Week 4: Innovation and Competition

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Econ 220C: Topics in Industrial Organization

How do market structure and innovation interact?

Aghion et al. (2005)

Killer acquisitions

Cunningham, Ederer, and Ma (2020)

Question

Does competition in the product market lead to more or less innovation? Discuss

Aghion and Tirole (1994) call this the second-most studied question in all of IO (after the link between product market competition and profits)

The Arrow argument

"The preinvention monopoly power acts as a strong disincentive to further innovation" (Arrow 1962)

In other words, a monopolist already earning healthy profits has no incentive to disrupt the status quo. Product market competition *increases* innovation

The Schumpeter argument

"The firm of the type that is compatible with perfect competition is in many cases inferior in internal, especially technological, efficiency" (Schumpeter 1942)

Schumpeter argues that large firms are better equipped to invest in R&D and the prospect of market power and large scale is critical to incentivize firms to invest in innovation. Product market competition *decreases* innovation

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Aghion, Bloom, Blundell, Griffith, and Howitt (2005)

Influential paper "Competition and Innovation: An Inverted-U Relationship"

Key idea:

- The incentive to innovate is strong when the difference between pre-innovation and post-innovation rents is large
- Product market competition does two things:
  1. It lowers pre-innovation rents $\rightarrow$ increases the difference (Arrow effect)
  2. It also lowers post-innovation rents $\rightarrow$ it decreases the difference (Schumpeter effect)

Consumers and preferences I

- There is a unit mass of consumers who each provide one unit of labor inelastically
- Each consumer has the following preferences:

$$u(y_t) = \ln(y_t)$$

where y_t is made up of a continuum of intermediate goods:

$$\ln(y_t) = \int_0^1 \ln(x_{jt})dj$$

Consumers and preferences II

- We have

$$u(y_t) = \ln(y_t) = \int_0^1 \ln(x_{jt})dj$$

- Note that this is very similar to Cobb-Douglas utility – consider the discrete case:

$$u(\vec{x}_t) = \prod_{j=1}^{J} x_{jt} \rightarrow \text{take logs (monotonic transform)} \rightarrow u(\vec{x}_t) = \sum_{j=1}^{J} \ln(x_{jt})$$

- **Key implication:** consumers will spend an equal share of income on all x_{jt} (normalize this common amount to 1)

Competition in each sector

- The market for each good j is a duopoly with firm A and B
- Consumers maximize $x_j = x_{Aj} + x_{Bj}$ s.t. $p_{Aj}x_{Aj} + p_{Bj}x_{Bj} = 1$
- Firms have different costs of production
  - Labor is the only input and production function is CRS. Take wage w as given
  - For L units of labor, each firm can produce

$$x_j(L) = \gamma^{k_i} L \text{ for } i = A, B$$

    where k_i represents the technology level of i and $\gamma > 1$
  - CRS implies that

$$x_j(\gamma^{-k_i}) = 1$$

    i.e., it takes γ^{-k_i} units of labor to produce one unit of output
  - Thus, costs are given by

$$c_i(x_j) = w x_j \gamma^{-k_i}$$

Even and uneven sectors

- Let l be level of technology for the leader, and let m be the gap over the follower (both integers)
- Profits: let π_m (respectively, π_{-m}) be the equilibrium profit flow of a firm m steps ahead (respectively, behind)
  - Note that the assumptions about logarithmic technology and cost structure imply that profits only depend on m, and not on absolute levels
- Assumption: $m \leq 1$. If leader gets more than one step ahead, the laggard can automatically catch up
- Result: only two types of sectors
  1. Even sectors ($m = 0$)
  2. Uneven sectors ($m = 1$)

R&D spending

- The leading firm can spend $\psi(n) = n^2/2$ units of labor to get a Poisson hazard rate of innovating one step forward of n
- The lagging firm moves one step ahead with hazard rate h if it spends nothing; it has hazard rate rate $h + n$ if it spends $\psi(n)$
  - Captures the idea that it's easier to move ahead if you're not on the frontier
- Objects of interest: n_0, n_{-1}, n_1
- Note that we immediately know $n_1 = 0$ (Why? The automatic catch-up assumption)

