Wage and Layoffs Risk Across Tenure

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Stylized facts

1. Young workers experience higher job instability: 18.7% unemp for < 25yo vs 6.3% for $25-49$yo [1]
2. Risk when employed: higher layoff rate; higher layoff, but lower wage passthrough (of firm shocks)
3. France employs hiring and wage subsidies to address this:
   "Contrat d'engagement jeunes (CEJ)", "Aides aux employeurs d'apprentis" – 5bil € [2]

To evaluate the impact of these policies, need to understand why labor market experiences differ by age

[1] Source: https://www.insee.fr/en/statistiques/serie/001688536

[2] Source: "Projet annuel de performances. Annexe au projet de loi de finances pour 2024" – Travail et emploi

Introduction

Remember the 2nd stylized fact:

- Young workers have: Higher layoff rate, higher layoff passthrough, lower wage passthrough

BUT most of the heterogeneity is due to differences in tenure Evidence

This paper: A framework of workforce management and wage/layoff trade-off

- Reconcile the wage/layoff risk heterogeneity across tenure
- Consistent with
  - Large scale survey+admin evidence (Bertheau et al. 2024)
    - "Firms that express opportunistic layoffs are less likely to implement wage cuts"
  - Productivity job ladder Bertheau-Vejlin (2023)
  - Wage dynamics across firm productivity and age (WiP)
- Adverse implications of labor policies: hiring subsidies raise layoff risk for juniors (WiP)

Model Ingredients

Theory: layoffs give better control (rather than wage cuts) over which worker leaves

- Heterogeneous match quality
- No quality-dependent wages: can't use wages to rid of unproductive workers
- Decreasing returns to scale: replace unproductive workers instead of scaling up

Wage setting - Dynamic contracting: state- and tenure-contingent wages and layoffs

Mechanism:

- Newly hired workers on average less productive and cheaper to lay off
- In low prod periods, firms fire juniors to reduce payroll and raise worker quality
  - Remaining juniors, now of higher avg quality, take smaller wage cuts than seniors

Related Literature

- **Layoff puzzle:** Why firms fire instead of cutting wages? Bewley (1998), Bertheau et al. (2024)

  Contribution: theory of layoffs based on optimal workforce management

- **Labor cleansing:** Davis and Haltiwanger (1990), Hall (2000), Berger (2018)

  Contribution: apply the theory to wage-firing trade-off

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  Firm dynamics with search frictions: Elsby and Michaels (2013), Schaal (2017), McCrary (2022), Elsby and Gottfries (2022), Bilal, Engbom, Mongey, and Violante (2022)

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- **Technical contribution:** the two literatures combined not solvable in principle

  "A Limited Tenure Approximation" method allows to solve the model tractably

  Wages flat in tenure after X years $\rightarrow$ enough to keep track of tenure at early stages of a career

Wage growth in the data

Model Overview

2 agent types: continuum of risk-averse workers and risk-neutral firms

- Firm dynamics: DRS prod-n technology, entry/exit
- Dynamic contracts with each match, matches of heterog quality

On-the-job, directed search:

- Continuum of submarkets $m \in M$, defined by the value v_m owed to workers
- Matching probability determined by tightness θ_m

Discrete time

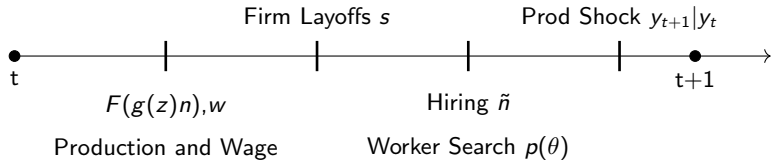

Figure: Within-period time line

Workers

Unemployed workers produce and consume b

Employed workers are paid and consume w

All workers search for a job:

- Workers decide in which submarket $m \in M$ to search, value v_m upon matching
- Unemployed problem:

$$U = \max_m u(b) + \beta[(1 - p(\theta_m))U + p(\theta_m)v_m]$$

- Employed workers are owed

$$v = \max_m u(w) + \beta[sU + (1 - s)[(1 - p(\theta_m))v' + p(\theta_m)v_m]]$$

All but v, v_m chosen by the employing firm

Firms

Free-entry of firms: pay κ_e to **open**, then κ_f to stay open

Incumbent firms employ a measure n of workers to **produce**

- **Stochastic** productivity, y – stochastic shifter
- Matches are of high or low quality, observed only by the firm
- z – proportion of high q matches, common knowledge
- Firm produces $yF(g(z)n) = y(g(z)n)^{\alpha}, g(z) = z + \alpha_z(1-z)$; $\alpha, \alpha_z < 1$

