

IDEAS AND FIRM DYNAMICS WHEN IT TAKES TWO TO TANGO

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discussion by

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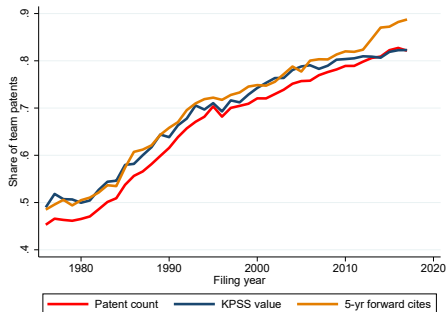
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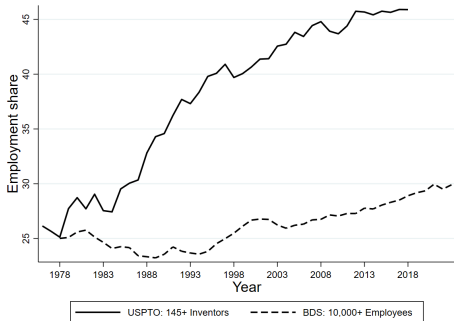
First take

- ▶ An insightful paper!
- ▶ Patenting in teams surged: what is behind it?
 - ▶ Teams as higher RTS technology
 - ▶ RTS advantage increased over time (knowledge specialization)
 - ▶ Increased inventor misallocation due to reduced spillovers
- ▶ Many aspects to like:
 - ▶ Elegant theory, clear analytical representation of wedges
 - ▶ New empirical regularities; straightforward mapping to calibration
 - ▶ Valuable insight on the driver and consequences of inventor concentration
- ▶ Discussion of (i) team formation & γ , (ii) spillovers & policy, (iii) connection with literature

Motivating Facts



A) Team share of patents



B) Concentration

+Fact 2. 88% of co-inventor pairs employed by the same firm within ± 5 years $\Rightarrow$ teams form *within* firms.
(Revelio)

Framework

- ▶ A static model of inventor allocation and team formation
- ▶ Firm f with productivity ε_f receiving spillovers ζ chooses n_f inventors and production mode:

$$y_f = \zeta \varepsilon_f (\tilde{z}_f n_f)^\alpha, \quad \alpha < 1 \quad (\text{span of control})$$

- ▶ **Solo mode:** $\tilde{z}_f = z$ (constant)
- ▶ **Team mode:** pairwise match productivity $z_{ij} \sim \text{Pareto}(x, 1/\gamma)$ with $x < z$
- ▶ Max of n Pareto draws $\Rightarrow \tilde{z}_f = \mathbb{E}[\tilde{z}_i] = x \Gamma(1 - \gamma) n_f^\gamma$
- ▶ Mode decision: $y^{solo} = \zeta \varepsilon_f (z n_f)^\alpha$ vs. $y^{team} = \zeta \varepsilon_f [x \Gamma(1 - \gamma) n_f^\gamma n_f]^\alpha$
 - ▶ $\alpha(1 + \gamma) > \alpha$ vs. $x < z$ (lessens DRS but lower min productivity)
 - ▶ Cutoff rule: team if $\varepsilon_f > \tilde{\varepsilon}^{team}$
- ▶ Symmetric spillovers $\zeta = \left(\int_{f \in F} \varepsilon_f n_f^\beta df \right)^\theta, \quad \beta < \alpha$
 - ▶ Given concavity $\beta < 1$, concentration endogenously reduces spillovers

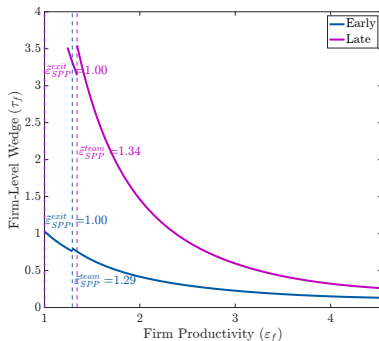
Analysis and Results

- ▶ Analytical representation of inventor MP wedges (decr. in ε_f, n_f)
- ▶ Idea generation & spillovers functions mapped to data to back out parameters
- ▶ Calibration to two periods—pre- and post-2000—varying x, z, γ, β

Decomposing the Role of Idea Production Function Changes: γ only

	Early	Late	γ only	Change
Inventor wage w	0.724	0.878	0.877	21.0
Prod. cutoff (exit)	1.004	1.241	1.327	32.1
Prod. cutoff (team)	1.580	1.740	1.455	-8.0
Share of solo-based firms	93.7	87.2	42.8	-50.9
Share of team patents	57.8	90.4	97.8	40.1
Emp concentration	32.8	78.9	80.4	47.6
Average firm size	7.1	27.1	41.0	477.7
Spillovers ζ	0.903	0.827	0.827	-8.4
Output (normalized)	1.000	1.213	1.210	21.0

Rise in γ drives most changes.



Larger wedges for small firms.

Team Formation: Data

1. Testable prediction: Team-based firms are more innovative. Do the data conform?
 - Why not calibrate x_E based on regression coefficients?
2. In data, firms mix solo and team work. Show estimates with continuous team measure?

