Digital (Killer?) Acquisitions

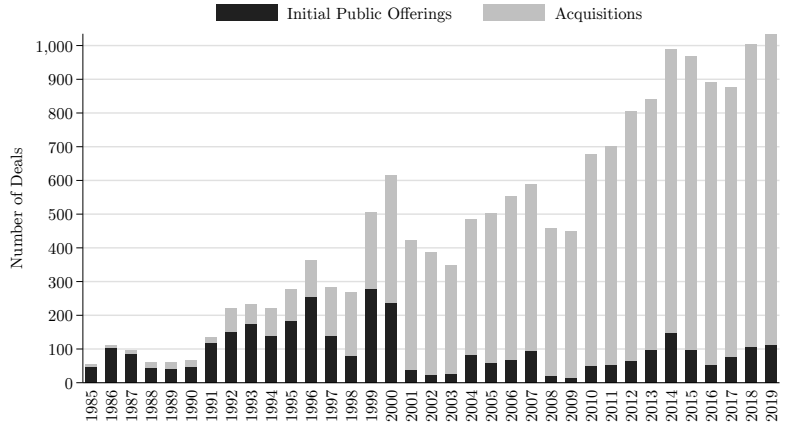
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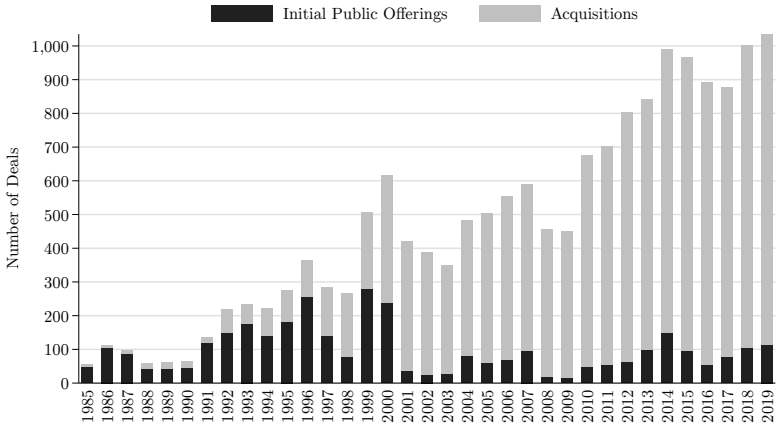


Acquisitions have become the dominant exit strategy for startups



Number of VC-backed startups that exited via an initial public offering (black) or an acquisition (gray) by year.
Source: National Venture Capital Association and Ederer and Pellegrino (2023)

Acquisitions have become the dominant exit strategy for startups





- Over this time frame, GAFAM + CIQ completed more than **1,200 acquisitions**.

Motivation

- Growing concerns about "killer acquisitions" in tech including GAFAM (Google, Amazon, Facebook, Apple, Microsoft) and others (Cisco, Intel, Qualcomm)
- Innovation theories (and evidence) of harm have become more common (Federico et al., 2017, 2018; Motta and Tarantino, 2021; Valletti, 2025)
- Regulatory scrutiny: DOJ, FTC, EC, CMA, 2023 Merger Guidelines; DMA requires notification
- **Key question: Do acquisitions by large tech firms hinder or enhance innovation?**

Contributions

1. Provide a comprehensive empirical mapping of the acquisition behavior of eight major technology firms (GAFAM plus Cisco, Intel, and Qualcomm)
   - We manually compile a dataset of over 1,200 acquisitions and link to patent data from PatentsView and labor market data from Revelio Labs.
2. CPC group-level analysis of innovation before/after acquisitions
   - Panel dataset at the technology-class-year level that allows us to analyze innovation trends surrounding each deal
3. Patent-level evidence (citations) of innovation spillovers
   - Panel dataset at the patent-year level combined with workforce data that allows us to track innovation spillovers before and after big tech acquisitions.