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Lay off proportion s of employed workers and **hire** $\tilde{n}$ new workers of avg quality z_0

- Choose where to post vacancies: trade-off btw cost of hiring $\frac{c}{q(\theta_m)}$ and cost of employment
- **Assumption**: $v_m = u(w_m) + \beta v_0$, v_0 – owed value once incumbent, common to all firms/submarkets $\rightarrow$ firms indifferent across all submarkets, Block Recursive eq-m Block Recursivity

Contracting Framework

Dynamic Contracting: history-contingent wages and layoff risk, subject to ex-ante worker value

Recursive Formulation: $\mathcal{C} \equiv \{w, s, \{v'\}_{y'}\}$; v: promised utility

Trade-off: insurance-provision (stable wages) vs incentive-provision (volatile wages)

DRS: contracts cannot be considered independently

- A Limited Tenure Approximation: differentiate workers by tenure, up to K steps

Wage growth in the data

State space: prod-ty y, measure of workers n_k, promised value v_k, and avg quality z_k $\forall k \in K$

Assumption: can't set quality-dependent wages $\rightarrow$ only layoffs affect quality

contract C_k

Firm Problem with CRS

Choose wages w, layoffs s, future promise $v'_{y'}$ to maximize:

$$J(y,v) = \max_{v'_{y'},w,s} \underbrace{y}_{\text{Production}} - \underbrace{w}_{\text{Payroll}} + \beta E_{y'|y}(1-s)(1-p(v'))J(y',\{v'_{y'}\})$$

Subject to the Promise-keeping:

$$u(w) + \beta[sU + (1-s)[(1-p(v'))v' + p(v')\hat{v}]] = v$$

$p(v') \equiv p(E_{y'|y}v'_{y'})$: probability that the worker leaves when contract promises v' *on average*

$\hat{v} \equiv \hat{v}(v')$: outside option if the worker transitions to another firm

Firm Problem with DRS

Choose wages w, layoffs s, future promise $v'_{y'}$ for each worker i to maximize:

$$J(y,n,P(v_i)) = \max_{v'_{y',i}, w_i, s_i, \tilde{n}} \underbrace{yF(n)}_{\text{DRS Production}} - \underbrace{\int w_i dP(v_i)}_{\text{Payroll}} - \underbrace{\frac{c}{q}\tilde{n}}_{\text{Hiring}} - \kappa_f + \beta E_{y'|y} J(y', n', \{P(v'_{y',i})\})$$

Subject to the Promise-keeping:

$$u(w_i) + \beta[s_i U + (1-s_i)[(1-p(v'_i))v'_i + p(v'_i)\hat{v}]] = v_i \; \forall i \in \mathcal{I}$$

Labor movements in size LoM:

$$n' = n\int (1-p(v'_i))(1-s_i)dP(v_i) + \tilde{n}$$

Infinite-dimensional state-space $P(v_i)$, not solveable!

Firm Problem with DRS, Limited Tenure Approximation

Choose wages w, layoffs s, future promise $v'_{y'}$ at each tenure level to maximize:

$$J(y,\{n_k\},\{v_k\}) = \max_{v'_{y',k},w_k,s_k,\tilde{n}} \underbrace{yF(\sum_k n_k)}_{\text{DRS Production}} - \underbrace{\sum_k w_k n_k}_{\text{Payroll}} - \underbrace{\frac{c}{q}\tilde{n}}_{\text{Hiring}} - \kappa_f + \beta E_{y'|y} J(y',\{n'_k\},\{v'_{y',k}\})$$

Subject to the Promise-keeping at each tenure level:

$$u(w_k) + \beta[s_k U + (1-s_k)[(1-p(v'_{k+1}))v'_{k+1} + p(v'_{k+1})\hat{v}]] = v_k \; \forall k < K$$

