Beyond statutes: Implicit firing costs in an Aging Economy

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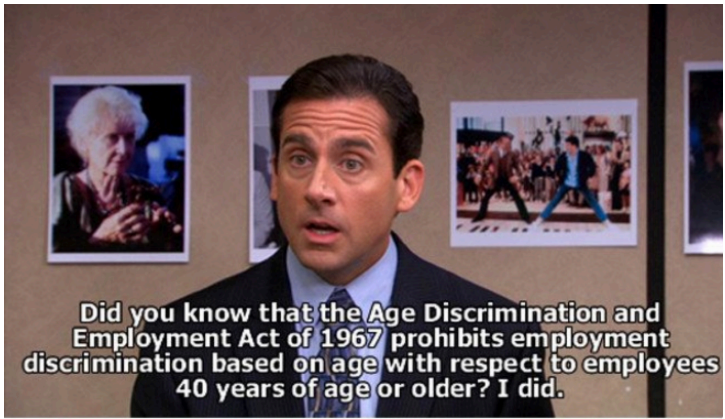
Motivation (1): the workforce is aging

- Workers 40+ are now $\approx$ 46% of US employment—and rising.
- Retirement is later; working lives are longer.



Motivation (2): ADEA is a firing cost

- ADEA (1967): workers 40+, firms with $\geq$ 20 employees; enforced by private lawsuits.
- Economically: a tax on *discharging* a protected worker.
- Crucially: **retirement is not a discharge**—attrition escapes the tax.
- Classic question (Lazear 1990; Hopenhayn–Rogerson 1993): what do firing costs do to allocation and welfare?

*What does an **age-specific** firing cost do to older workers' labor market—*

and how does its aggregate cost change as the population it covers grows old?

What we do

1. **Measure** ADEA enforcement from the universe of federal court cases (state$\times$year).
2. **Document** two facts with a triple-difference (old $\times$ covered $\times$ enforcement): a *firm-size gradient* and an *age gradient* of the separation lock-in.
3. **Model**: Hopenhayn–Rogerson with a firing tax only on protected separations—and attrition.
4. **Quantify**: a unified calibrated GE model generates both facts and prices the statute as the workforce ages.

Preview of results

- Enforcement *retains* older workers in covered firms: strongest in the largest firms, peaking at age 62.
- One model generates both gradients; the implied settlement is ≈ 2 annual wages—realistic.
- At that tax, deterrence is nearly complete: **visible lock-in, cheap lock-in**—settlements are almost never paid.
- But the misallocation cost of the *same statute* rises $\times 23$ per worker as the workforce ages.

Related literature

- *Firing costs, firm dynamics*: Hopenhayn–Rogerson (1993), Bentolila–Bertola (1990), Petit (2021). $\rightarrow$ we add an age-specific tax and an attrition margin.
- *Age-discrimination laws*: Lahey (2008), Neumark–Stock (1999), Adams (2004). $\rightarrow$ we use continuous *enforcement* variation, not law existence.
- *Older-worker mobility*: the hiring paradox; Bianchi et al. (2023) on delayed retirement.

I. Measuring enforcement

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The ADEA enforcement measure

- FJC Integrated Database: every civil case terminated in federal district court:
- nature-of-suit, ADEA statute sections.
- Tens of thousands of cases, 1994–2022, with disposition and judgment codes.

$$fc_{st} = \frac{\#\{\text{settled } or \text{ plaintiff judgment}\}}{\#\{\text{all ADEA resolutions}\}} \qquad \rightarrow \qquad fc_z \text{ (z-scored)}$$

- State$\times$year; 3-year centered window, minimum case count.
- High fc_z: firing a protected worker is expensive (settlements likely).
- Settlement-inclusive: most cases end in settlement, not judgment.

Properties of the measure

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- **Post-1994 only**: earlier statute-section coding (coverage rises 30% $\rightarrow$ 95% over 1987–94).
- Interpretation: enforcement *association* with dense fixed effects;

Why firm size is the coverage margin

- ADEA's federal floor is 20 employees
- State thresholds never change 1994–2021
- But federal litigation exposure *rises with firm size* far beyond 20: deep pockets, visibility.
- $\Rightarrow$ identify from the *continuous* firm-size gradient of exposure.

