Codify the firm: Organizational Capital over the Firm Life Cycle

From worker-owned human capital to firm-owned organizational capital

Aria Liu | UCLA Anderson

Firm-specific knowledge along the spectrum of ownership

Worker-owned — workers capture more of the rents

Firm-owned — owners capture more of the rents

	Firm-Specific Human Capital	Key-Talent–Embodied Organizational Capital	Firm-Owned Organizational Capital
Where it sits	Worker-embodied	Worker-embodied	Organization-embedded
Who holds the claim	Worker has mobility and bargaining power	Cash-flow claims shared by talent and owners	Transferable with the firm; owners receive the rents
If the worker leaves	Capability may leave with the worker	Capability may move with the key talent	Capability remains after the worker departs
Canonical model	*Jovanovic (1979); Prescott–Visscher (1980); Becker (1993)*	*Eisfeldt–Papanikolaou (2013)*	*Atkeson–Kehoe (2005)*

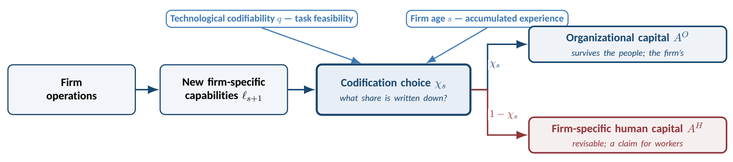
This paper: codification walks a firm rightward as it ages

- **Where a firm sits decides who bears risks and who captures rents.**

Two strands of literature: ownership of firm knowledge

	Worker-owned human capital	Firm-owned organizational capital
Where it resides	Workers, or worker–firm matches	The organization: plants, routines, systems
Who controls access	Depends on retaining key talent	The firm
Who receives the rents	Shared between workers and owners	Firm owners
Key references	Becker (1964) • Jovanovic (1979) • Prescott–Visscher (1980) • Hart–Moore (1994) • Eisfeldt–Papanikolaou (2013)	Atkeson–Kehoe (2005) • Lev–Radhakrishnan (2005) • Corrado–Hulten–Sichel (2009) • Peters–Taylor (2017) • Crouzet–Eberly–Eisfeldt–Papanikolaou (2022)
This paper	One firm, both forms: χ_s splits the same flow of new knowledge, and age walks the firm from the left column to the right one.	

A model of organizational capital and codification choice



ACCUMULATION | codification splits the flow of new knowledge

$$\underbrace{\log A^O_{s+1} = \log A^O_s + \chi_s \ell_{s+1}}_{\text{organizational capital, the firm's}} \qquad \underbrace{\log A^H_{s+1} = \log A^H_s + (1-\chi_s)\ell_{s+1}}_{\text{firm-specific human capital, the workers'}}$$

$$\underbrace{\log A_s = \log \tau + \textstyle\sum_{j<s} \ell_{j+1}}_{\text{total knowledge, free of } \chi} \qquad \underbrace{C_s \equiv \frac{\log A^O_s - \log \tau}{\log A_s - \log \tau} \in [0,1]}_{\chi \text{ accumulated: the codified share}}$$

COSTS AND BENEFITS | documentation, rigidity, continuity, retention

$\Gamma_s = \frac{\gamma}{2q}\chi_s^2 \ell_{s+1}\, d(A_s)$	**cost** the documentation bill, cheaper where q is high
$\mathbb{E}_s\, \ell_{s+1} = \mu_s\big(1 - \lambda C_s\big)$	**cost** written-down knowledge is harder to revise
$L_s = 1 - e^{-\theta(1-C_s)G_s}$	**benefit** less is lost when a key person goes
$\omega_s = \frac{1}{1+i}\,\mathbb{E}\, V_{s+1}\big(A^H_s, 1\big)$	**benefit** a smaller claim to pay that person

THE FIRM'S PROBLEM | one choice variable, χ_s

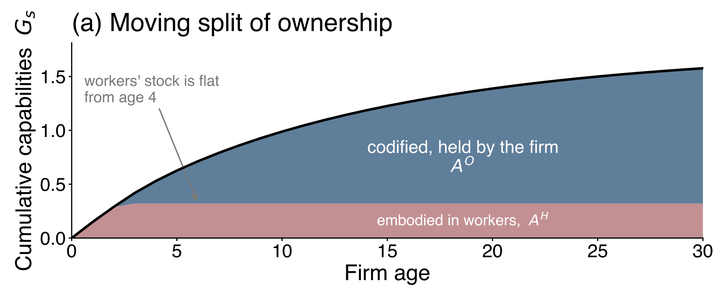
$$V_s\big(A^O_s, A^H_s\big) = \max_{\chi_s \in [0,1]} \underbrace{d(A_s)\big(1 - p_s L_s\big) - w_m - \omega_s - \Gamma_s}_{\text{dividend to owners at age } s} + \tfrac{1}{1+i}\,\mathbb{E}_s\, V_{s+1}\big(A^O_{s+1}, A^H_{s+1}\big)$$