Profits in uneven sectors

In uneven sectors, the laggard firm makes zero profit and the lead firm sells all of the x_j

- Recall that spending on x_j was normalized to 1. So revenue is 1
- Recall that costs are given by $c_i(x_j) = wx_j\gamma^{-l}$
- The leader thus wants to solve

$$\max_{x_j}\{1 - wx_j\gamma^{-l}\}$$

  but the solution here is $x_j = 0$ – we are missing a constraint. If we set x_j too low, the implied price becomes high enough that the laggard firm will makes profits selling too
- Thus, we need to add the constraint that the laggard firm won't profit / enter:

$$\text{subject to } 1 - wx_j\gamma^{-(l-1)} < 0$$

- The constraint binds, so $x_j = \frac{1}{w\gamma^{-(l-1)}}$. Plugging this in yields

$$\pi_1 = 1 - \gamma^{-1}$$

Competition and profits in even sectors

In even sectors, firms will make zero profits if they compete a la Bertrand. They will make positive profits if they collude.

- In general, $\pi_0 = \varepsilon \pi_1$ for some $0 \leq \varepsilon \leq 1/2$
- The higher is ε, the more collusion
- Thus we can parameterize competition as $\Delta = (1 - \varepsilon) \in [1/2, 1]$ – higher values correspond to more competition
- $\Delta \pi_1$ is also the incremental profit that the firm who becomes the leader will get

R&D investment as a function of competition

- As previously mentioned, key items of interest are n_0 and n_{-1}
- But we want to know how these vary with Δ
- Consider the incentive to invest in an even sector (n_0)
  - If Δ is large, you are currently making very little profits. If you successfully innovate, the increase is profit is large. Opposite if Δ is small. Thus, n_0 is *increasing* in Δ. This is the "Arrow effect"
- Consider the incentive to invest in an uneven sector (n_{-1})
  - If Δ is large, you won't make much profit if you catch up to the leader. Thus the incentive to innovate is small. Opposite if Δ is small. Thus, n_{-1} is *decreasing* in Δ. This is the "Schumpeter effect"

Paper derives n_0 and n_{-1} in closed form, but this is the key intuition!

Overall innovation rates I

- Overall innovation in a sector depends on both n_0 and n_{-1}, but also on the fraction of time the industry spends in even versus uneven states (and these fractions are endogenous)
- Let μ_0 be the steady-state probability of being in the even state, and $\mu_1 = 1 - \mu_0$ the uneven state
- The steady-state probability we go from uneven to even is:

$$\mu_1(n_{-1} + h)$$

- The steady-state probability we go from even to uneven is

$$\mu_0(2n_0)$$

- In steady-state, these two probabilities must be equal!

Overall innovation rates II

- The overall flow of innovation is

$$I = \underbrace{2\mu_0 n_0}_{\text{Pr(innovate, even)}} + \underbrace{\mu_1(n_{-1} + h)}_{\text{Pr(innovate, uneven)}}$$

- Using the fact that $2\mu_0 n_0 = \mu_1(n_{-1} + h)$ and $\mu_0 + \mu_1 = 1$, we can explicitly solve for $\mu_0 = \frac{n_{-1}+h}{2n_0+n_{-1}+h}$ and $\mu_1 = \frac{2n_0}{2n_0+n_{-1}+h}$
- Plugging this all in yields:

$$I = \frac{4n_0(n_{-1} + h)}{2n_0 + n_{-1} + h}$$

How does the overall innovation rate vary with Δ?

- Paper shows that I is increasing in Δ up to a point, and then decreasing. This creates the "inverted-U"
- Intuition is as follows:
  - When Δ is very small (little competition), firms are happy to be in the even state. Little incentive for firms to innovate, so we stay in that state. In the uneven state, the laggard firm is very motivated to innovate, so we leave that state quickly. Thus we stay in the even state most of the time with little motivation to innovate in that state. An increase in competition should reduce this and increase innovation.
  - When Δ is close to one (lots of competition), firms are unhappy to be in the even state. Lots of incentive for firms to innovate, so we leave that state quickly. In the uneven state, the laggard sees little benefit to innovating, so we stay in that state. Thus we stay in the uneven state most of the time with little motivation to innovate in that state. An increase in competition should exacerbate this and decrease innovation.