II. Two facts

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Design: triple-difference

- **QWI** (universe; state×year×age×firm size): separations, hires, churning.
- **SIPP** (monthly panel 2013–23; clean individual firm size)

$$y_{ast} = \beta\, \text{old}_a \times \text{large}_s \times fc_{z,st} + (\text{pairwise}) + \text{FE} + \varepsilon$$

- FE: state×yr, old×state, old×yr, large×state, large×yr, old×large. Cluster by state.
- Absorbs state cycles, secular aging, firm-size trends.
- $\beta < 0$ on separations = **lock-in**: enforcement retains older workers in covered firms.

Fact 1 (QWI): older-worker separations fall with enforcement

- Base triple-difference (older vs. prime): separations -0.31 ($p = .055$); gross worker flows -0.72 ($p = .04$).
- Effect exists *only* at covered/large firms.

- **Churning**—replacement turnover in excess of net growth—falls with enforcement in large firms.
- This is the ***Hopenhayn–Rogerson mechanism***: the tax suppresses *reallocation*.
- **Hiring paradox**: older-worker *hires* also fall ($p = .02$)—an older hire is a future taxed liability.

Fact 1: the firm-size gradient

Firm-size band	Separations	Churning
< 20	-0.12	-0.05
20–49	-0.21	-0.08
50–249	-0.20	-0.07
250–499	-0.44^{**}	-0.13^{***}
500+	-0.44^{**}	-0.11^{**}

Monotone and *convex*: nothing below 250 employees, significant at the top.

Fact 1: all QWI flow results

Outcome	Specification	Estimate
Separations	DDD (old$\times$large$\times fc_z$)	-0.31^{*}
Gross worker flows	DDD	-0.72^{**}
Separations	bands 250–499 / 500+	-0.44^{**} / -0.44^{**}
Churning	bands 250–499 / 500+	-0.13^{***} / -0.11^{**}
Older hires	DiD (old$\times fc_z$)	-0.0025^{**}
Older earnings	DiD	+ (composition)

- Older (55+) vs. prime; employment-weighted; clustered by state; units vary by row (per 1SD enforcement).
- Earnings "+" reflects a more senior retained workforce;

Fact 1: QWI checks and extensions

Check	Design	Result
Uncovered placebo	same DDD, exempt units	$-$, 2.6$\times$ smaller (nss)
Timing	lead / lag 10 yr	$+0.20$ (nss) / $+0.23$ (nss)
Aging amplification	$\times$ old-share (split)	-0.59 ($p = .07$)
Aging amplification	$\times$ old-share (cont.)	-0.10 (nss)

- All flow results robust to the 5-yr post-1994 enforcement measure.

Fact 2 (SIPP): sample

- Monthly panels 2013–2023; private wage/salary workers 25–64; firm-wide size; $N \approx 482{,}000$ person-months.
- Three standard filters: full-month employment, full-time hours, non-imputed firm size.

Fact 2: the lock-in is concentrated near retirement

Old cutoff	E→N	E→U	E→NILF
40+	−0.0006	−0.0004	−0.0003
55+	−0.0011	−0.0008**	−0.0003
62+	**−0.0037*****	−0.0010	**−0.0027****

Coefficient: large $\times$ fc_z $\times$ old (monthly separation prob.).
Age-spline version: pointwise significant at ages 60–63.

- Enforcement retains *near-retirement* workers in covered firms.
- Both margins fall: exits to unemployment *and* exits to retirement.

Robustness (1): placebos

- **Demand orthogonality**: fc_z uncorrelated with state labor-demand shocks (within-$R^2 = 0.007$).
- **Young-worker placebo**: no "lock-in" for unprotected young workers ($+0.05$, $p = .79$).
- **Local shocks**: robust to state unemployment, congestion, firm-size composition $\times$ treatment.

Taking stock: two shapes to explain

1. **Firm-size gradient**: zero at exempt firms, convex, significant at 250+.
2. **Age gradient**: peak at 62+, taper at the very oldest ages.