WHO ENDS UP WITH THE RENTS | the split the spectrum above draws

$$\underbrace{\pi = \textstyle\sum_s \big[\, d(A_s)(1 - p_s L_s) - w_m - \omega_s \big]}_{\text{owners}} \qquad \underbrace{\Omega = \textstyle\sum_s \omega_s}_{\text{key people}}$$

ℓ_{s+1} knowledge created by operating • $G_s = \sum_{j<s} \ell_{j+1}$ cumulative learning • μ_s its mean, declining with age • q codifiability of the work, a fixed type • p_s hazard the key person is forced out • θ share of A^H lost with them • λ rigidity • γ cost scale • $d(A)$ variable profits • w_m manager's wage • π entry blueprint • i discount rate

- **One choice, χ_s, determines where the firm's knowledge lives.**
- Benefits scale with what is accumulated; costs, with what is left to learn.
- **So χ^*_s rises with age,** and with q, which enters only the cost.
- Free entry zeroes the discounted sum; the profile of χ splits π from Ω.



- Young firms store more firm-specific knowledge in people; mature firms, in the firm.
- **As every firm approaches full codification, differences in q matter less.**

The benefits and costs of codification

	What the firm loses when a key person goes	How strong that person's claim on the rents is
	$\theta(1 - C_s)G_s$	$\omega_s = (1+i)^{-1}\mathbb{E}V(A^H_s)$
CODIFIED firm-retained org. capital, A^O	**small**	**weak**
TACIT firm-specific human capital, A^H	**large**	**strong**

Margin	Benefit of codification	Cost of codification
Retention	Knowledge remains with the firm after key-worker departure	Eliciting, documenting and maintaining knowledge is costly
Scalability	Capabilities can be replicated across workers, units and managerial layers	Standardization reduces discretion and local adaptation
Appropriability	More firm-specific rents accrue to owners; less worker hold-up	Workers may have weaker incentives to create or reveal knowledge
Dynamic response	Greater continuity and consistency of execution	Codified routines can become rigid or technologically obsolete

Measure codification: codification feasibility and status

q TECHNOLOGICAL CODIFIABILITY
COULD work of this kind be written down?
A property of **the bundle of tasks**, from the firm's occupational composition.

C CODIFICATION LEVEL
HAS this firm actually written it down?
A choice of **the firm**, from job positions, postings and 10-K text.

- **q is the constraint the firm faces; C is χ accumulated, what it did about it.**
- Occupation shares from résumé-based worker profiles, scores from O*NET.
- **LLM rates one task statement at a time,** 0–3, 19,264 of them.

PAYROLL AND TIMEKEEPING CLERKS — occupation score 0.95
"Verify attendance, hours worked, and pay adjustments, and post information onto designated records."
model's reason: "rule-based verification and posting against payroll systems; fully proceduralizable and machine-checkable."

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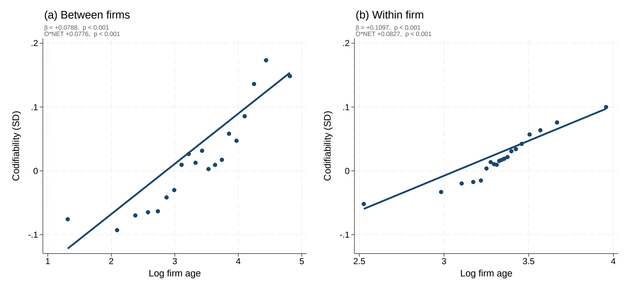
CHIEF EXECUTIVES — occupation score 0.20
"Appoint department heads or managers and assign or delegate responsibilities to them."
model's reason: "requires judgment on internal talent, trust, and authority; not a defined, verifiable, delegable process."