Returns to Scale in Team Production

	(1) All	(2) Public Firms
$\log n_{ft}$	0.757*** (0.002)	0.818*** (0.004)
$\log n_{ft} \times \mathbf{1}(\text{team}_{ft})$	0.039*** (0.004)	0.0875*** (0.006)
$\log n_{ft} \times \mathbf{1}(\text{team}_{ft}) \times \text{Post}_t$	0.031*** (0.004)	0.011* (0.006)
$\mathbf{1}(\text{team}_{ft})$	-0.677*** (0.004)	-0.732*** (0.008)
Post_t	-0.019*** (0.003)	-0.058*** (0.009)
$\log n_{ft} \times \text{Post}_t$	0.003 (0.002)	0.019*** (0.004)
$\mathbf{1}(\text{team}_{ft}) \times \text{Post}_t$	-0.049*** (0.005)	-0.015 (0.011)

Estimated level effect of team production (pre-2000):

$$\log y^{\text{team}} - \log y^{\text{solo}} = -0.677 + 0.039 \log n$$

$$> 0 \iff n > e^{17.4} \approx 3 \times 10^7$$

⇒ Team firms do not outperform solo firms.

Team Formation: Alternative Theory

- ▶ In data, median team share 0.88 vs. binary choice in model
- ▶ Assume team decision is per inventor: $\tilde{z}_i = \max\{z, Z_i\}$ with $Z_i = \max_{j \neq i} z_{ij}$

$$\Pr(\text{team} \mid n_f) = 1 - (1 - p)^{n_f - 1}, \quad p \equiv (x/z)^{1/\gamma}$$

- ▶ Team share rises smoothly in n_f ; single-inventor firms solo by construction
- ▶ $\mathbb{E}[\tilde{z}_i] \rightarrow z$ for small n_f vs. $\mathbb{E}[\tilde{z}_i] \rightarrow x\Gamma(1 - \gamma)n_f^\gamma$ for large n_f
- ▶ **Size-dependent RTS** without $\tilde{\varepsilon}^{team}$ cutoff
- ▶ Trade-off: smooth team share vs. analytical representation of wedges

γ : Further Analysis

γ is the sole quantitative determinant of key shifts; deserves deeper discussion.

1. Timing: more than half of the rise in team patent share occurs pre-2000.
 - ▶ Consider alternative periodizations?
2. Firm size and L concentration overshoot notably, driven by the rise in γ .
 - ▶ Why not use the level implied by internal calibration (Appendix B.5.1)?
3. Robustness against alternative channels (vs. time-invariant κ, c, η)
 - ▶ Higher entry cost via κ (Gutierrez et al. 2021)
 - ▶ Higher fixed cost via c (De Ridder 2024)
 - ▶ Flatter tail of ex-ante types via η (Sterk et al. 2021; as in Appendix)

Spillovers: Theory, Measurement, Misallocation

- ▶ Misallocation and policy results depend crucially on β : $\tau_f^{team} \propto n_f^{\beta-\alpha(1+\gamma)}$
- ▶ Team spillover (n_f^β) < $\sum$ solo spillovers (n)
 - ▶ Compelling if higher knowledge specialization increased team value?
 - ▶ Issue: spillover is concave fnc. of # inventors; not patent output or quality.
- ▶ Spillovers can depend on team status.
 - ▶ Empirical test: Can you interact firm size with team-status in spillover fnc. estimation?
 - ▶ The magnitude of the decline can also differ (Choi et al. 2025).
- ▶ Dynamic effects (e.g., on entrants) could amplify the costs.

Policy Implication

- ▶ Policy implication is to support small firms.
- ▶ Discussion of key parameters
 - ▶ Magnitude / type of spillovers (β) matter.
 - ▶ Fixed inventor supply: elastic supply could damp wages and exit cutoff.
- ▶ Contrast with relevant work
 - ▶ Young vs. small dichotomy (Haltiwanger et al. 2013)
 - ▶ Selection vs. spillovers and exit margin (Acemoglu et al. 2018)

Connections to the Literature

1. Technological change causing concentration (Aghion et al. 2023; De Ridder 2024); span of control
2. Lower exogenous diffusion (Akcigit and Ates, 2023); also through concentration
3. Higher inventor concentration and wages (Akcigit and Goldschlag, 2023); but with higher innovative output
4. Consistent with rise of combinatorial patents (Choi et al. 2025); but with reduced spillovers

Connections to the Literature

5. Ideas harder to find, but only via reduced spillovers (Bloom et al. 2020). Caution:
 - ▶ Aggregate / firm-level research efficiency flat or higher in late period
 - ▶ Fixed inventors, higher output; R&D spending & output increase the same; firm-level inventor output better (for $n > 9$)

6. Can you think about responsiveness (Decker et al. 2020)?
 - ▶ Not an exact mapping since no dynamics; one time shock
 - ▶ Still, can define responsiveness as $\partial \log n / \partial \log \varepsilon$
 - ▶ = RTS: flat for solo and higher for team

Conclusion

- ▶ Very interesting read!
- ▶ A rich blend of novel facts, elegant theory, informative quantitative findings
- ▶ Additional empirical and quantitative work on key aspects to enrich
- ▶ Looking forward to the extended analysis!

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