Seniority under Monopsony and Population Aging

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Motivation

- Seniority-based wages and stable jobs: an engine of East Asian economic growth
- Now blamed for labor market inefficiencies
- Firms with 100+ workers: seniority-based wages 75% (early 2010s) $\rightarrow$ 50% today
- Has the return to tenure really fallen? If so, why?

▸ Figure

What we do

- Method: period-specific versions of the A&S and Topel estimators
- Fact 1: returns to tenure peaked in the early 2000s and then substantially declined
- Fact 2: the decline moves together with population aging
- Model: monopsony shapes the seniority wage structure; aging flattens it

Data and the identification problem

KLIPS 1998–2024: regular wage workers aged 20–65

$$\log w_{ijt} = \mathbf{f}(T_{ijt})'\boldsymbol{\beta}_T + \mathbf{f}(X_{ijt})'\boldsymbol{\beta}_X + Z'_{ijt}\boldsymbol{\gamma} + y_t + \varepsilon_i + \nu_{ij} + u_{ijt} \quad \text{where} \quad \mathbf{f}(v) = (v, v^2, v^3, v^4)'$$

- Tenure T is correlated with worker quality ε_i and match quality ν_{ij}
- OLS is biased up; worker FE removes ε_i but not ν_{ij}

Two standard estimators

1. Altonji & Shakotko (1987) IV
   - Instrument: $z_{ijt} = T^m_{ijt} - \overline{T^m}_{ij}$ (deviation from the job-spell mean)
   - $\sum_{t \in ij} z_{ijt} = 0$ in each job spell $\Rightarrow$ z_{ijt} is orthogonal to ε_i and ν_{ij}

2. Topel (1991) two-step first differences (2SFD)
   - Step 1 (within-job first differences), Let $B = \beta_{T1} + \beta_{X1}$:

$$\Delta \log w_{ijt} = B + \sum_{k=2}^{4} \left(\beta_{Tk} \Delta T^k_{ijt} + \beta_{Xk} \Delta X^k_{ijt} \right) + \Delta Z'_{ijt} \boldsymbol{\gamma} + \Delta u_{ijt}$$

   - Step 2 (experience at job start $X^0_{ij} = X_{ijt} - T_{ijt}$):

$$\log w_{ijt} - \hat{B} T_{ijt} - \sum_{k=2}^{4} \left(\hat{\beta}_{Tk} T^k_{ijt} + \hat{\beta}_{Xk} X^k_{ijt} \right) = \beta_{X1} X^0_{ij} + Z'_{ijt} \boldsymbol{\gamma} + e_{ijt} \implies \hat{\beta}_{T1} = \hat{B} - \hat{\beta}_{X1}$$

Full-sample returns

Cumulative return to tenure, Korea

	OLS	FE	IV	Topel
10 years	0.131***	0.075***	0.040***	0.119***
	(0.008)	(0.008)	(0.009)	(0.010)
15 years	0.204***	0.114***	0.065***	0.174***
	(0.010)	(0.011)	(0.012)	(0.011)
20 years	0.286***	0.162***	0.099***	0.235***
	(0.011)	(0.014)	(0.015)	(0.013)

A&S-type IV, 10-year return

Country	Study	Return
Korea	this paper	4.0%
US	Altonji–Shakotko (1987)	6.6%
US	Altonji–Williams (2005)	∼11%
UK	Dustmann–Pereira (2008)	5.4%
Germany	Zwick (2011)	5.6%
Denmark	Buhai et al. (2014)	4%
Portugal	Buhai et al. (2014)	14%
Japan	Nakamura (2024)	5.7%

- Ordering OLS > Topel > FE > IV, as Altonji & Williams (2005) predict
- Korea's return to tenure is moderate compared to other countries

Time-varying returns (1): A&S instruments by period

$$\log w_{ijt} = \sum_p D_{pt}\,\boldsymbol{\beta}'_{Tp}\mathbf{f}(T_{ijt}) + \boldsymbol{\beta}'_{X}\mathbf{f}(X_{ijt}) + Z'_{ijt}\boldsymbol{\gamma} + y_t + e_{ijt}, \qquad D_{pt} = \mathcal{I}\{t \in p\}$$

Instrument for $D_{pt}T_{ijt}$:

(a) $D_{pt}(T_{ijt} - \overline{T}_{ij})$: sum $\neq 0$

(b) $D_{pt}(T_{ijt} - \overline{T}_{ijp})$: no jump

(c) $D_{pt}T_{ijt} - \overline{(D_pT)}_{ij}$: baseline

	Period 1				Period 2				Mean	
	98	99	00	01	02	03	04	05	subtracted	Sum
Worker 1: one spell, tenure 3 in 1998										
T	3	4	5	6	7	8	9	10		
D_2T	0	0	0	0	7	8	9	10		
z^a	0	0	0	0	0.5	1.5	2.5	3.5	52/8	8
z^b	0	0	0	0	−1.5	−0.5	0.5	1.5	34/4	0
z^c	−4.25	−4.25	−4.25	−4.25	2.75	3.75	4.75	5.75	34/8	0
Worker 2: one spell, tenure 20 in 1998										
T	20	21	22	23	24	25	26	27		
z^a	0	0	0	0	0.5	1.5	2.5	3.5	188/8	8
z^b	0	0	0	0	−1.5	−0.5	0.5	1.5	102/4	0
z^c	−12.75	−12.75	−12.75	−12.75	11.25	12.25	13.25	14.25	102/8	0
Worker 3: hired in 2002										
T	–	–	–	–	0	1	2	3		
$z^{a,b,c}$	–	–	–	–	−1.5	−0.5	0.5	1.5	6/4	0
Worker 4: employer change in 2003 (two spells)										
T	3	4	5	6	7	0	1	2		
z^a	0	0	0	0	2	−1	0	1	25/5; 3/3	2; 0
z^b	0	0	0	0	0	−1	0	1	7/1; 3/3	0; 0
z^c	−1.4	−1.4	−1.4	−1.4	5.6	−1	0	1	7/5; 3/3	0; 0

(c) sums to zero in each spell and grows with tenure ⇒ valid, with a strong first stage

Time-varying returns (2): Topel 2SFD by period

Let $B_p \equiv \beta_{T1p} + \beta_{X1}$ and $C_{ijt} \equiv \sum_{m=2}^{4} \beta_{Xm} \Delta X_{ijt}^m + \Delta Z_{ijt}' \gamma + \Delta u_{ijt}$. Within-job first differences give:

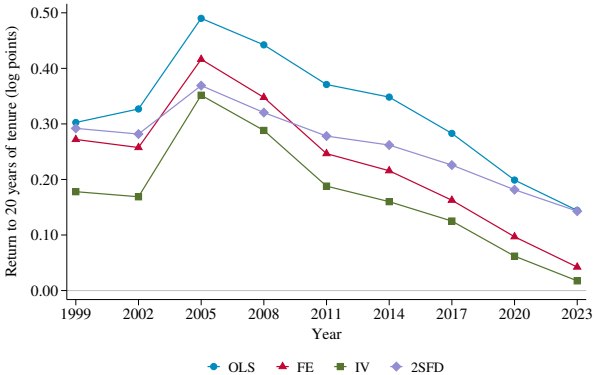
(i) Within p: $\Delta \log w_{ijt} = B_p + \sum_{m=2}^{4} \beta_{Tmp} \Delta T_{ijt}^m + C_{ijt}$

(ii) From $p-1$ to p: $\Delta \log w_{ijt} = B_p + \underbrace{(B_p - B_{p-1})\, T_{ijt-1}}_{\text{repricing}} + \sum_{m=2}^{4} \left(\beta_{Tmp} T_{ijt}^m - \beta_{Tm,p-1} T_{ijt-1}^m \right) + C_{ijt}$

Stacking (i) and (ii) with $V_{ijtp}^m \equiv \mathcal{I}\{t \in p\} T_{ijt}^m - \mathcal{I}\{t-1 \in p\} T_{ijt-1}^m$, $\sum_p V_{ijtp}^1 = 1$:

$$\Delta \log w_{ijt} = \sum_p \left[B_p V_{ijtp}^1 + \sum_{m=2}^{4} \beta_{Tmp} V_{ijtp}^m \right] + C_{ijt}$$

Fact 1: returns to tenure have fallen



20-year cumulative return, 3-year windows

- Peak in 2004–06 (all four)
- Then a fall of 60–95%
- 2022–24: 0.14 (OLS), 0.02 (IV)
- Same trend, different levels