Roadmap & Preview

1. Data & Descriptive Analysis
   - Most targets do not have patents, but if they do, they are more valuable
   - Many repeat acquisitions in the same CPC group
   - More acquisitions $\leftrightarrow$ more patent consolidation
   - Sharp drop in target employee retention after acquisitions

2. Panel Data Analysis at CPC Level
   - Innovation frequently precedes acquisition: undermines killer acquisition narrative.
   - Evidence consistent with incumbents acquiring startups to access promising technologies

3. Panel Data Analysis at Patent Level
   - Patent citations increase post-acquisition
   - Increases are more pronounced when there are follow-on acquisitions
   - Increases are more pronounced when target employee retention is low

Takeaway: Acquisitions often amplify diffusion of acquired technologies, especially in domains with follow-on deals or where acquired employee turnover is high.

Data Sources

- **Acquisitions**: Amazon, Apple, Cisco, Facebook, Google, Intel, Microsoft, Qualcomm
  $\Rightarrow$ Focus of the innovation and antitrust policy debate!
- **Patents**: USPTO with CPC classification; focus on sections G and H
- **Workforce**: Revelio Labs resume histories for pre- and post-acquisition retention

Unit of analysis

- CPC class by year for technology-level event studies
- Patent by year for citation dynamics and heterogeneity

Details on Acquisition Data | Details on Workforce Data

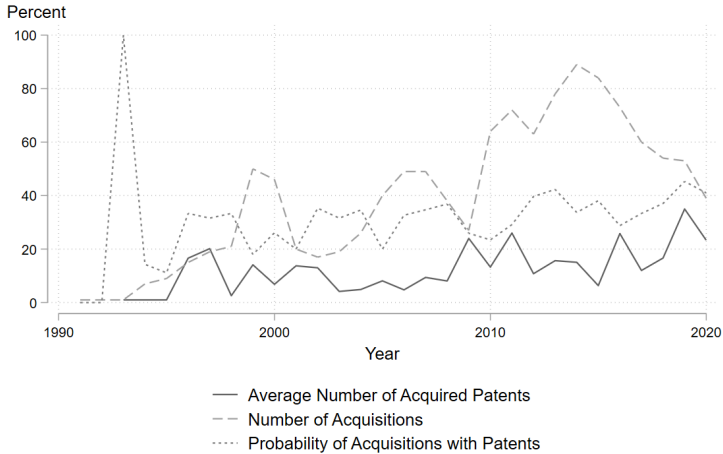
A Few Caveats

- Patents $\neq$ Innovation
  - Unpatentable innovations
  - "Looking under the lamp post" critique
  - Most acquired firms never patent
- Cooperative Patent Classification Codes $\neq$ Markets
  - Primary purpose: prior art searching
  - Combine "related" (substitute and complementary) tech
  - Cognizable partition with ≥ 1 CPC per patent
- Correlation $\neq$ Causation
  - Many descriptive facts
  - Will flag cases where causal interpretation invited
  - Utility of "average effects" for merger review?

Descriptive Analysis

Acquisition Landscape and Targets

- 8 acquirers completed more than **1,200 acquisitions** in 1987-2020.
- Google (260), Microsoft (236), and Cisco (222) are the most active acquirers, followed by Apple (126) and Amazon (103).
- Acquisitions are highly clustered in the late 1990s and again in the 2010s.