"Empirics"

Cross-industry scatterplots!

- Measure innovation using citation-weighted patents
- Measure competition using the 1 - Lerner Index – high values correspond to more competition (lower markups)
- Each observation is an industry-year

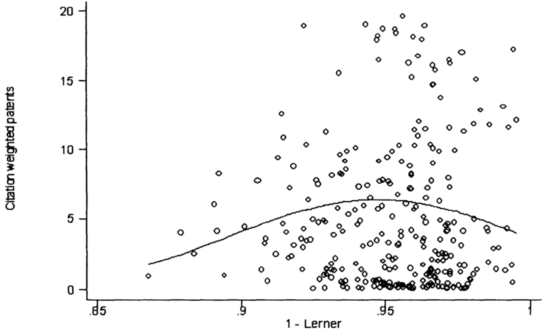


FIGURE I
Scatter Plot of Innovation on Competition

The figure plots a measure of competition on the x-axis against citation-weighted patents on the y-axis. Each point represents an industry-year. The scatter shows all data points that lie in between the tenth and ninetieth deciles in the citation-weighted patents distribution. The exponential quadratic curve that is overlaid is reported in column (2) of Table I.

Is this model definitive and how should it inform competition policy?

This inverted-U has been very influential in merger litigation. But recall a few important assumptions – how heavily should we rely on this paper?

- Innovation is in some sense very narrow
  - No new products can be invented
  - Fixed income shares, even if products improve
- The leader cannot innovate $\rightarrow$ in some sense, crippling the Arrow effect
- Other models come to different conclusions, and are very sensitive to modeling assumptions and precise comparative statics

My subjective takeaways...

- The question of how market structure affects innovation is challenging, because forces pull the key comparative static in both directions. Thus theoretical results are either going to be ambiguous or conflicting
- My view is that a sweeping theory is not possible. Rather, the path forward is investigating narrower settings and deeply understanding the institutional details (so that modeling decisions can reflect these)
- The empirics are way behind the theory, so there is potentially a lot to do here
- Progress here would be really helpful for policy

One such example: Poege (2022)

- In 1952, Germany's leading chemical company IG Farben was broken up by the Allies (because of its importance for the German war economy). Very innovative company (three of its scientists won Nobel Prizes)
- The breakup made some of the technology areas more competitive (increased the *HHI* index)

Table 1: ΔHHI implied by the breakup

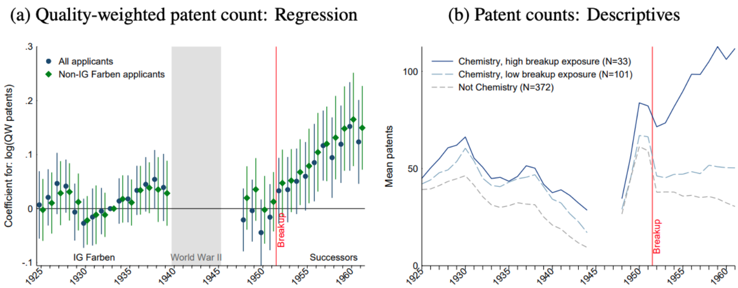
Selected technology classes	Patents 1925-1939					48-52
	Count	IG %	HHI^{IG}	$HHI^{\overline{IG}}$	ΔHHI	ΔHHI
8M: Coloring	643	56.45	3323	944	2379	1717
12G: Processes (general)	400	25.75	713	311	402	174
12K: Ammonium, Cyanides	484	16.43	382	211	171	263
22E: Indigo-based dyes	377	76.39	5910	1582	4328	2592
29B: Chemical fibers	601	28.79	891	219	671	159
30H: Drug development	1050	14.67	253	107	146	70
39C: Synthetic plastics	325	50.77	2647	869	1778	783
45L: Pesticides	700	31.29	1078	380	698	245
Means for ΔHHI > p75 (N=33)	731	37.07	1820	625	1195	641
Means for ΔHHI ≤ p75 (N=102)	681	4.40	403	380	23	43
Means overall	693	12.38	750	440	310	190