Fact 2: earnings profiles flatten, especially within a job

- Stayers gain tenure and experience together: wage growth reflects both
- We estimate cross-sectional wage profiles over the career by period

All regular workers:

$$\log w_{it} = \sum_p \mathcal{I}\{t \in p\}\, q_p(X_{it}) + Z_{it}'\boldsymbol{\gamma} + y_t + e_{it}$$

First-job stayers ($T = X$) vs. other regular workers:

$$\log w_{it} = \sum_p \mathcal{I}\{t \in p\}\left[L_{it}\, g_p(T_{it}) + (1 - L_{it})\, h_p(X_{it}) + \delta_p L_{it}\right] + Z_{it}'\boldsymbol{\gamma} + y_t + e_{it}$$

10-year growth (log points)	2004–06	2022–24
All regular: $q_p(10)$	0.294^{***}	0.169^{***}
	(0.026)	(0.019)
First-job stayers: $g_p(10)$	0.431^{***}	0.179^{***}
	(0.027)	(0.020)

Panel check (same workers, entry 1998–03 vs. 2010–14): 0.40 → 0.23

▸ Table ▸ Figure

Fact 3: what moved with the seniority decline?

- GDP growth, uncertainty, unemployment: cyclical, no trend
- Union density rose
- Share of workers aged 45+ rose steadily
- Separation rate fell

▸ Figure

Model: overview

- OLG model with labor market frictions
- Monopsony and strategic markdown adjustments shape the seniority wage structure
- The wage scheme resembles the Lazear-type back-loaded structure with different logics
- Aging lowers the seniority premium via productivity and markdown responses

Model: structure

- OLG: workers live two periods (junior, senior); cohort sizes vary
- Dual labor market: regular vs. spot
- Regular firms offer a contract $\{w^Y, w^O, \text{training}\}$ under search frictions
- Human capital grows with firm training and worker effort
- Seniors can be poached or move to a competitive spot sector
- Taste shocks in all job choices $\Rightarrow$ upward-sloping labor supply $\Rightarrow$ monopsony
- The model nests the standard sources of the seniority premium:
  - Firm-specific human capital investment (Becker, 1962)
  - Self-enforcing incentive device (Lazear, 1979)
  - Recruiting and retention (Burdett and Coles, 2003; Stevens, 2004)

Model: wage equation under monopsony

Monopsony wage plus a dynamic wedge (Manning, 2003):

$$w^z = \Big(\underbrace{M^z}_{\text{MPL}} + \underbrace{D^z}_{\text{dynamic wedge}} \Big) \frac{\mathcal{E}^z}{1+\mathcal{E}^z} \qquad \Longleftrightarrow \qquad \mathfrak{m}^z \equiv \frac{M^z - w^z}{w^z} = \frac{1}{\mathcal{E}^z} - \frac{D^z}{w^z}$$

Margin	Wedge D^z	Intuition
Junior	$-\mathcal{X}$ (training − continuation value)	net hiring cost shifted to juniors
Committed senior	$\Xi\, w^O/\mathcal{E}^O$ (recruiting + effort)	attracts juniors; induces effort
Poaching	0	static monopsony

Model: decomposing the seniority premium

$$\text{(a) stayer vs. own junior:} \quad \log \frac{w^O h^{RR}}{w^Y h} = \underbrace{\log(1+\mathcal{H})}_{\text{HC growth}} + \underbrace{\log \frac{M^O}{M^Y}}_{\text{relative MPL}} + \underbrace{\log \frac{1+\mathfrak{m}^Y}{1+\mathfrak{m}^O}}_{\text{markdown}}$$

$$\text{(b) stayer vs. poached senior:} \quad \log \frac{w^O h^{RR}}{w^{RP} h^{RP}} = \underbrace{\log \frac{1+\mathcal{H}}{1+\delta\mathcal{H}}}_{\text{firm-specific HC}} + \underbrace{\log \frac{1+\mathfrak{m}^{RP}}{1+\mathfrak{m}^O}}_{\text{markdown}}$$