Labor movements in size LoM:

$$n'_1 = \tilde{n}; \quad n'_k = n_{k-1}(1-p(v'_k))(1-s_{k-1}) \forall k < K$$

Firm Problem with DRS, Limited Tenure Approximation

Choose wages w, quality-contingent layoffs s, future promise $v'_{y'}$ at each tenure level to maximize:

$$J(y,\{n_k\},\{v_k\},\{z_k\}) = \max_{v'_{y',k},w_k,s_k,\tilde{n}} \underbrace{yF(\sum_k g(z_k)n_k)}_{\text{DRS Production}} - \underbrace{\sum_k w_k n_k}_{\text{Payroll}} - \underbrace{\frac{c}{q}\tilde{n}}_{\text{Hiring}} - \kappa_f + \beta E_{y'|y} J(y',\{n'_k\},\{v'_{y',k}\},\{z'_k\})$$

Subject to the Promise-keeping at each tenure level:

$$u(w_k) + \beta[s_k U + (1-s_k)[(1-p(v'_{k+1}))v'_{k+1} + p(v'_{k+1})\hat{v}]] = v_k \; \forall k < K$$

Labor movements in size and quality LoM:

$$n'_1 = \tilde{n}; \quad n'_k = n_{k-1}(1-p(v'_k))(1-s_{k-1}); \quad \underbrace{z'_k = min(\frac{z_{k-1}}{1-s_{k-1}}, 1)}_{\text{Fire bad matches first}} \forall k < K$$

Layoffs Cause Smaller Wage Cuts

Firings affect both future size and (average) match quality:

$$\underbrace{\frac{\partial E_{y'|y} J(y', n'_k, \{v'_{y',k}\}, \{z'_k\})}{\partial n'_k}(1 - p(v'_k))}_{\text{Quantity Effect}} = \underbrace{\frac{\partial E_{y'|y} J'}{\partial z'_k} \frac{\partial z'_k}{\partial s_{k-1}}}_{\text{Quality Effect}} - \underbrace{\frac{R(v'_k) - U}{u'(w_{k-1})}}_{\text{Compensation for firing risk}}$$

$\rightarrow$ The smaller is prod-ty α_z of bad matches, the more likely the firm is to fire

- $R(v'_k) = (1 - p(v'_k))v'_k + p(v'_k)\hat{v}$ - future value if not fired
- $\frac{\partial z'_k}{\partial s_{k-1}} = \frac{z_{k-1}}{n_{k-1}(1-s_{k-1})^2}$ effect of firings on quality

Asym Info

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Wage growth governed by

$$\underbrace{\frac{1}{u'(w'_k)}}_{\text{Future wage}} - \underbrace{\frac{1}{u'(w_{k-1})}}_{\text{Current wage}} = \underbrace{\eta(v'_k) E_{y'|y} \frac{\partial J'}{\partial n'_k}}_{\text{Future value of marg worker}} = \eta(v'_k) E_{y'|y} \underbrace{[y' g(z'_{k+1}) F'(\sum_k g(z'_k) n'_k) - w'_{k+1} + \beta ...]}_{\text{Envelope theorem}}$$

$\rightarrow$ Whenever firm fires, marginal worker of that tenure becomes more valuable $\rightarrow$ **smaller** wage cuts

Asym Info

Parametrization

No calibration set-up yet. Model solved with $K = 2$ steps, annual freq.

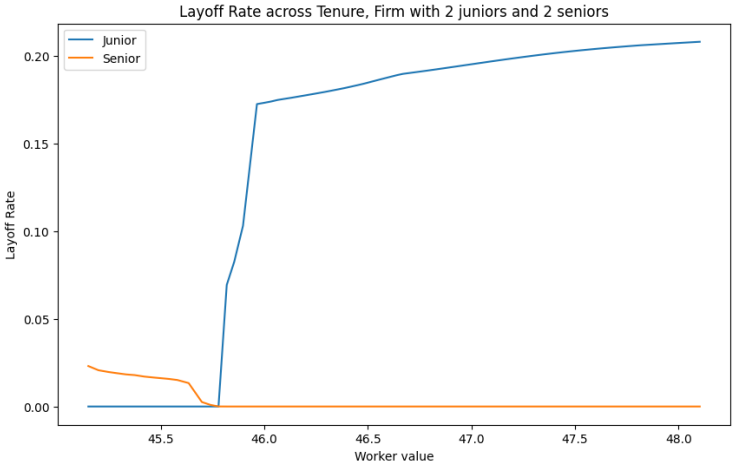
Search parameters taken from Souchier (2023), firm dynamics parameters from Schaal (2018)

