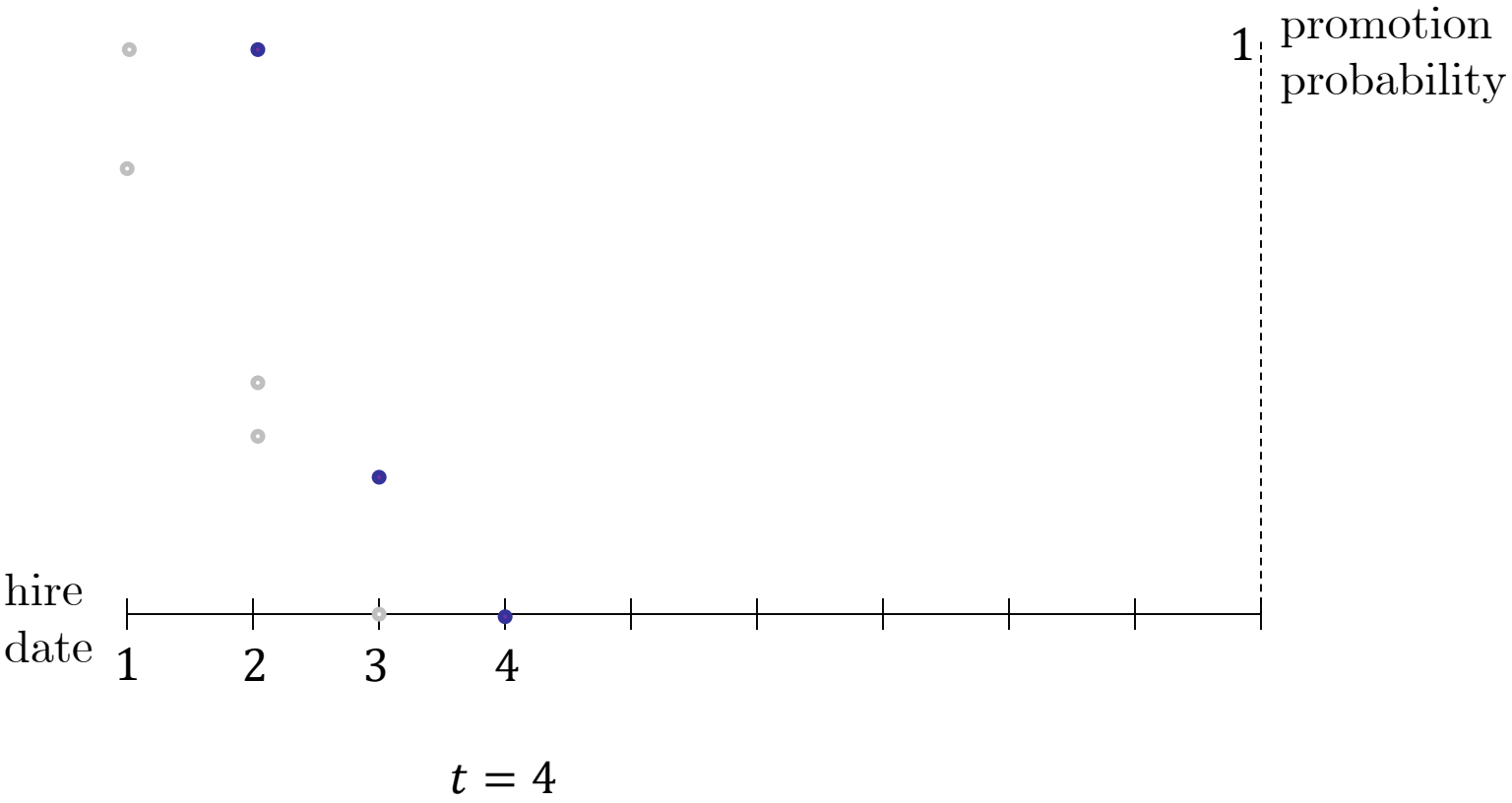