- (a) Productivity alone: -0.18; with markdowns: $+0.33$
- (b) Stayer premium 0.29 = firm-specific HC 0.21 + markdown 0.08
- $\mathfrak{m}^O < \mathfrak{m}^Y$: earnings grow faster than productivity (back-loaded)
- Unlike Lazear: losses on juniors, gains on seniors; mainly a recruiting motive

▸ Figure

Model: aging flattens the earnings profile but strengthens back-loading

Aging ($g \downarrow$)	Juniors	Senior stayers
MPL	$\uparrow$	$\downarrow$
Markdown	$\uparrow$	$\downarrow$
Wage	$\downarrow$ (despite MPL $\uparrow$)	$\downarrow$ (less than MPL)

- Aging raises juniors' MPL and lowers seniors' MPL $\Rightarrow$ the wage profile flattens
- Spot wages fall $\Rightarrow$ juniors accept larger markdowns
- Fewer juniors $\Rightarrow$ high senior wages become a more important recruiting lever
- Net effect: a flatter earnings profile, but a more back-loaded wage structure

▸ Figure

Takeaways

- We extend the A&S and Topel estimators to time-varying returns to tenure
- Korea's return to tenure fell substantially
- Firms' strategic use of monopsony power creates a back-loaded wage structure
- Aging flattens life-cycle earning profiles; markdown adjustments partly offset this

Thank you for listening!

Questions and comments are welcome

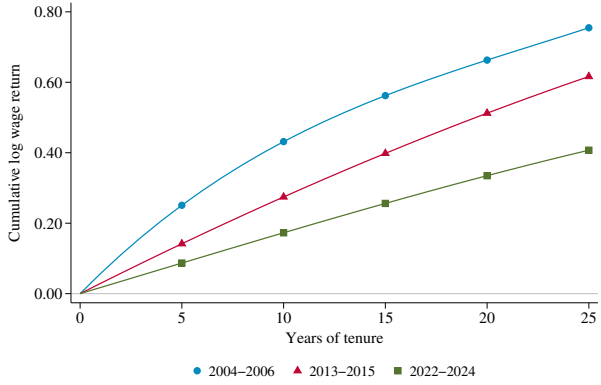
Figure: wage schemes at firms with 100+ workers



Source: Supplementary Survey on Labor Force Survey at Establishments (MOEL)

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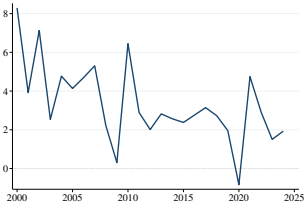
Figure: within-firm wage growth of first-job stayers



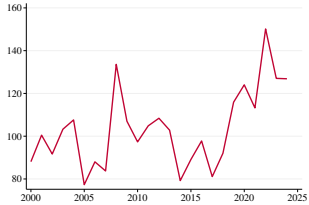
Cumulative log wage growth $g_p(T)$: flatter at every tenure; most of the drop comes early

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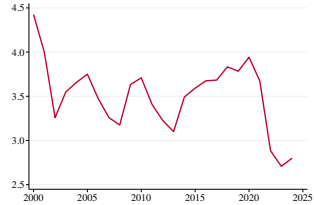
Figure: macroeconomic indicators



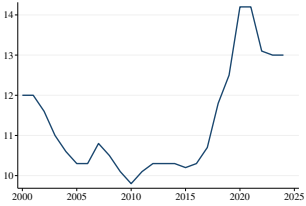
GDP growth (%)



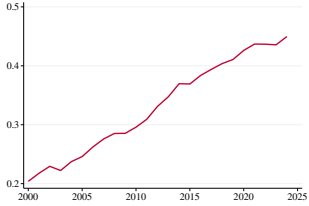
EPU



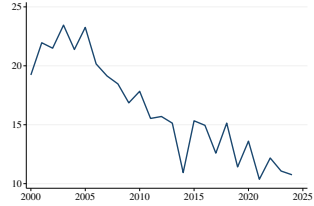
Unemployment rate (%)



Union density (%)



Share aged 45+



Separation rate (%)

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Appendix: cumulative earnings growth by period