- Log utility
- Production function $F(\sum_k z_k n_k) = (\sum_k g(z_k) n_k)^{0.85}$
- Bad matches half as productive as good ones: $g(z_k) = z_k + 0.5(1 - z_k)$
- Half of incoming juniors are of high quality $z_0 = 0.5$
- Junior worker promised value v_0 fixed to value of unemployment

Calibration plans

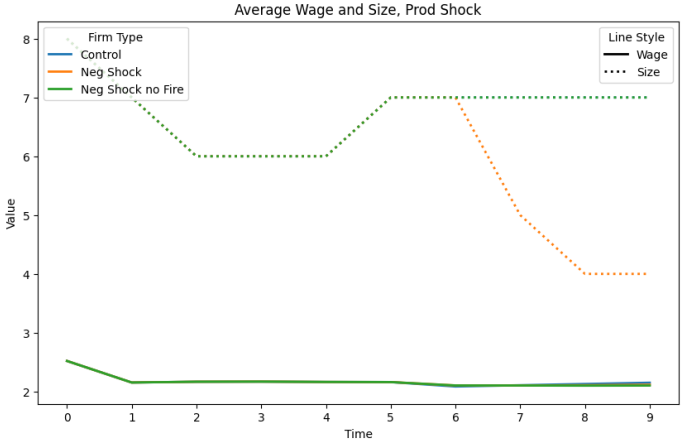
Junior vs Senior Layoffs

Fix firm state, the same quality between juniors and seniors, firms still most likely to fire juniors.



Wage Cuts Smaller If Fire

Simulate a single firm, no J2J transitions, force a negative prod shock.



Negative shock induces wage cuts, but cuts are greater if not allowed to fire.

"Firms that report opportunistic layoffs are less likely to implement wage cuts" (Bertheau et al. 2024)

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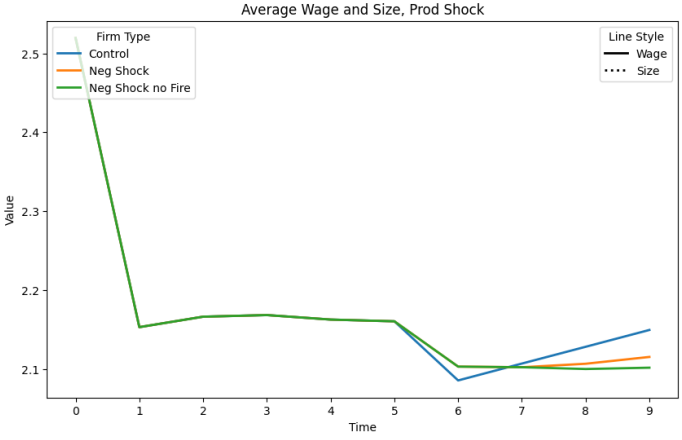

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Empirical Validation: Wage Dynamics Across Productivity and Age (WiP)

Drop the bonus wage assumption, let firms choose the value v_m they will owe to the new workers

Young/productive firms will hire workers for high v_m and heavily backload the wages

Consistent with:

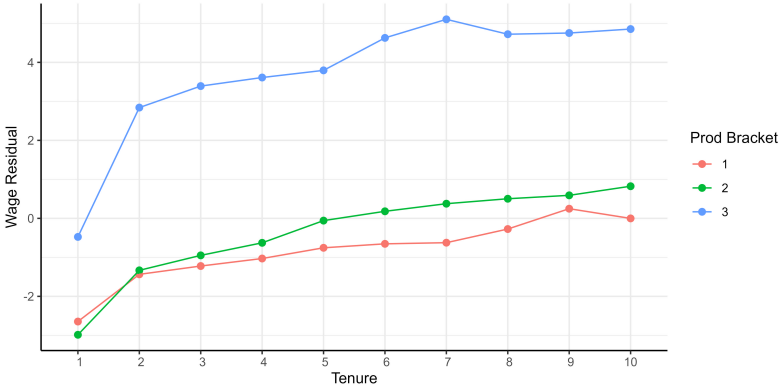
- Productivity (rather than wage or size) job ladder Bertheau-Vejlin (2023)
- Wage dynamics in French admin data:
  - Young firms pay less, but offer higher wage growth, especially when highly productive

Testing the implication in the data

French Matched Employer-employee data DADS, years 2008-2019.