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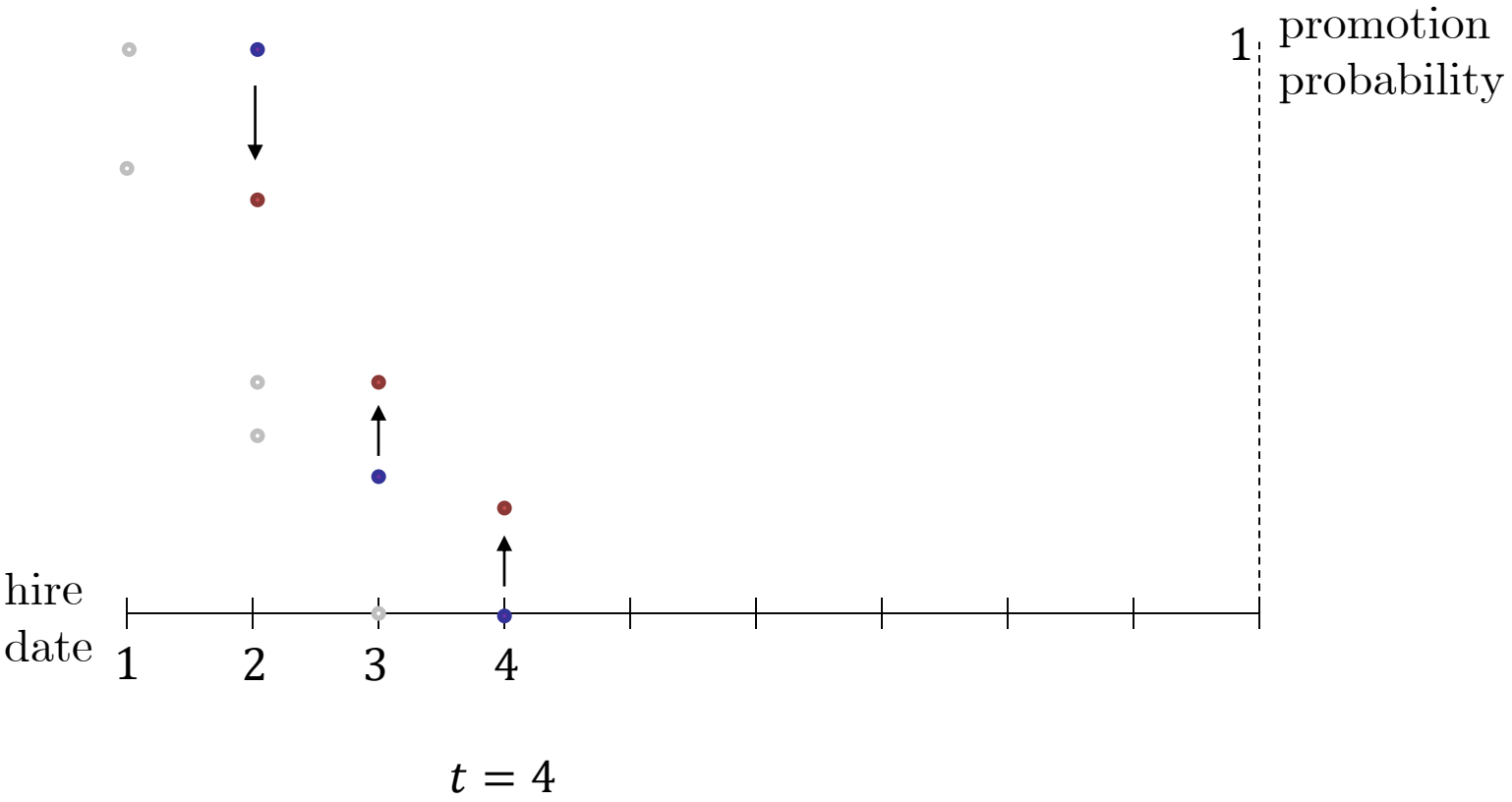