Notes: Shows the concentration change implied by the IG Farben breakup for selected technology classes and by breakup exposure. The columns show the count of granted patents, the share of patents by IG Farben or subsidiaries (IG %), the Herfindahl-Hirschman index considering all as one block (HHI^{IG}) and split up according to the eventual successors ($HHI^{\overline{IG}}$) as well as the difference, ΔHHI. The first columns consider patents filed between 1925 and 1939, and the last column for 1948-1952. Patent counts are rounded from fractional counts. Statistics are calculated by technology class, means across exposed/comparison technology classes in the last two rows.

One such example: Poege (2022)

- Technology areas that saw the biggest increase in competition saw the biggest increase in innovation
- Both for IG-Farben firms and non-IG firms

Figure 4: Technology class-level regressions: Quality-weighted counts



Notes: Descriptives and regressions comparing technology classes with high and low exposure to the IG Farben breakup, as defined by the 75th percentile of ΔHHI (185). Exposure is measured using pre-war (1925-1939) data, but the breakup is finalized and effective around 1952. Shows quality-weighted counts of granted patents, with average patent quality winsorized and rescaled to have average three and standard deviation one to exclude negative values. 4a shows OLS regressions of log quality-weighted patent counts in technology classes with and without pre-war IG Farben breakup exposure. Shows 95% confidence intervals. 4b shows average quality-weighted patent counts in the two groups. The graphs correspond to mean(log y) (left) and mean(y) (right), explaining the difference. The German patent office closed from 1945 to 1947. Wartime patent applications are largely prosecuted post-war and hence omitted.

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Killer acquisitions

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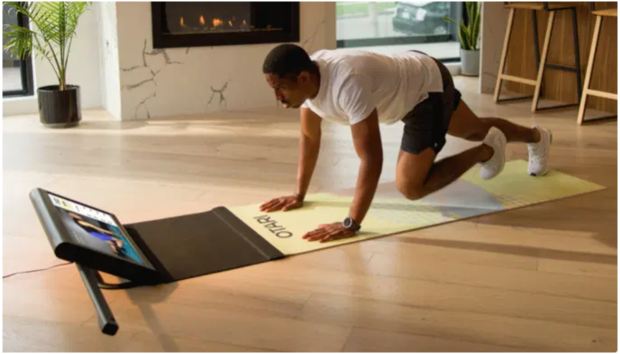
Why might an incumbent acquire an early-stage firm?

- Realize synergies, leverage fixed costs. Might be more efficient to finish developing the technology inside a larger firm $\rightarrow$ good for innovation
- Shut down a potential threat to monopoly power $\rightarrow$ bad for innovation. These are so-called "killer acquisitions"
- The idea that firms might acquire to prevent competition was previously raised by Gilbert and Newbury (1982)

Example from tech: Otari and Peloton

- Peloton acquired Otari, a company which was building an interactive yoga mat, in December 2020
- No evidence that Peloton did any work to commercialize the product, likely more concerned with shutting down a potential competitor



Example from pharmaceuticals: Questcor and Synacthen

- In the early 2000s, Questcor had a monopoly on adrenocorticotropic hormone drugs (ACTH) with its drug *Acthar* (purified from pig pituitary glands). It sold for $38,000 a vial as of 2017 and represented the majority of their revenues
- In the mid-2000s, Novartis began working on a synthetic version of the hormone *Synacthen*. It was not yet approved for use in the US
- Questcor acquired Synacthen in 2013 and promised to bring it to market in the US and develop it for additional indications, but did not follow through
  - As of 2017, Synacthen is sold overseas for a fraction of the cost
- A few data things to preview (compare to the tech example):
  - Due to strict FDA reporting requirements, it's possible to view incomplete projects even if they are shut down
  - It's (comparatively) easy to index how similar drugs are to each other (i.e., how potentially competitive they are)