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Route 2 | O*NET's scales, 28 selected items
WA Work Activities | WC Work Context | AB Abilities | WS Work Styles

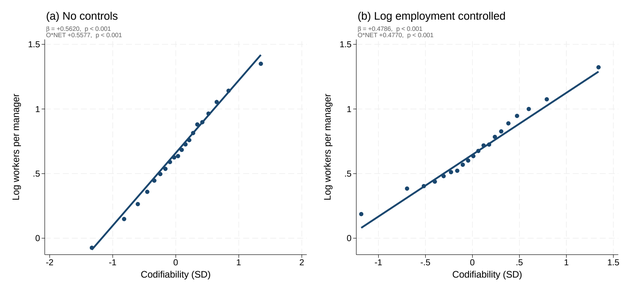
	Codified	Tacit
Records and systems	Documenting / Recording InformationWA • Interacting With ComputersWA	Interpreting Information for OthersWA
Standards and exactness	Evaluating Compliance with StandardsWA • Being Exact or AccurateWC • Attention to DetailWS • DependabilityWS • IntegrityWS	Adaptability / FlexibilityWS
Repetition and automation	Repeating the Same TasksWC • Degree of AutomationWC • Controlling Machines and ProcessesWA	InnovationWS
Perception vs. invention	Perceptual SpeedAB • Spatial OrientationAB • Estimating Quantifiable CharacteristicsWA	OriginalityAB • Thinking CreativelyWA • Problem SensitivityAB • Deductive ReasoningAB • Inductive ReasoningAB • Analytical ThinkingWS
Discretion and direction	—	Making Decisions and Solving ProblemsWA • Developing Objectives and StrategiesWA • Guiding and Motivating SubordinatesWA • IndependenceWS • Freedom to Make DecisionsWC, rev • Determine Tasks, Priorities and GoalsWC, rev

Fact 1: Codification and firm age



- Codification increases with firm age

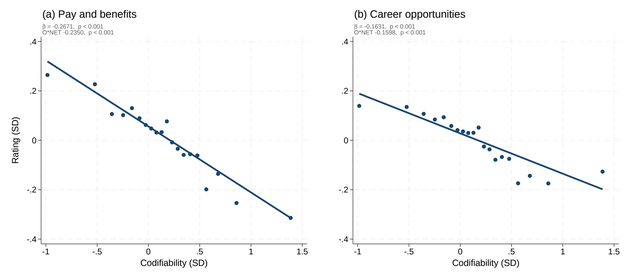
Fact 2: Codification and managerial span



- More codified firms have larger managerial spans

Managerial span = number of workers per manager. Data: Revelio job positions.

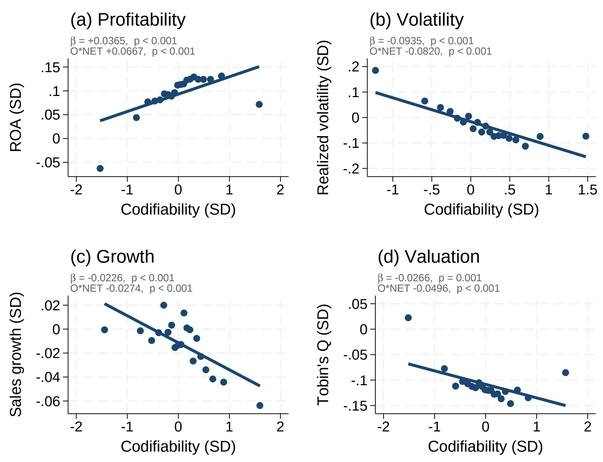
Fact 3: Codification and worker rents



- More codified firms invest less in workers, in pay and beyond pay

Data: Revelio Labs.

Fact 4: Codification and firm performance

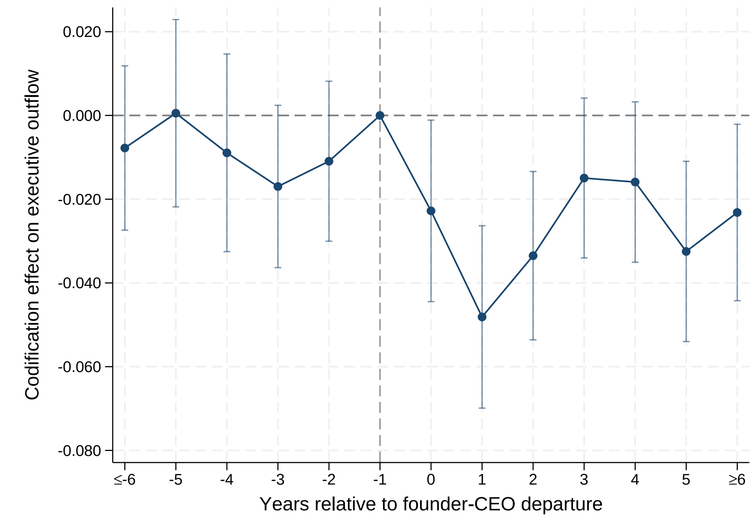


Data: CRSP and Compustat.