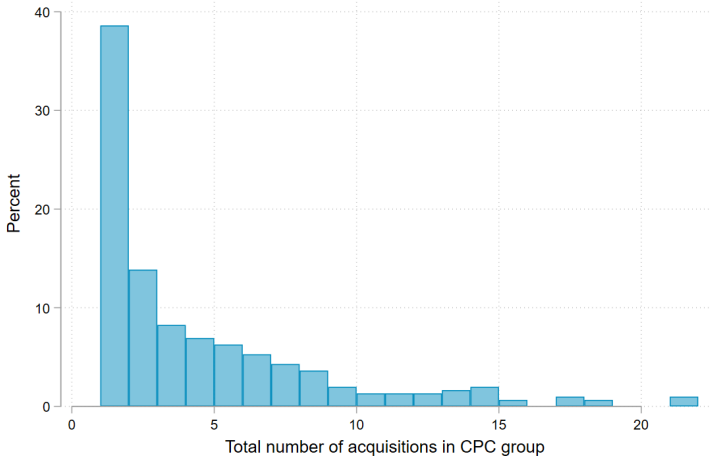


Targets and Patents

- Share of targets with at least one patent differs across acquirers.
  - Qualcomm (70%) and Intel (57%) acquire firms with patents most frequently.
  - Amazon (23%) and Facebook (17%) least frequently acquire patent targets.
- Conditional on patenting, portfolio sizes vary: Intel's acquired targets average 21 patents, Qualcomm 20, while Facebook's average is fewer than 4.
- Transactions with patented targets involve substantially higher median deal values.
  - Google: **$61M** (no patents) vs. **$500M** (with patents).
  - Cisco: **$126M** vs. **$282M**.
  - Apple: **$30M** vs. **$239M**.
- Overall, medians rise from **$100M** (no patents) to **$259M** (with patents).

Acquired Patent CPC Codes

- Our analysis focuses on CPC groups in classes G and H which are most relevant to digital innovation.
- 303 (out of ∼1200) CPC codes treated at least once
  - **38%** single acquisition event
  - **62%** multiple events



Heterogeneity Dimension #1: Repeat Acquisitions

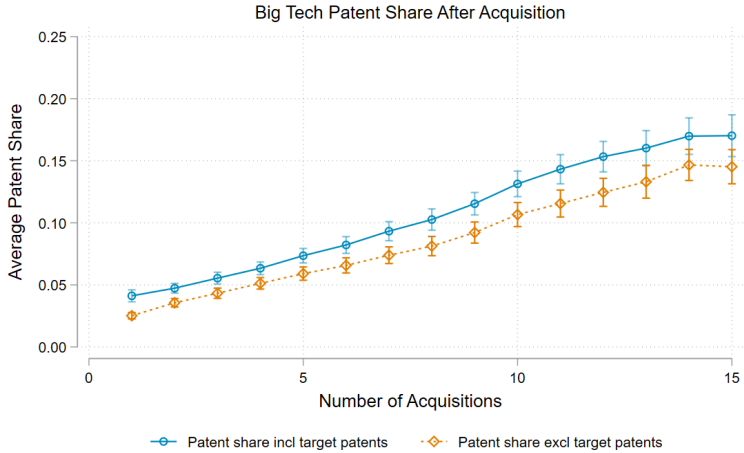
- Follow-on likelihood differs by acquirer:

Amazon	Apple	Cisco	Facebook	Google	Intel	Microsoft	Qualcomm
52%	68%	81%	92%	42%	72%	79%	73%

- Repeated later acquisitions tend to happen in CPCs where the acquirer has prior patents

Repeat Acquisitions and Patent Consolidation

- Within treated CPC groups, the share of patents owned by big tech combined is larger the higher the number of acquisitions within the CPC group.



Heterogeneity Dimension #2: Employee Retention

- Retention for target employees drops sharply at acquisition.
- **40%** of target employees leave within **one year** after the deal. By **three years**, cumulative attrition **exceeds 50%**.
- Variation in retention across acquirers is dwarfed by the variation across targets.
  - Qualcomm (50%) and Apple (53%) manage to retain the majority of target employees three years after acquisition, Amazon (39%) and Google (42%) less so.
  - We find the **full range of retention rates** between zero and one for all big tech companies except Amazon.

Retention Rates by Acquirer

Retention Gap

- Matched acquirer employees show less than half that attrition over the same window.
- Pattern is broad-based across acquirers, with Cisco exhibiting the highest overall retention.