	10 years		20 years	
	First-job stayers	All regular	First-job stayers	All regular
1998–2000	0.360***	0.280***	0.514***	0.383***
	(0.026)	(0.025)	(0.028)	(0.023)
2001–2003	0.339***	0.282***	0.527***	0.377***
	(0.028)	(0.025)	(0.028)	(0.023)
2004–2006	0.431***	0.294***	0.663***	0.443***
	(0.027)	(0.026)	(0.027)	(0.023)
2007–2009	0.334***	0.203***	0.577***	0.374***
	(0.029)	(0.028)	(0.027)	(0.023)
2010–2012	0.347***	0.230***	0.559***	0.383***
	(0.027)	(0.027)	(0.026)	(0.023)
2013–2015	0.295***	0.170***	0.520***	0.330***
	(0.030)	(0.028)	(0.027)	(0.024)
2016–2018	0.256***	0.174***	0.453***	0.313***
	(0.021)	(0.020)	(0.020)	(0.017)
2019–2021	0.213***	0.143***	0.379***	0.267***
	(0.020)	(0.019)	(0.018)	(0.017)
2022–2024	0.179***	0.169***	0.337***	0.273***
	(0.020)	(0.019)	(0.018)	(0.016)
Observations	39,875	104,705	39,875	104,705

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Appendix: full-sample estimates

	OLS	FE	IV	2SFD
Tenure	0.0147***	0.0097***	0.0049**	0.0157***
	(0.0023)	(0.0020)	(0.0022)	(0.0027)
Tenure^2/100	−0.0388	−0.0440	−0.0236	−0.0689**
	(0.0326)	(0.0276)	(0.0298)	(0.0350)
Tenure^3/1000	0.0282*	0.0253*	0.0172	0.0370**
	(0.0159)	(0.0134)	(0.0144)	(0.0163)
Tenure^4/10000	−0.0048**	−0.0037*	−0.0026	−0.0062***
	(0.0024)	(0.0020)	(0.0022)	(0.0024)
Observations	106,858	104,453	106,858	75,935
Kleibergen–Paap F	–	–	530.7	–

Appendix: estimates by period

	10 years of tenure				20 years of tenure			
	OLS (1)	FE (2)	IV (3)	2SFD (4)	OLS (5)	FE (6)	IV (7)	2SFD (8)
Cumulative return to tenure, by period								
1998–2000	0.175***	0.138***	0.018	0.141***	0.303***	0.272***	0.178***	0.292***
	(0.019)	(0.026)	(0.034)	(0.032)	(0.023)	(0.046)	(0.055)	(0.053)
2001–2003	0.176***	0.083***	0.027	0.137***	0.327***	0.257***	0.169***	0.282***
	(0.019)	(0.022)	(0.023)	(0.026)	(0.022)	(0.037)	(0.041)	(0.038)
2004–2006	0.274***	0.194***	0.200***	0.211***	0.490***	0.416***	0.352***	0.369***
	(0.019)	(0.019)	(0.023)	(0.023)	(0.021)	(0.032)	(0.034)	(0.031)
2007–2009	0.205***	0.118***	0.119***	0.149***	0.442***	0.348***	0.288***	0.320***
	(0.018)	(0.016)	(0.021)	(0.023)	(0.020)	(0.027)	(0.029)	(0.027)
2010–2012	0.175***	0.063***	0.042**	0.123***	0.371***	0.246***	0.188***	0.278***
	(0.016)	(0.013)	(0.018)	(0.014)	(0.018)	(0.022)	(0.025)	(0.020)
2013–2015	0.151***	0.073***	0.038**	0.119***	0.348***	0.216***	0.160***	0.262***
	(0.016)	(0.014)	(0.018)	(0.016)	(0.018)	(0.020)	(0.021)	(0.017)
2016–2018	0.111***	0.060***	0.033**	0.095***	0.283***	0.163***	0.125***	0.226***
	(0.013)	(0.012)	(0.017)	(0.016)	(0.015)	(0.017)	(0.019)	(0.017)
2019–2021	0.058***	0.023*	-0.003	0.053***	0.199***	0.097***	0.062***	0.182***
	(0.011)	(0.012)	(0.016)	(0.013)	(0.013)	(0.015)	(0.018)	(0.017)
2022–2024	0.033***	-0.011	-0.026*	0.031**	0.144***	0.042***	0.017	0.143***
	(0.011)	(0.013)	(0.016)	(0.013)	(0.013)	(0.015)	(0.017)	(0.016)
Observations	106,858	104,453	106,858	75,939	106,858	104,453	106,858	75,939
Kleibergen–Paap *F*	-	-	139.93	-	-	-	139.93	-