- A *uniform* firing tax delivers hoarding and less reallocation—but not these two cross-sectional shapes.
- They point to: litigation exposure rising in firm size; oldest-targeted layoffs meeting a rising retirement hazard.

III. Model

Environment (1): demographics and aging

- Discrete time, discount $\beta \in (0, 1)$. Workers are young (Y) or protected/old (O).
- Young age into protection at hazard δ_Y; protected workers retire at hazard δ_O. Constant young inflow B keeps demographics stationary.
- Old share:

$$\phi \equiv \frac{L_O}{L_Y + L_O} = \frac{\delta_Y}{\delta_Y + \delta_O}$$

- **Population aging** $= \phi \uparrow$. Two distinct sources: shorter youth ($\delta_Y \uparrow$), or—the empirically relevant one—*longer working life* ($\delta_O \downarrow$), which raises ϕ *and* slows the retirement attrition below.

Environment (2): firms and technology

- Continuum of firms; idiosyncratic productivity s follows a Markov chain $Q(s' \mid s)$ on a compact set, stochastically increasing (A1).
- DRS technology: $y = s\,n^{\alpha}$, $n = n_Y + n_O$, $\alpha \in (0, 1)$; young and old are perfect substitutes in production.
- Wages w_Y, w_O taken as given, determined in equilibrium; free entry at cost c_e; exogenous exit at rate δ_f, plus endogenous exit.
- Regularity: (A1)–(A4) — compact/Feller/increasing Q; $\beta < 1$; $\alpha \in (0, 1)$; $w_Y \geq w_O > 0$ in equilibrium. Old stocks live on a compact $\mathcal{K} = [0, \bar{k}]$.

The age-specific firing tax

- Young labor is frictionless: hired/released each period at w_Y.
- Old labor is quasi-fixed: let k be the protected stock. Absent action, retirement erodes it to $(1 - \delta_O)k$.

$$\text{firing cost} = \tau \left[(1 - \delta_O)k - k'\right]^+$$

- Reducing k *below* the attrition level is taxed; raising it (hiring old) is free at the wage.
- **Retirement is not a discharge—attrition escapes the tax.**

The firm's problem

Given (s, k), young employment targets the frictionless level $n^*(s) = (\alpha s / w_Y)^{1/(1-\alpha)}$; flow profit is

$$\pi(s, k) = s\big(\max\{n^*(s), k\}\big)^{\alpha} - w_Y[n^*(s) - k]^+ - w_O k.$$

The value function:

$$V(s, k) = \pi(s, k) + \max\Big\{ \underbrace{-\tau(1 - \delta_O)k}_{\text{exit}},\ \max_{k' \geq 0}\big[-\tau[(1 - \delta_O)k - k']^+ + \beta\, \mathbb{E} V(s', k')\big] \Big\}$$

- $k > n^*(s)$: the firm is **overstaffed**—it would employ fewer than k but can't costlessly shed them.

Lemma: the marginal value of an old worker

On the region where the firm operates,

$$V_k(s,k) = \underbrace{(w_Y - w_O)}_{\text{wage saving}} + \underbrace{\beta(1-\delta_O)\,\mathbb{E}\,V_k(s',k')}_{\text{survival-weighted continuation}}$$

- An *asset-value* interpretation: V_k is the discounted flow of wage savings until the worker is fired or retires, net of the tax paid if fired.
- V is continuous, concave in k (on the no-exit region); V_k is **decreasing in** τ—a larger tax lowers the continuation value of the marginal old worker.

Proposition 1: hoarding and a widening inaction band

For each k, thresholds $s_f(k) \leq s_h(k)$:

- **Fire** old ($k' < (1-\delta_O)k$) iff $s < s_f(k)$;
- **Hire** old ($k' > (1-\delta_O)k$) iff $s > s_h(k)$;
- **Inaction** (pure attrition) for $s \in [s_f(k), s_h(k)]$.

The band **widens in the tax**:

$$\partial s_f/\partial\tau < 0, \qquad \partial s_h/\partial\tau > 0$$

both old separations *and* old hires fall with τ.