Regress hourly real wages on occupation and year FEs, take the residual

Split firms by age (5 groups) and prod-ty (3 groups), measure avg wages across firm groups and tenure



Fixing young firms, more prod firms exhibit higher base wage and (much) higher wage growth

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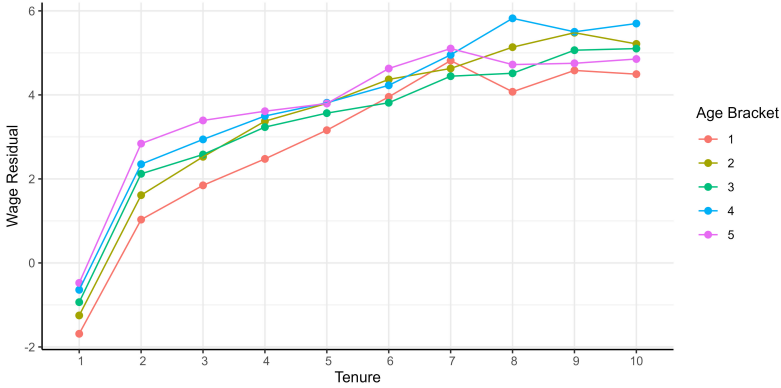

Fixing high prod-ty, young firms exhibit lower base wage but catch up over time

Testing the implication in the data

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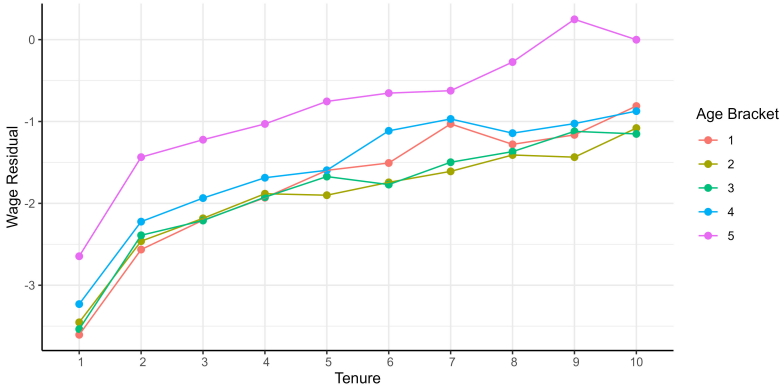
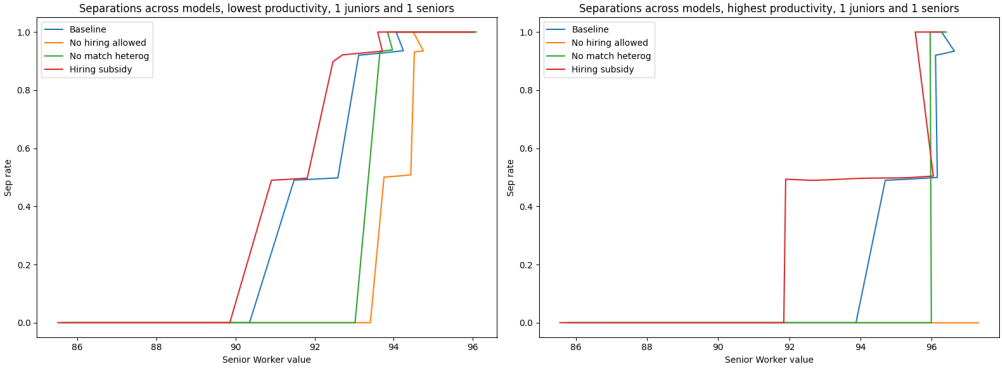


Fixing low productivity, wages in younger firms never catch up

Policy Implication: Effect of Hiring Subsidy



Takeaway: Hiring subsidy **amplifies** layoffs

Conclusion

Puzzle: Why are junior workers more subject to firings than wage cuts?

Answer: Juniors cheaper to fire, surviving juniors are of higher quality, so wage cuts less useful

- Dynamic contracting in multi-worker firms with heterogeneous matches
- Endogenously generates layoffs
- Consistent with productivity job ladder and wage dynamics across firm prod-ty and age

To be done:

- Calibrate the model
- Quantitatively reassess the motivating evidence
- Consider policy implications

Motivating Evidence

Young workers exhibit higher layoff risk, layoff passthrough, but lower wage passthrough.