Appendix: calibration

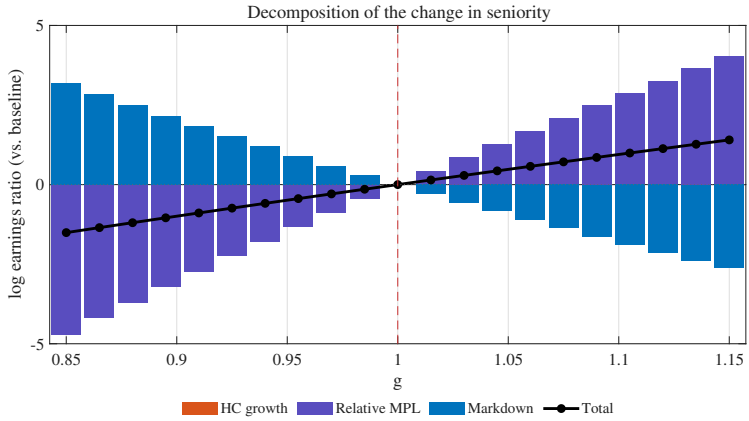
Parameter	Symbol	Value	Target	Data	Model
Initial HC std	σ_h	0.317	Regular share, juniors	0.829	0.839
HC growth scale	Φ_H	1.391	Regular share, seniors	0.741	0.750
HC growth curvature	ρ_H	1.144	Senior/junior ratio, regular	1.301	1.305
HC transferability	δ	0.239	Senior/junior ratio, spot	1.176	1.172
Vacancy cost	κ_v	0.0114	Spot/regular ratio, juniors	0.867	0.862
Taste shock, juniors	σ^Y	0.179	Spot wage-bill share	0.176	0.177
Taste shock, sector	σ^S	0.231	Earnings var., junior regular	0.101	0.101
Taste shock, poaching	σ^R	0.231	Var. gap, senior regular	0.017	0.017
Junior weight	ω^Y	0.604	Var. gap, senior spot	0.008	0.008
Age substitution	ε^Y	3.299	Training cost share	0.010	0.010
Regular-sector weight	ω^R	0.881	Pseudo-elasticity	0.084	0.084

- External calibration: $g = 1$, $\beta = 0.845$, $s^X = 0.07$, $\zeta = 1.5$, $\eta = 0.5$

Appendix: markdowns by margin

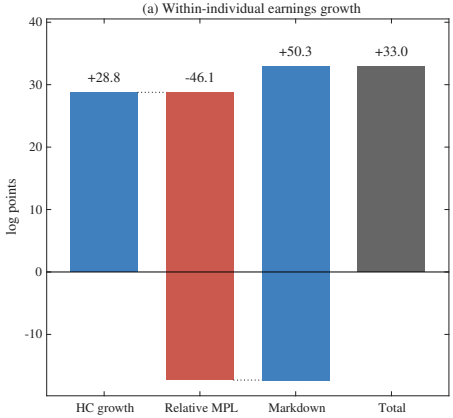
Margin	Markdown	$1/\mathcal{E}$	Training	Continuation	Recruiting	Effort	$\mathcal{E}$
Junior	1.005	1.154	0.022	−0.171			0.87
Senior stayer	0.212	0.913			−0.657	−0.044	1.10
R-poaching	0.315	0.315					3.18
S-poaching	0.369	0.369					2.71

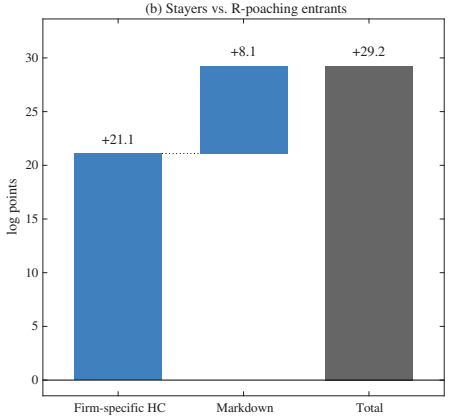
Figure: decomposition of the change in seniority



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Figure: earnings decomposition





(a) senior stayer vs. junior (b) senior stayer vs. poached senior (log points)

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