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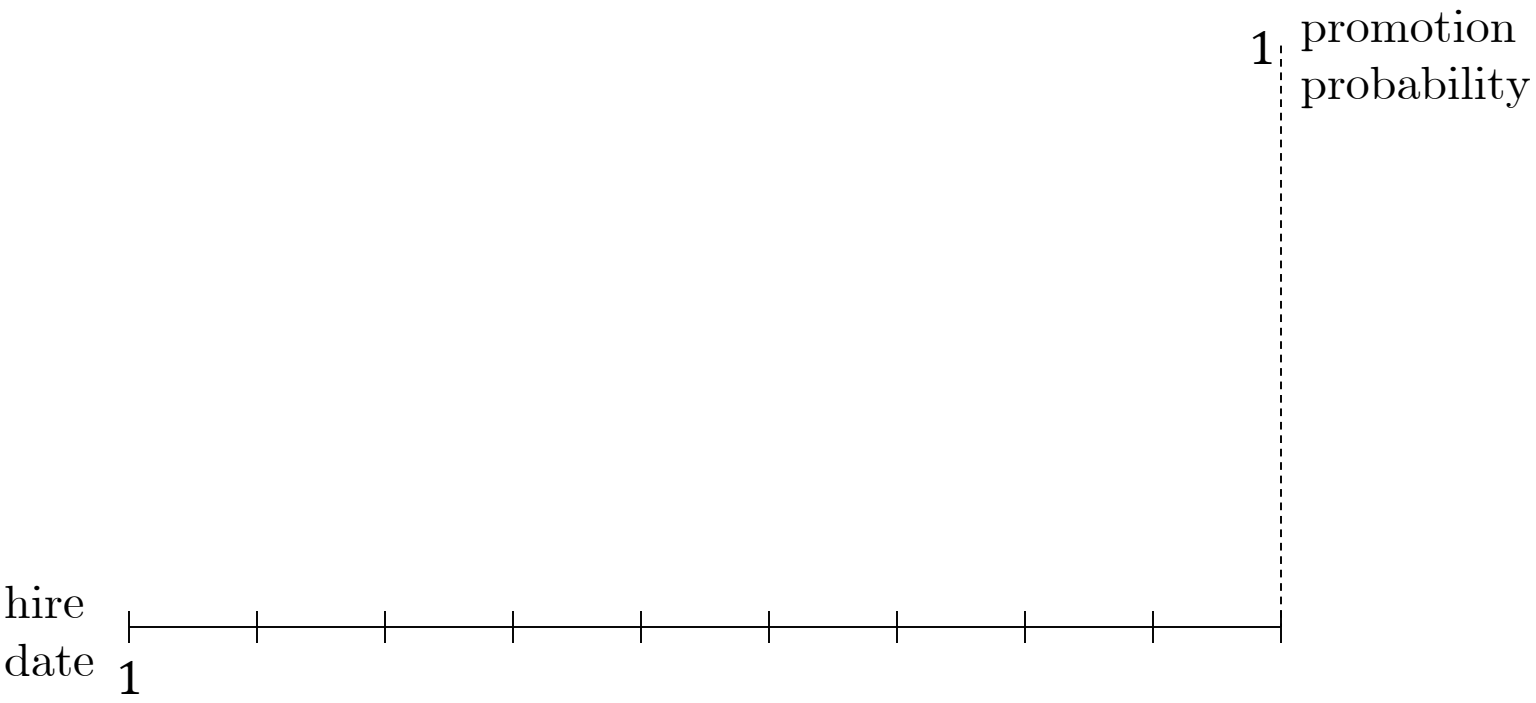

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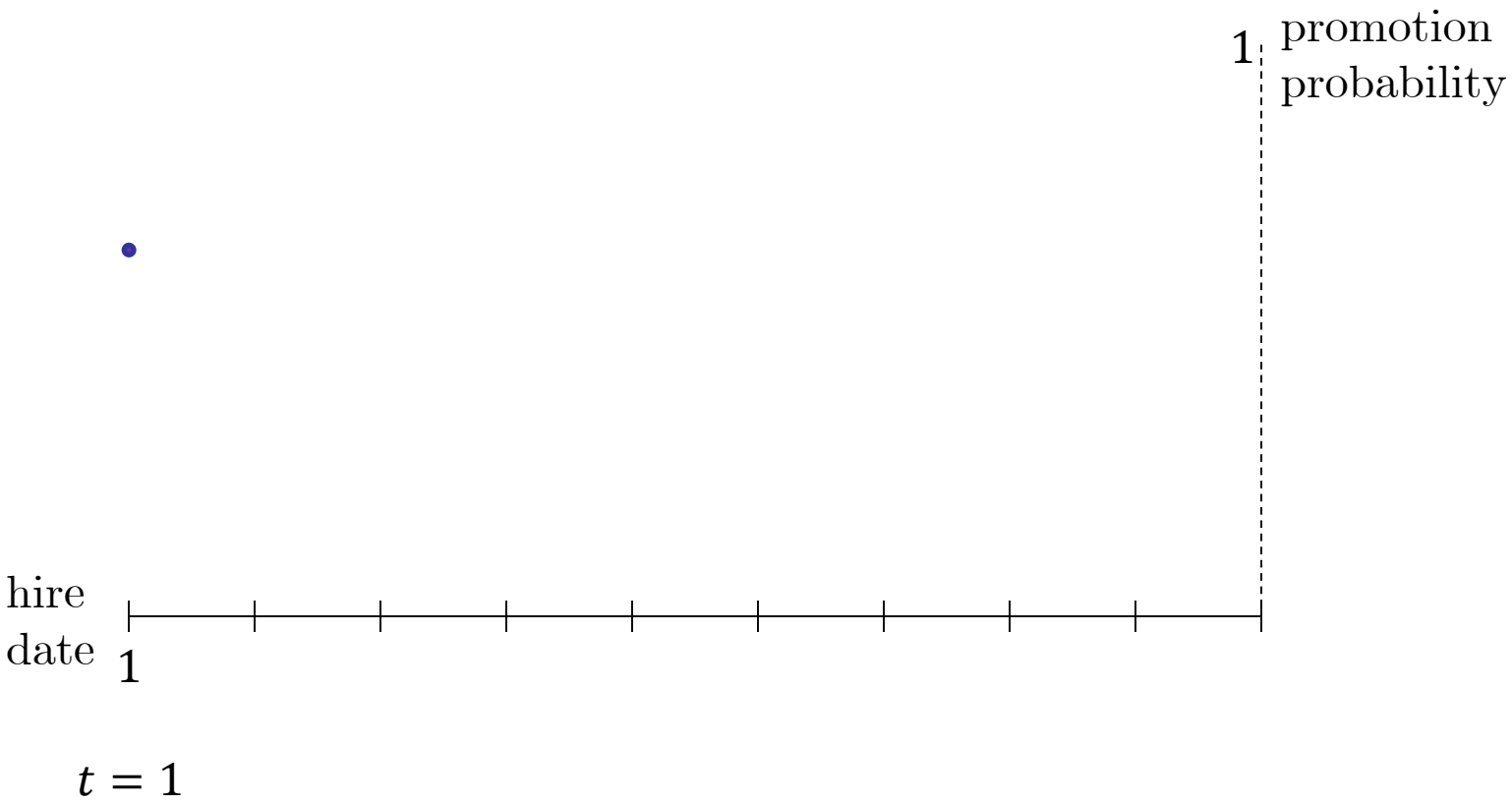