Proposition 2: attrition slackens the tax

- Firing volume is $[(1-\delta_O)k - k_f(s;\delta_O)]^+$; **both** the mechanical term $(1-\delta_O)k$ *and* k_f fall as δ_O rises.
- As $\delta_O \to 1$: $(1-\delta_O)k \to 0 \leq k_f$, so firing volume $\to 0$—attrition alone delivers all desired downsizing, tax-free.
- **The tax binds on low-δ_O (younger-old, 55–62) workers**; near-retirement (high-δ_O, 62+) workers can be waited out for free.
- Measured separations still fall with τ at *all* ages (Prop. 1), but the **deadweight cost is concentrated on the 55–62 group**—the 62+ lock-in is real but cheap.

Stationary equilibrium

A value V, policies, wages (w_Y, w_O), entry mass M, firm measure μ such that:

1. V solves the Bellman equation with the stated policies;
2. **free entry**: $\int V(s,0)\, dG(s) = c_e$;
3. **labor markets clear**: $\int n_Y \, d\mu \leq L_Y$, $\int k \, d\mu \leq L_O$, complementary slackness pins w_Y, w_O;
4. μ is invariant under the policy, Q, exit, entry;
5. demographics satisfy $\phi = \delta_Y/(\delta_Y + \delta_O)$.

The hiring paradox,

- Because old hiring is deterred (Prop. 1), aggregate old labor demand $\int k \, d\mu$ can fall *short* of supply L_O.
- The residual older workers are **non-employed**—the model's account of the hiring paradox.
- This margin *grows* exactly when the population ages: more L_O chasing deterred old-labor demand.

Proposition 3: aging amplifies the distortion

Let $\mathcal{L}(\tau;\phi) = \ln Y(0;\phi) - \ln Y(\tau;\phi)$ (output loss).

$$\frac{\partial \mathcal{L}}{\partial \phi} > 0, \qquad \frac{d\mathcal{L}}{d(\text{aging})}\Big|_{\delta_O \downarrow} = \underbrace{\frac{\partial \mathcal{L}}{\partial \phi}\Big(-\frac{\partial \phi}{\partial \delta_O}\Big)}_{\text{extensive}>0} + \underbrace{\Big(-\frac{\partial \mathcal{L}}{\partial \delta_O}\Big)_{\phi}}_{\text{intensive}>0} > 0$$

- **Extensive**: a larger ϕ scales up *both* the misallocated-old mass and the non-employment margin.
- **Intensive**: aging via $\delta_O \downarrow$ weakens attrition (Prop. 2), so the tax binds on a *larger* set of workers—the per-worker deadweight itself rises.

Proposition 4: general-equilibrium incidence

A higher τ:

(a) **Lowers the old wage**, $dw_O/d\tau < 0$ (partial capitalization of the firing liability)—but pass-through is *partial*: part of the demand response is quantity, not price.

(b) **Raises measured misallocation**: low-s firms retain old stock, dispersing the marginal product of old labor and lowering TFP (Hsieh–Klenow allocative-efficiency logic).

(c) Both effects **strengthen as ϕ rises**.

(d) If w_O is floor-constrained, incidence shifts from wages to **older non-employment** one-for-one.

Within-firm aging: young hires as future liabilities

- Sharper mechanism: young workers age *inside the firm*—a fraction δ_Y become protected next period.
- Old law of motion: $k' = (1 - \delta_O)k + \delta_Y n_Y -$ (firing) $+$ (hires).
- Young-labor FOC gains a shadow term:

$$s\alpha n^{\alpha-1} = w_Y + \beta\,\delta_Y\,\mathbb{E}[-V_k(s', k')]$$

- Firms **under-hire young too** whenever the marginal old worker is a net liability ($\mathbb{E}\,V_k < 0$, i.e. τ large relative to the wage saving) and δ_Y is non-trivial.
- Predicts stringent protection depresses *youth* hiring in aging economies

IV. Quantification

A unified calibrated model

One Bellman problem embeds all mechanisms:

- State (x, k); timing: retirement $\rightarrow$ keep-or-fire $\rightarrow$ free young hiring $\rightarrow$ aging-in $k' = k_p + \delta_Y(n - k_p)$.
- 21 permanent productivity types $\rightarrow$ the firm-size distribution.
- Free entry pins the wage.
- A cohort layer maps the firing policy into six age cohorts (42–67) with rising $\delta_O(a)$, oldest-first.