Theoretical framework

Model has three periods:

- At $t = 0$ the **takeover decision** occurs. An entrepreneur E has an early-stage idea. They can be acquired by A at some (endogenous) price P by one of n other firms in the market
- At $t = 1$ the **development decision** occurs. Either the entrepreneur or acquirer (depending on $t = 0$) can sink some cost k to try and develop the project. The probability of success is ρ^E or ρ^A depending on who owns the company. If development does not continue, there is liquidation value L
- At $t = 2$ **competition** occurs. All firms compete a la Bertrand with vertical and horizontal differentiation. The new product may or may not compete, depending on whether it was successfully developed in $t = 1$

Like most multi-period models, we will solve this one backwards

Product market competition ($t = 2$)

Consider the entrepreneur if her product is not acquired:

- If E succeeds (S), she will maximize $p^E q^E$ and get profits $\pi^E_{\neg acq,S} \geq \pi^A_{\neg acq,S}$ because she has the best product on the market
- If E fails (F), she will get $\pi^E_{\neg acq,F} = 0$ and the other firms will get $\pi^A_{\neg acq,F} > \pi^A_{\neg acq,S}$ since there is now less competition

Consider the acquirer if the entrepreneur is acquired:

- If A fails (F), he will only sell a single product. He will maximize $p^A_{old} q^A_{old}$ and get $\pi^A_{acq,F} = \pi^A_{\neg acq,F}$
- If A succeeds (S), he will be a two-product oligopolist who competes against $n-1$ other firms. He will jointly maximize $p^A_{old} q^A_{old} + p^A_{new} q^A_{new}$ and get $\pi^A_{acq,S} > \pi^A_{acq,F}$

Product market competition ($t = 2$)

Putting this all together yields the following profit rankings for the entrepreneur:

$$\pi^E_{\neg acq,S} > \pi^E_{\neg acq,F} = \pi^E_{acq,S} = \pi^E_{acq,F} = 0$$

and for the acquirer:

$$\pi^A_{acq,S} > \pi^A_{acq,F} = \pi^A_{\neg acq,F} > \pi^A_{\neg acq,S} > 0$$

Development decision ($t = 1$)

Consider the entrepreneur if her product is not acquired. From her perspective, all that matters is:

$$\Delta^E \equiv \pi^E_{\neg acq,S} - \pi^E_{\neg acq,F}$$

Consider the acquirer if the entrepreneur is acquired. From his perspective, all that matters is:

$$\Delta^A \equiv \pi^A_{acq,S} - \pi^A_{acq,F}$$

This difference will always be larger for E, i.e., $\Delta^E > \Delta^A$. Why? Because A experiences some cannibalization of its existing product. This is larger when there is more overlap between the new product and the old product

Development decision ($t = 1$)

Entrepreneur will develop if

$$\rho^E \Delta - k \geq L$$

Acquirer will develop if

$$\rho^A \Delta - k \geq L$$

This implicitly defines two cutoff k's, below which the project gets developed:

- $k^E \equiv \rho^E \Delta^E - L$
- $k^A \equiv \rho^A \Delta^A - L$

Who develops more? $\Delta^E > \Delta^A$ is a force pushing E to develop more. But if $\rho^A > \rho^E$ ("synergies") then A is pushed to develop more. In general, we have:

$$k^E > k^A \iff \Delta^E / \Delta^A > \rho^A / \rho^E$$

How is the development decision affected by competition?