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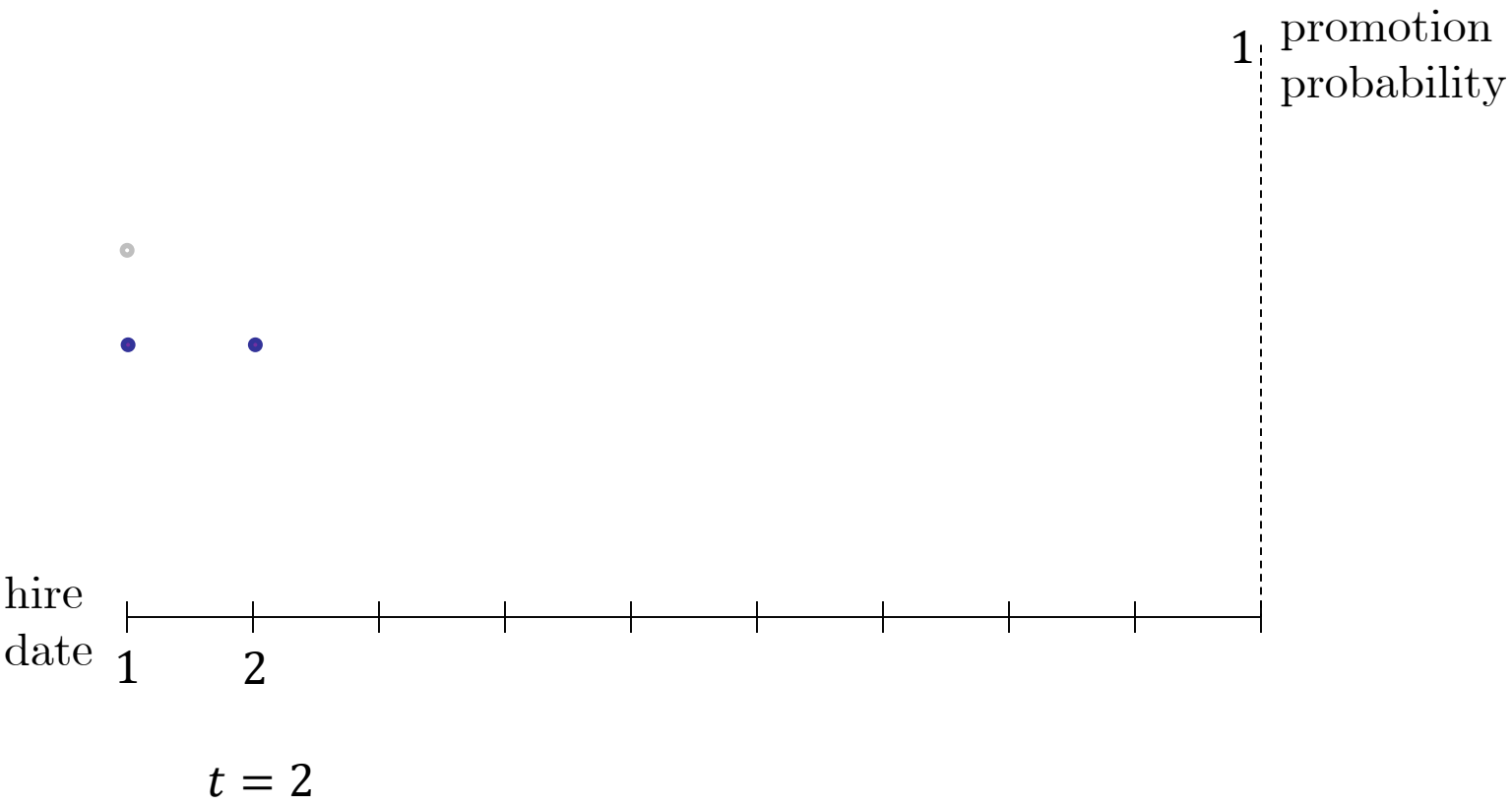