Probabilistic settlement: the size mechanism

$$p_{\text{sue}}(n) = 1 - e^{-n/\kappa}, \qquad \kappa = 300 \text{ employees}$$

- Firing a covered firm's protected worker pays τ *with probability* $p_{\text{sue}}(n)$: deep pockets, visibility.
- Expected exposure $\tau\, p_{\text{sue}}(n)$ **rises with firm size**—shocks are identical across firms.
- The size gradient will come from exposure, not from shock heterogeneity.

Calibration

Parameter	Value	Target
$\alpha, \beta, \rho_x, \delta_f$	0.65, 0.96, 0.90, 0.08	standard
σ_x	0.30	firm employment volatility
$\sigma_{\bar{s}}$, scale	0.85, 14	QWI size distribution
$\delta_Y,\ \delta_O$	0.065, 0.075	40+ share $\approx$ 0.46
κ	300 emp.	litigation exposure
τ	**2.13 annual wages**	QWI lock-in (0.53pp)

$\tau \approx$ two years' pay $\approx$ observed ADEA settlement + defense costs.

Implied enforcement exposure by firm size

Firm size	expected cost $\tau\, p_{\text{sue}}$ (annual wages)
$<$ 20 (exempt)	0 (statute)
20–49	0.24
50–249	0.84
250–499	1.52
500+	**2.05**

One statute, very different effective taxes.

The model generates the firm-size gradient

Size band	lock-in (pp per year)
$<$ 20 (exempt)	$+0.00$
20–49	-0.07
50–249	-0.40
250–499	-0.57
500+	$-\mathbf{0.66}$

- Monotone, convex, zero at exempt: the QWI pattern.

…and the age gradient

Cohort	lock-in (pp per year)
42	$+0.01$
47	-0.02
52	-0.61
57	-1.17
62	$\mathbf{-1.32}$
67	-0.80

- Peak at 62, taper at 67: the SIPP shape.
- Why the taper: the very oldest exit by retirement regardless (Prop. 2)—little involuntary separation left to block.

Welfare: the same statute in an aging economy

δ_O	ϕ (old share)	misallocation	aggregate
0.16 (young workforce)	0.158	0.014%	0.002%
0.10	0.231	0.092%	0.021%
0.06 (old workforce)	0.333	**0.319%**	**0.106%**

- Statute fixed; aging = lower retirement hazard.
- $\times$**23 per worker,** $\times$**50 aggregate.**
- Slow retirement makes every hoarding episode *persist*: the intensive channel dominates.

Counterfactual: which demographic force drives the cost?

Scenario	ϕ (40+)	old wage ω	statute cost
1995 baseline	0.456	1.187	1.27%
population slowdown only	0.494	1.145	1.26%
delayed retirement only	0.506	1.137	1.47%
both on (=2020)	0.553	1.089	1.53%

- Exogenous age-specific labor supply; entry growth 1.3% $\rightarrow$ 0.2% (BLS), retirement hazard anchored to the measured 40+ employment-share path; the old wage clears the market.
- **Population slowdown alone:** $\approx$ **zero cost effect**—it shifts composition, but the old wage absorbs it.
- **Delayed retirement alone carries** $+0.20$**pp of the** $+0.26$**pp total.**
- *It is not that there are more old workers; it is that they retire later.*

Conclusion

- ADEA enforcement is an age-specific firing cost: it visibly retains older workers—most in the largest firms, most at 62+.
- One calibrated model generates both facts at a realistic settlement ($\approx$ 2 annual wages).
- Today the regime is cheap: threatened, not paid.
- But **the same law costs an order of magnitude more in an old economy than in a young one**—the statute's cost is a demographic variable.

Thank you.