Event study: organizational disruption after founder departure

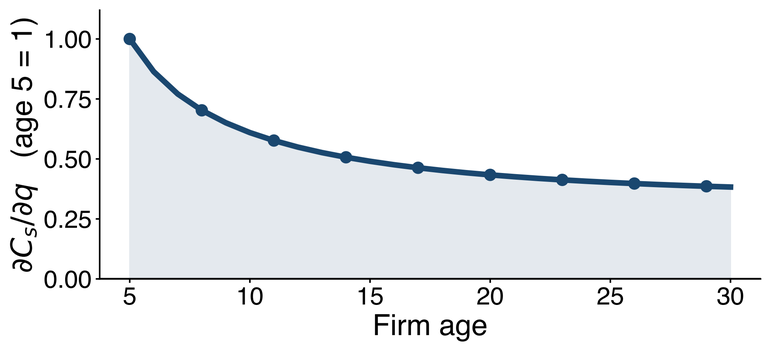
$$\text{Key talent outflow}_{it} = \alpha_i + \delta_t + \sum_{k \neq -1} \big(\beta_k + \gamma_k Z_i\big) D^k_{it} + \phi' X_{it} + \varepsilon_{it}$$

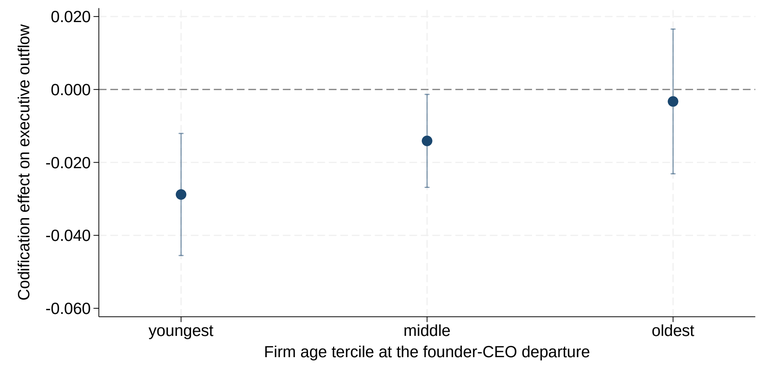
- D^k_{it}: years to the founder-CEO departure, $k = -6$ to $+6$, ends binned, -1 out.
- Z_i: codifiability, z-scored within year, frozen the year before the departure.
- **The figure plots γ_k:** how the outflow path tilts with codifiability.
- X_{it}: controls, the key talent inflow rate.
- Firm and year fixed effects; standard errors clustered by firm.



- Flat pre-period, negative in the departure year, -0.048 the year after.
- Pooling the post-period, per SD of codifiability:
- **1.9 percentage points less key talent outflow after a founder-CEO leaves.**

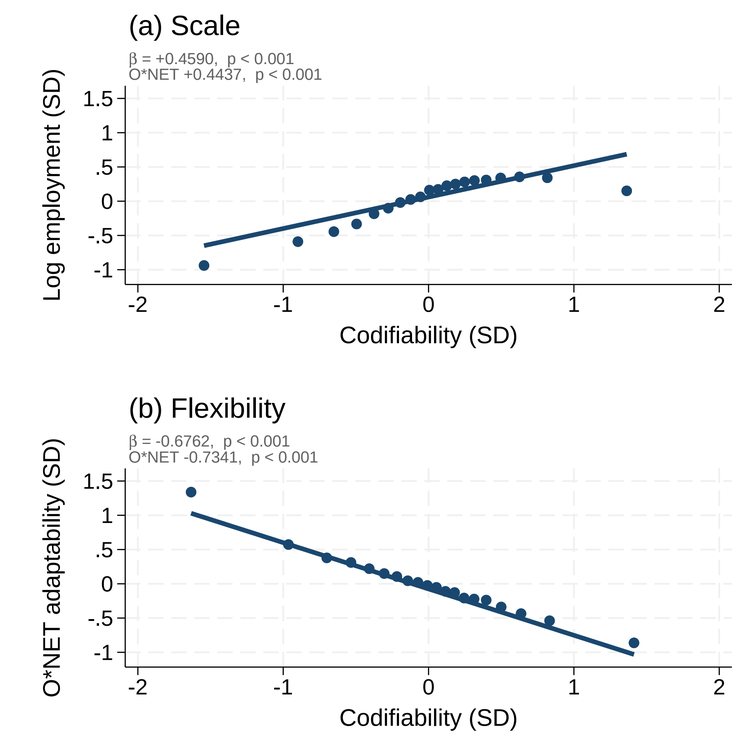
Codifiability sorting decreases with firm age





- **Codifiability sorts young firms more than old firms.**

The trade-off: scale vs. adaptability



- More codifiable firms are larger and less adaptable.

NAICS3 × year fixed effects.

Aria Liu, UCLA Anderson | aria.liu.phd@anderson.ucla.edu