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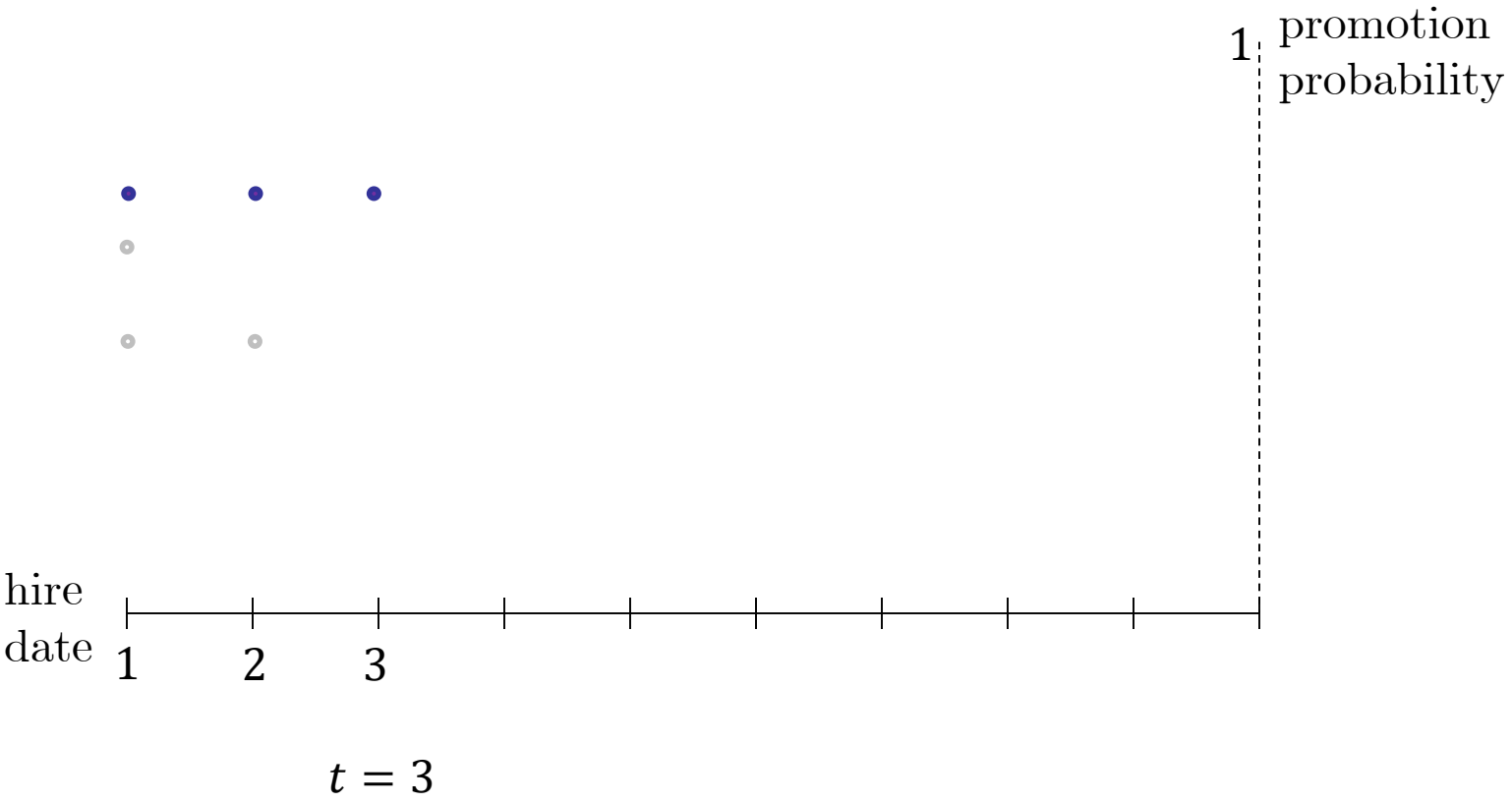