CPC Group-level Analysis

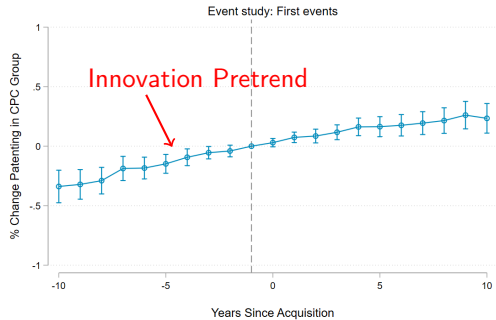
CPC Group Level Analysis: Baseline Setup

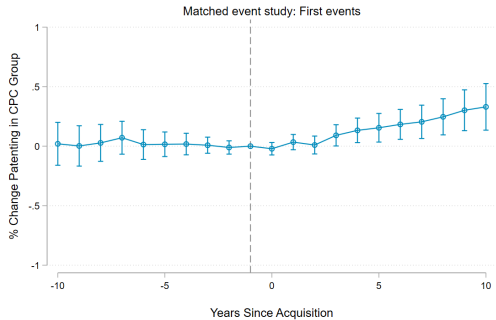
- Outcome is the arcsin-transformed share of patents filed in CPC group c in year t: $lpat_{ct}$.
- Baseline event study around the first acquisition within a CPC group:

$$lpat_{ct} = \alpha + \gamma_c + \lambda_t + \sum_{s=-10}^{10} \tau_s \cdot 1\{t = y + s\} + \varepsilon_{ct}$$

- γ_c are CPC-group fixed effects; λ_t are year fixed effects.
- Event window is $s \in [-10, 10]$; y is the acquisition year in that CPC group.
- To sharpen identification, we also match treated CPC groups to control CPC groups with similar pre-trends and levels.

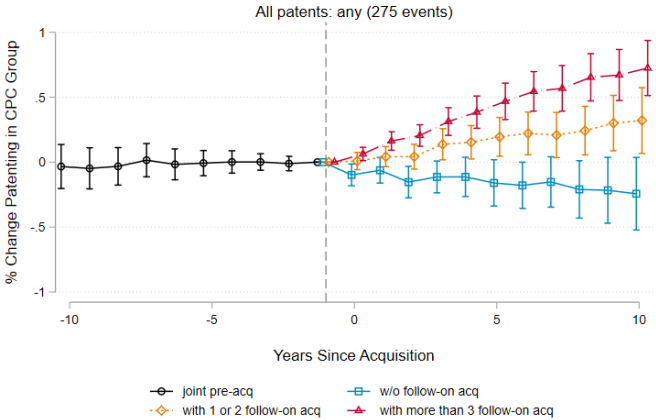
Acquisitions and Innovation





- **Innovation increases** after a first acquisition within a CPC group.

Repeat Acquisitions in CPC Groups



- But **only if** CPC groups experience **more follow-on acquisitions**.

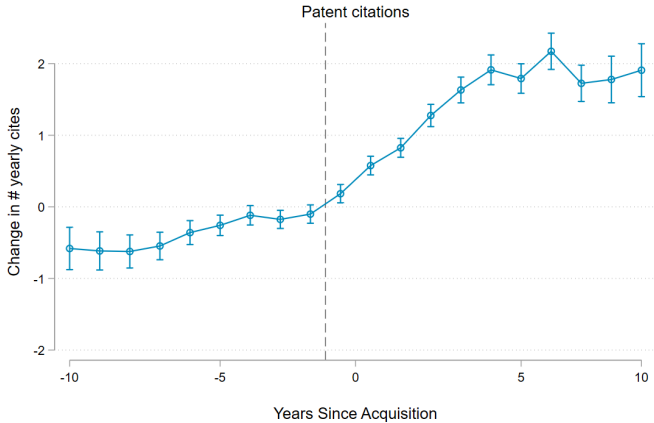
Regression results for # of Acq

Patent-level Evidence

Patent Level Analysis: Impact of Acquisitions on Citations

- We now focus on the impact of acquisitions on **individual patents**.
- Outcome: forward citations to focal patent p in CPC c, year t (cit_{pct}).
  - Citations as a proxy for technological significance, economic value, but also innovation spillovers.
- Estimation strategy following Rysman and Simcoe (2008):
  1. **Diff-in-Diff**
  $$cit_{pct} = \alpha + \tau PostAcq_{pt} + age_{pt}^2 + age_{pt}^3 + \gamma_p + \lambda_{ct} + \epsilon_{pct}$$
  2. **Event study** with dynamic treatment effects τ_s around acquisition year
- Controls: patent age profile (quadratic/cubic), CPC$\times$year fixed effects, patent fixed effects

Forward Citations to Target Patents



- Forward citations to target patents increase after 1st acquisition event in a CPC group.
- Effects are visible in both application-year and grant-year counts.