- Let's think about the difference in these cutoff values:

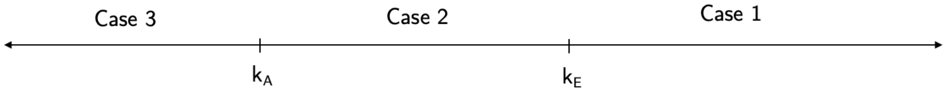
$$k^E - k^A = \rho^E \Delta^E - \rho^A \Delta^A$$

- When n is small, Δ^E is bigger (more of a monopolist) and Δ^A is smaller (more cannibalization). Thus, $k^E - k^A$ is larger in less competitive markets. **Entrepreneur is relatively more motivated to develop than acquirer in uncompetitive markets**
- A bit of an extension, but let T^E be the patent term for the new product and T^A be the remaining patent term for A's product. It T^A is short, then Δ^A is large. Only a short period of cannibalization, followed by a longer period of monopoly. Thus, $k^E - k^A$ is larger when T^A is long. **Entrepreneur is relatively more motivated to develop than the acquirer when the acquirer has a long remaining patent term**

Acquisition decision ($t = 0$)

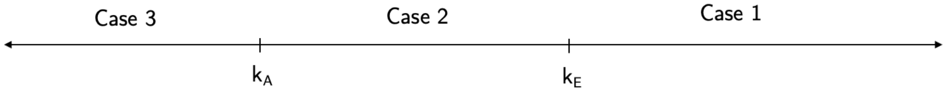
For an acquisition to happen, the acquisition price P must exceed the entrepreneur's expected payoff.

Start by considering the case $k^E > k^A \iff \Delta^E/\Delta^A > \rho^A/\rho^E$. We have three sub-cases:



1. $k > k^E$: Nobody will develop the project, since everyone prefers L (indifferent to who owns it)

Acquisition decision ($t = 0$)



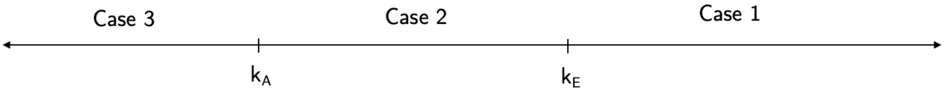
2. $k^E \geq k > k^A$: E would continue, but A would terminate. The "killer acquisition" happens iff the benefit to A outweighs the benefit to E (because then they can find a mutually agreeable price):

$$\underbrace{\pi^A_{acq,F} - [\rho^E \pi_{\neg acq,S} + (1-\rho^E)\pi_{\neg acq,F}]}_{\text{expected benefit to } A \text{ of stopping } E} \geq \underbrace{\rho^E \pi^E_{\neg acq,S} + (1-\rho^E)\pi^E_{\neg acq,F} - k - L}_{\text{expected benefit to } E \text{ of continuing}}$$

This reduces to

$$\rho^E(\pi^A_{acq,F} - \pi^A_{\neg acq,S}) \geq \rho^E \Delta^E - k - L$$

Acquisition decision ($t = 0$)



3. $k \leq k^A$: Both firms will develop the project. If an acquisition happens, it will be an acquisition to continue. The acquisition occurs iff the benefit to A outweighs the benefit to E:

$$\left[\rho^A \pi^A_{acq,S} + (1-\rho^A)\pi^A_{acq,F} - k - L\right] - \left[\rho^E \pi^A_{\neg acq,S} + (1-\rho^E)\pi^A_{\neg acq,F}\right] \geq$$

$$\rho^E \pi^E_{\neg acq,S} + (1-\rho^E)\pi^E_{\neg acq,F} - k - L$$

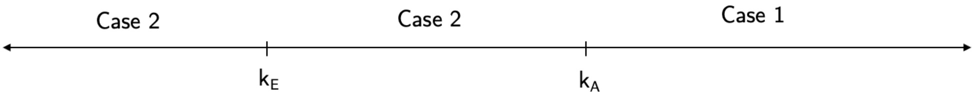
This reduces to

$$\rho^E(\pi^A_{acq,F} - \pi^A_{\neg acq,S}) \geq \rho^E \Delta^E - \rho^A \Delta^A$$

Hint: recall that $\pi^A_{acq,F} = \pi^A_{\neg acq,F}$ and $\pi^E_{\neg acq,F} = 0$

Acquisition decision ($t = 0$)

Next consider the case $k^E \leq k^A \iff \Delta^E/\Delta^A \leq \rho^A/\rho^E$. We have two sub-cases:



1. If $k > k^A$, nobody will develop and both have value L
2. If $k < k^A$, then the acquirer will always acquire and develop:

$$\rho^A \Delta^A - k - L \geq \rho^E \Delta^E - k - L$$

by assumption

So when do killer acquisitions happen?