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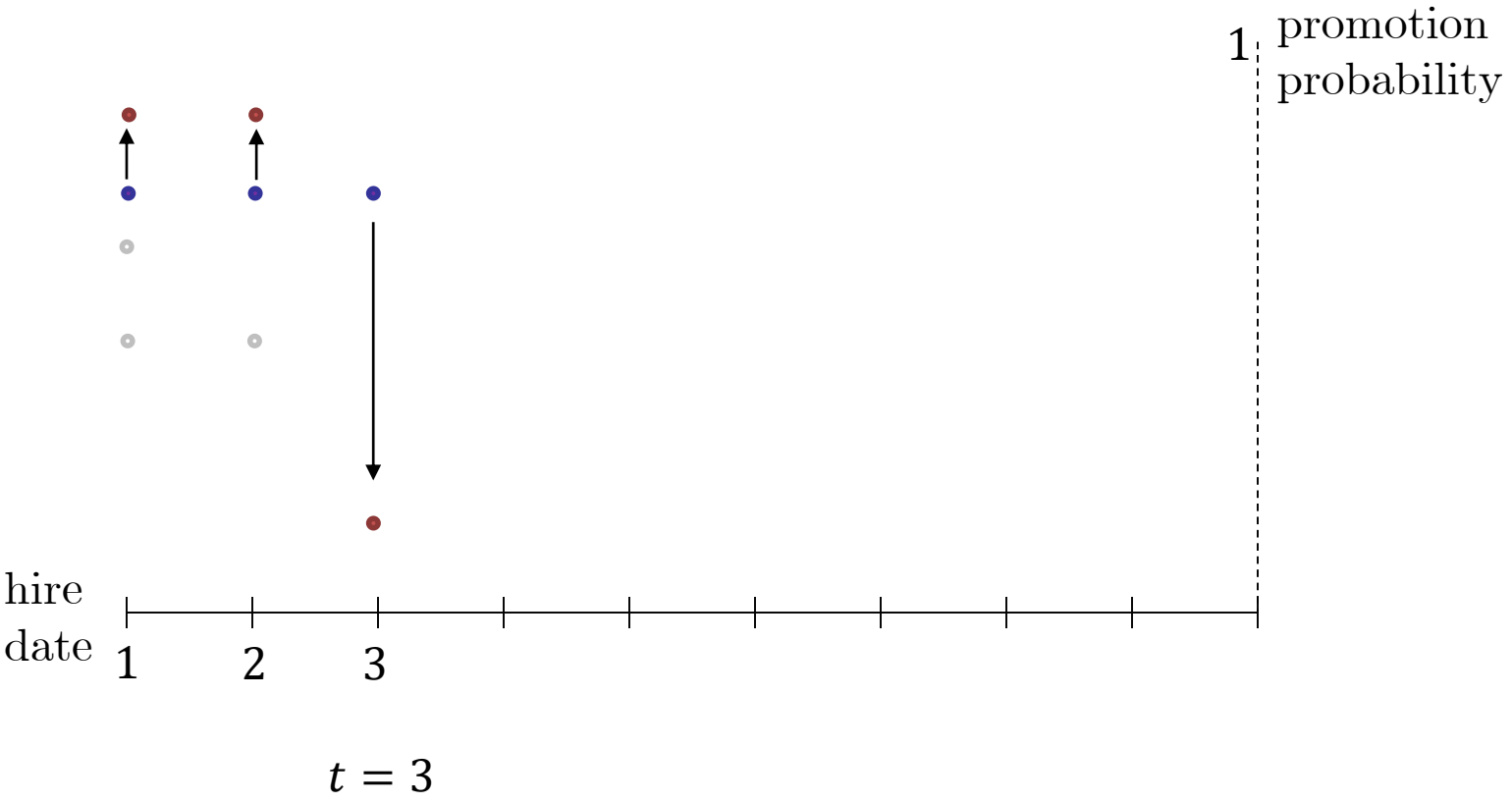

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Seniority-Based Promotions

Allocate opportunities to workers who can "pay" upfront for them

Seniority-blind may allocate "too many" opportunities, hence excess rents, to later cohorts, so may gain from basing promotions on seniority

But strict seniority (FIFO) may allocate "too many" opportunities to early cohorts, giving them excess rents

Seniority-Based Policies In General

If firm must downsize, it has to decide whom to lay off, when, and how.

Older cohorts are less likely to get laid off. If they get laid off (and never rehired), they will receive a larger severance payment.

If the firm rehires in the future, it first rehires more-senior workers. After it hires them back, it treats them better than new hires.