All the age coefficients wash out after introducing tenure

	Layoff rate				Log Wages	
Regressors	(1)	(2)	(3)	(4)	(1)	(2)
Age	−0.16	−0.04				
Tenure		−0.45				
Firm Shock			−1.12	−1.34	−0.14	−0.35
Firm Shock * Age			0.02	−0.00	0.10	0.04
Firm Shock * Tenure				0.09		0.22

Table: Layoffs and Wages passthrough across age and tenure. Time and experience (except (1),(2)) controls[3]. Worker and job FEs for wage regression. Data: DADS Panel + FARE, 2008-2019 Back

[3]Experience can play a similar role to tenure in disabling the effect of age in (1) and (2), but not in the passthrough regressions

Heterogeneous Match Quality

Consider a simplified, 2 period, contracting model. Assume completely persistent match types.

$$J(\{n_z\}, v) = \max_{\{w_z\},\{w'_z\},\{s_z\},\{\tilde{s}_z\}} F(\{n_z\}) - \sum_z n_z w_z + \beta[F(\{n'_z\}) - \sum_z n'_z w'_z]$$

s.t. LoM:

$$n'_z = n_z(1 - s_z)(1 - p(w'_z))$$

PK:

$$u(w_z) + \beta[\tilde{s}_z U + (1 - \tilde{s}_z)((1 - p(w'_z))u(w'_z) + p(w'_z)u(\hat{w})] = v$$

In addition to this, firm may decide what kind of info to reveal to the worker.

Heterogeneous Match Quality

Assume: Firm is free to reveal information as long as it is not lying

Assume additionally that the firm wants to keep high z and lose low z workers

- Firm can get rid of low z workers either by incentivizing OJS or firing them
- Full information reveal can help with OJS probability $p(w'_z)$
- Firing is cheaper when information is not fully revealed: high z and low z workers share the firing risk
- Firm can utilize both at the same time: pool the low z workers that it wants to fire with high z ones

Implcation: Prevalence of layoffs depends on the likelihood of workers leaving during OJS $\rightarrow$ layoff more common in recessions, wage cuts - in more local shocks Back

Achieving Block Recursivity

Assume all the jobs have the same starting value v_0

- The choice of which submarket to post in does not affect the future value of the worker, just the sign-on bonus:

$$min_{\tilde{v}}\Big[-\int_{v_0}^{\tilde{v}} \frac{1}{u'(w(v))}dv - \frac{c}{q(\theta(\tilde{v}))}\Big]$$

  where $w(v)$ such that $u(w(v)) + \beta v_0 = v$

- **Interpretation:** hires differ in their sign-on bonuses, not in their future wages
- This cost of hiring is independent of the firm's state
- Set $\theta(\tilde{v})$ such that **all** the firms are indifferent across **all** the submarkets

$\rightarrow$ Firms only care about productivity state, and **not** the distribution of labor Back

Full General Equilibrium

Fix the number of tenure steps K in advance.

- Each period, firms may enter the market upon paying a fixed cost c
- Upon entry, they start with a single worker at step 0 and value v_1
- Free-entry condition at the firm-level: firms enter until $J(y_0, \{1, 0, ...\}, \{v_1, ...\}) = c$
- Market tightness $\theta(v)$ is set such that
  1. New firms are indifferent between entering and staying out
  2. Incumbent firms are indifferent between hiring from different submarkets
- Once incumbent, firms treat θ as exogenous and solve the contracting problem. Back

Optimal Wage Growth in a Multi-worker Setting

For every $1 < k < K$, wage growth path nests that of a single-worker firm:

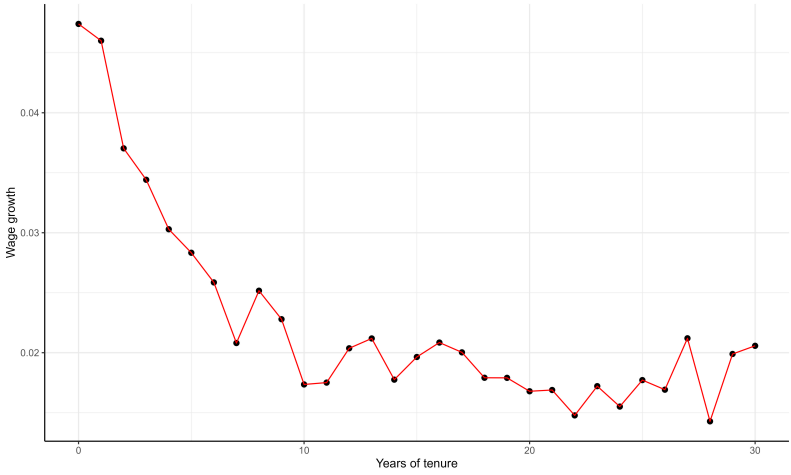
$$\frac{1}{u'(w'_k)} - \frac{1}{u'(w_{k-1})} = \eta(v'_k)\frac{\partial E_{y'|y} J'}{\partial n'_k}$$