Heterogeneity

- By Follow-on Acquisition:
  - We explore whether the impact of acquisitions on patent citations varies by the presence of a follow-on acquisition within a CPC group.
  - Compare acquisitions **with** vs **without follow-on acquisitions**
- By post-acquisition employee retention:
  - We explore whether the impact of acquisitions on patent citations varies by the share of target employees still employed at the acquirer three years after acquisition.
  - Compare acquisitions **below** vs **above median retention**.
  - Acquihires may be used to manage innovation spillovers.
  - Suppressed innovation spillovers may be a sign of talent hoarding.

Diff-in-Diff Estimates of Acquisition Impact on Patent Cites

	(1) #Citations	(2) #Citations	(3) #Citations
PostAcquisition	1.13***	0.89***	1.17 ***
	(0.09)	(0.12)	(0.10)
Post×FirstNoFollowon		0.56	
		(0.42)	
Post×FirstFollowon		1.71**	
		(0.54)	
Post×Retention			-0.79*
			(0.40)
Adj. R2	0.42	0.42	0.41
Avg. Outcome	0.80	0.80	0.81
N	44250965	44250965	37923926

Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Event study graphs

Who Cites? Acquirer/Target vs Third Parties

- Decompose forward citations by source:
  - Citations by the acquirer and its acquired targets
  - Citations by other firms
- Post-acquisition increases are present for both, with larger growth from third parties in most specifications.
- Results indicate both internal knowledge integration and broader spillovers within treated CPCs.

Robustness

- Baseline diff-in-diff with CPC and year fixed effects shows positive and economically meaningful post-acquisition increases in forward citations.
- Robustness:
  - Application-year vs grant-year citation counts
  - Excluding self-citations
  - Alternative normalizations by CPC activity
- Coefficients are stable across specifications and samples.

Regressions

Conclusion

- **1,200 acquisitions** by eight major technology firms since the late 1980s
  - Acquired targets do not often have patents, but deals involving patented targets are significantly larger in value.
  - Acquisitions are followed by increases in patenting, especially when there are repeated acquisitions in the same technology area.
  - Acquired patents receive more forward citations post-acquisition, with stronger effects for first-in-sequence acquisitions.
  - Employee retention is limited, but sometimes allows innovation to diffuse faster.
- Big tech acquisitions **can accelerate innovation** in the tech sector, though impacts are heterogeneous across firms, technologies, and acquisition sequences.
- Policymakers should consider **innovation-centric guidelines** that incorporate patenting, employee retention, and technology sequence.

Thank You!



Paper available at https://florianederer.github.io/digital.pdf

Acquisition Data

- Manually curated dataset of startup acquisitions by 8 major tech firms:
  - Amazon, Apple, Cisco, Facebook, Google, Intel, Microsoft, Qualcomm
- Firms chosen due to:
  - Longstanding role in digital/IT sectors
  - Frequent acquirers of startups
  - Central in competition and innovation policy debates
- All 8 firms have faced antitrust scrutiny for acquisitions
  - FTC review of Instagram/WhatsApp, CMA review of Apple–Shazam, Qualcomm–NXP collapse, scrutiny of Microsoft/Amazon pipelines