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The Original Program

$$\max_{N,v,w,p} \sum_{t=1}^{T} \delta^{t-1} \left[\theta_t f\left(N_{1,t}, N_{2,t}\right) - \sum_{h^t \in \mathcal{H}^t} w(h^t)\ell(h^t) \right]$$

subject to

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No Excess Rents to New Hires

Lemma

All new hires into activity 1 receive $v = R_1$ *(no excess rents)*

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Lemma

All new hires into activity 1 receive $v = R_1$ (no excess rents)

Suppose $v > R_1$ for new hires into activity 1 in period t

- New hires being motivated solely by promotion prospects, and $w = 0$
- Hire more workers today, promote them w/pr 1 at τ s.t. existing cohort-t workers are first promoted with positive probability, and pay them 0 until τ
- Fire some existing new hires at that point

Reformulated Production Problem

Lemma

All new hires into activity 1 receive $v = R_1$ *(no excess rents)*

Production path N^* *solves the original problem if and only if it solves the following reformulated problem:*

Reformulated Production Problem

$$\max_{\{N_{i,t}\}_{t=1}^{T}} \sum_{t=1}^{T} \delta^{t-1}\left[\theta_t f\left(N_{1,t}, N_{2,t}\right) - c_1 N_{1,t} - c_2\, N_{2,t}\right] - \sum_{t=1}^{T} \delta^{t-1} H_t R_1 - N_{2,1} R_2$$

subject to the **no-excess-rents condition**:

There exists an incentive-compatible personnel policy that gives no excess rents to new hires.

Reformulated Production Problem

$$\max_{\{N_{i,t}\}_{t=1}^{T}} \underbrace{\sum_{t=1}^{T} \delta^{t-1}\left[\theta_t f\left(N_{1,t}, N_{2,t}\right) - c_1 N_{1,t} - c_2 N_{2,t}\right]}_{\text{total surplus}} - \underbrace{\sum_{t=1}^{T} \delta^{t-1} H_t R_1 - N_{2,1} R_2}_{\text{incentive rents}}$$

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$$\underbrace{X_t \equiv N_{2,t} - (1-d)N_{2,t-1} - (1-d)\hat{p}N_{1,t-1}}_{\text{excess opportunities in period } t}$$

Reformulated Production Problem

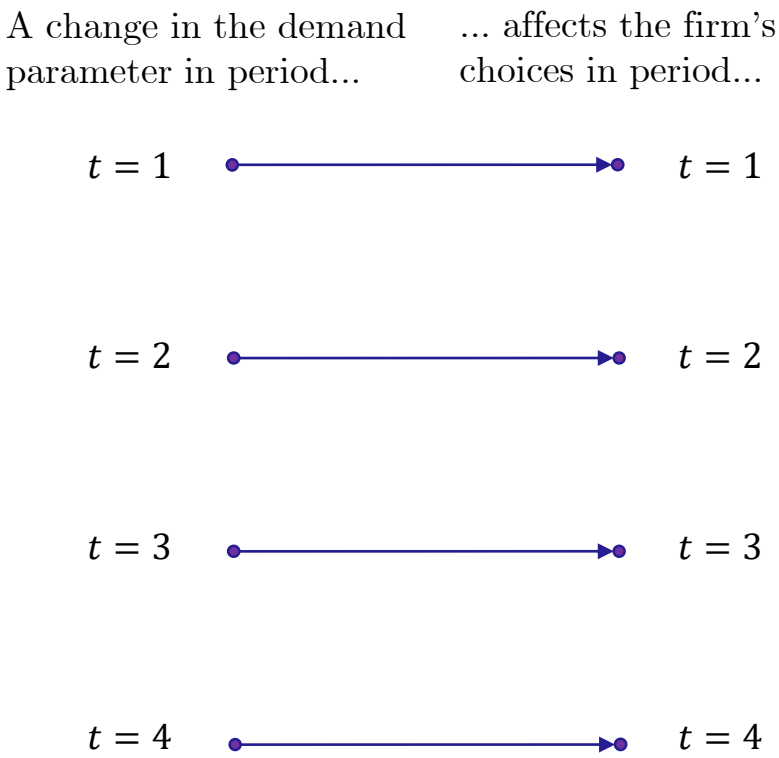
$$\max_{\{N_{i,t}\}_{t=1}^{T}} \overbrace{\sum_{t=1}^{T} \delta^{t-1}\left[\theta_t f\left(N_{1,t}, N_{2,t}\right) - c_1 N_{1,t} - c_2 N_{2,t}\right]}^{\text{total surplus}} - \overbrace{\sum_{t=1}^{T} \delta^{t-1} H_t R_1 - N_{2,1} R_2}^{\text{incentive rents}}$$

subject to the **no-excess-opportunities constraints**:

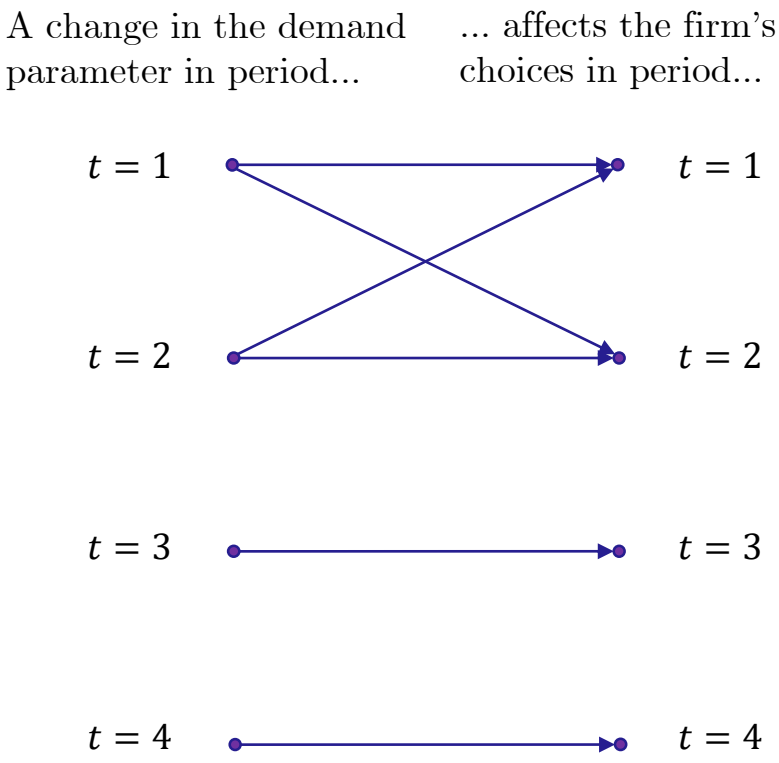
$$\begin{aligned} X_2 &\leq 0 \\ X_2 + \delta X_3 &\leq 0 \\ &\vdots \\ \sum_{t=2}^{T} \delta^{t-2} X_t &\leq 0 \end{aligned}$$

$$\underbrace{X_t \equiv N_{2,t} - (1-d)N_{2,t-1} - (1-d)\hat{p}N_{1,t-1}}_{\text{excess opportunities in period } t}$$

If all of the no-excess-opportunities constraints are slack:

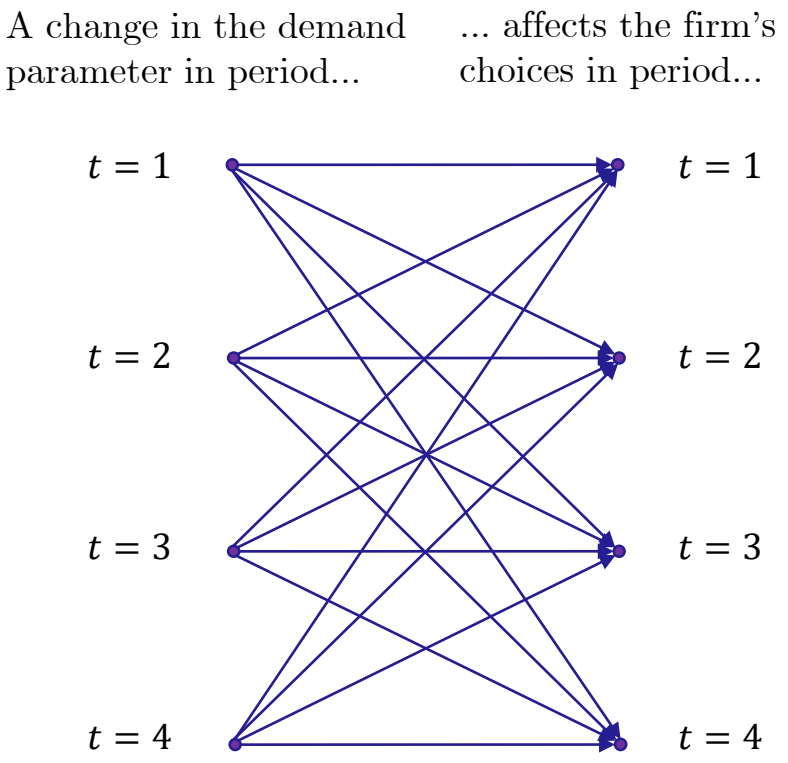


If only the $t = 2$ constraint is binding...



intertemporal **linkages** b/t pds 1 and 2

If the $t = 4$ constraint is binding…



intertemporal **linkages** b/t pds 1, 2, 3, and 4

Conclusion

Model linking dynamic production decisions and dynamic incentives

Dynamic motivation—rent-extraction trade-off leads to:

- Seniority-based personnel policies
- Opportunity-creation motive for firm growth

Broader implication of organizationally constrained opportunities: career spillovers across workers (Bianchi et al. 2018)