The last promise v'_K considers the effect on both upcoming and current long-term incumbents

$$\underbrace{\frac{1}{u'(w'_K)}}_{\text{Costlier tomorrow}} - \underbrace{\frac{\frac{n_{K-1}(1-s_{K-1})}{u'(w_{K-1})} + \frac{n_K(1-s_K)}{u'(w_K)}}{n_{k-1}(1-s_{K-1}) + n_K(1-s_K)}}_{\text{Both tenure levels cheaper today}} = \underbrace{\eta(v'_K)\frac{\partial E_{y'|y} J'}{\partial n'_K}}_{\text{Higher retention probability}}$$

Back

Wage Growth across Tenure



Log (real) wage growth appears to flatten after about 10 years of tenure at the firm.

Back

Precise Parameters

- Search function: hiring cost κ (or match efficiency α[4]), OJS search efficiency s_{job}
- Unemp production: b
- DRS: if curvature fixed[5], κ_f and κ_e[6]
- HMQ: ratio of good workers q_0 and relative prod-ty p_q
- Stoch prod-ty: correlation λ_z and variance σ_z
  - If I introduce agg prod-ty, need also the same for that + maybe correlation btw the two productivities?

A total of 9 parameters + curvature of prod-n function

[4] Have to be careful, these are not isomorphic as in BL, might be better just to take Schaal's f-n, where he normalizies $\alpha = 1$

[5] For curvature, can use employment share of > 500 firms

[6] Following Bilal et al. (2022), the latter may be directly pinpointed given other parameters. Not sure if applicable, but worth looking into

Table of Moments

Moments	Souchier/Schaal	Andrei
Average duration non-employed in months/Rate of new hires	14.3 (0.063)	12.8%
Annual separation rate into non-employment	5.5% (0.071%)	4.3%
Annual job-to-job transition rate	6.6% (0.10%)	6.3%
Tenure profile of wages at 7.5 years	7.1% (0.04%)	33%
s.d. of firm productivity growth	0.30 (0.026)	0.39
s.d. of sector productivity growth	0.057 (0.019)	0.078
Annual persistence of firm productivity	0.81 (0.01)	0.79
Average estab size/Firm size	15.6	17.9/32.5
Ratio of jobs created by opening estab/Opening firms	21%	6%
Proportion of jobs created by $> 10/ > 100/ > 500$ firms	-	0.87/0.59/0.38
National min to mean wage ratio	-	0.44

Table: Targeted moments in Souchier/Schaal vs. Andrei

HMQ Approaches

Approach 1: Passthrough of productivity wrt separations (interpretation 1pp increase in EU raises y by $x\%$)

Completely uncontrolled to include cross-section variation

- Firm productivity: -... something
- Sect productivity: -0.046
- Agg productivity: 0.002

Approach 2: Response of senior/junior wage ratio to separations

Intuition: workers that survived layoffs are on avg higher quality, so should be better paid

Use sd of wages across tenure levels within a firm/job+year to measure

- Within a job
  - Job FEs, so no cross-sectional variation: 1.88
  - No job FEs: -0.85
- Within a firm
  - Job FEs, so no cross-sectional variation: 1.24
  - No job FEs: -1.94

HMQ Approaches

Approach 3: Labor Share

When a firm fires, the total labor share of firm should go down, but the **per worker** share should go up, as the worse workers were fired

- Per worker vs Total labor share response to EU without firm FE: 1.58/-0.37
- Per worker vs Total labor share response to EU with firm FE: 0.04/0.10

Works only without firm FEs! Why?

Alternative: responses to productivity shocks.

- Per worker vs Total labor share response to firm shock: -0.43/0.19
- Per worker vs Total labor share response to agg shock: -0.82/0.81

DOES NOT work when using hiring rate, even lagged

- Per worker vs Total labor share response to hire rate without firm FE: 0.196/-0.002
- Per worker vs Total labor share response to hire rate with firm FE: 0.009/0.016

, but works exactly as expected with firm size: -0.022/0.018 Back