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Employee Work Histories

- Workforce data from LinkedIn profiles via Revelio Labs
- Match target/acquirer firms to identify employees
- Coverage:
  - Acquisitions from 2005 onward (LinkedIn founded in 2003)
  - 1190 acquisitions $\rightarrow$ 932 post-2005
  - 567 cleanly matched to Revelio Labs data
- Construct unbalanced panel of position-year observations
  - Track employees over 5-year window around acquisition
  - Handle overlapping positions, short stints, education jobs
  - Acquirer subsidiaries included as acquirer positions

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Retention Rates by Acquirer



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Heterogeneity by Number of Acquisitions

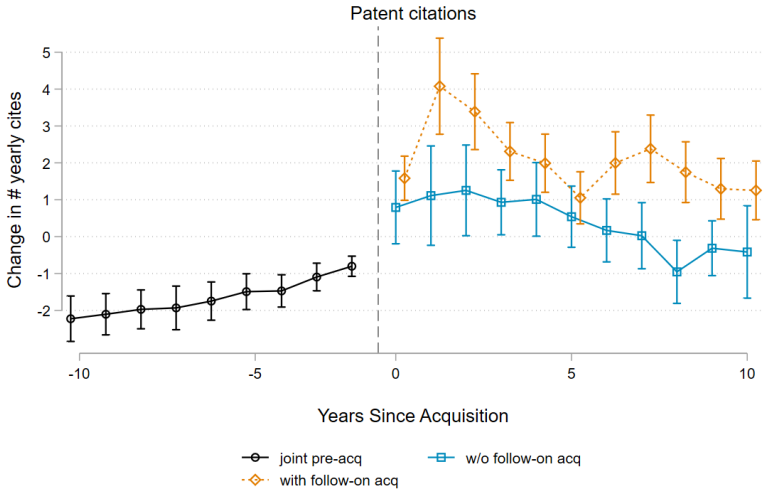
	(1) Unmatched	(2) Matched sample
Post 1st Event	0.24***	-0.03
	(0.06)	(0.07)
Post 2nd Event	0.24***	0.25**
	(0.06)	(0.09)
Post 3rd Event	0.13*	0.23**
	(0.07)	(0.08)
Post 4th Event	0.16*	0.19*
	(0.08)	(0.09)
Constant	2.75***	4.40***
	(0.02)	(0.04)
CPC FE	yes	yes
Year FE	yes	yes
Adj. R2	0.12	0.25
N	34236	11880

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

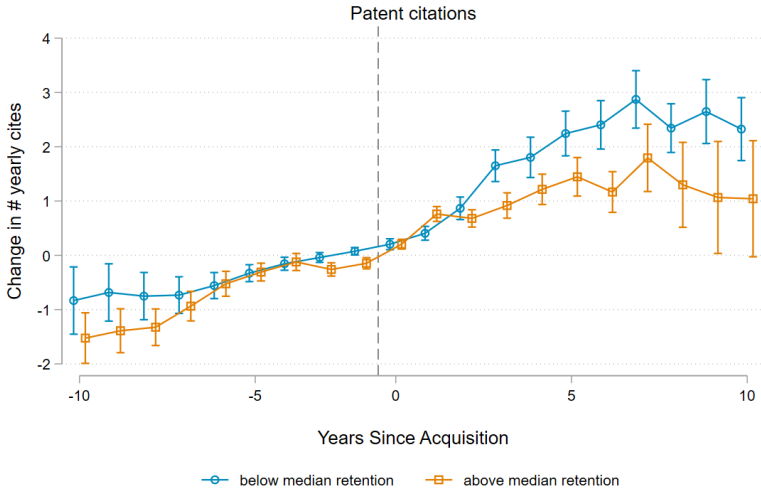
Table: Innovation heterogeneity by number of events.

Citation Effect by Follow-on Acquisitions



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Citation Heterogeneity by Employee Retention



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Robustness Citation Regression

	(1) #NonSelfCit	(2) #PatFamCit	(3) #GYCit
PostAcquisition	0.85***	0.43***	1.48***
	(0.08)	(0.06)	(0.09)
Adj. R2	0.42	0.32	0.38
Avg. Outcome	0.80	0.48	0.72
N	44250965	44250965	44250965

Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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