We need several things to happen

- The acquirer needs to have a lower cost threshold than the entrepreneur, i.e., $k^A < k^E$. This allows A to shut down a project E would develop. One way this can happen is if ρ^A is small
- The acquirer needs to gain a lot from not allowing the project to come to market, i.e., $\pi^A_{acq,F} - \pi^A_{\neg acq,S}$ needs to be large. One way this can happen is if the new product and the acquirer's product are very similar (indexed by γ)

So when do killer acquisitions happen?

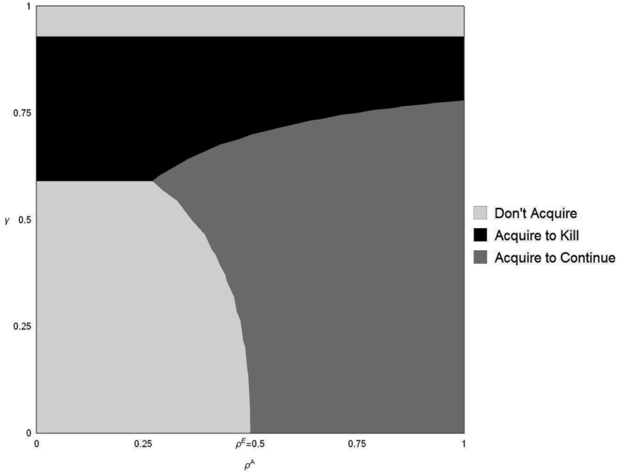


FIG. 2.—Optimal acquisition strategies. This graph plots the optimal acquisition decisions—"Don't Acquire" (light gray), "Acquire to Kill" (black), and "Acquire to Continue" (dark gray)—as functions of the acquirer's development capability ρ^A and the degree of substitutability γ. The other parameter values are $\alpha^A = \alpha^E = 100$, $\rho^E = 0.5$, $L = 20$, $k = 80$, and $n = 2$.

Key model predictions

If acquirer synergies (ρ^A) are not too large, then...

1. After an acquisition, overlapping drug projects should be less likely to be developed
2. This effect should be more pronounced when competition is low or incumbent remaining patent terms are long
3. Acquisitions by incumbents should target entrepreneurial firms developing drugs with overlap

Data

1. Pharmaprojects data from Pharma Intelligence
   - Drug-level development milestones ("target identified," "patent filed," "registration for clinical trial," etc.)
   - Drug market ("hypertension") and mechanism of action ("calcium channel antagonist") together define an overlapping project
2. Combine several data sources to track acquisitions (Securities Data Company, Deals Intelligence, VentureXpert)

Empirical design: modified triple difference

Main estimating equation for drug i in year t:

$$Dev_{i,t} = \alpha_0 + \gamma_1 \cdot I(\mathrm{Acq})_i + \gamma_2 \cdot I(\mathrm{Acq})_i \times I(\mathrm{Post})_{i,t} + \gamma_3 \cdot I(\mathrm{Acq})_i \times I(\mathrm{Overlap})_i$$

$$+\beta \cdot I(\mathrm{Acq})_i \times I(\mathrm{Post})_{i,t} \times I(\mathrm{Overlap})_i + FE + \varepsilon_{i,t}$$

where

- γ_1 lets acquired drugs differ in levels
- γ_2 captures change in development post-acquisition
- γ_3 lets overlapping acquired drugs differ in levels
- β is the coefficient of interest: differential change in development post-acquisition for overlapping drugs. Model predicts this should be negative

Note some missing terms due to (a) collinearity of FEs and Post and (b) Overlap only defined if Acq=1

Main results

- Acquired, overlapping projects are 3.7pp less likely to have a development event after acquisition than non-overlapping acquired projects. This represents a 20% decrease
- Acquired, overlapping projects are 5.7pp (3.7+2.0) less likely to have a development event after acquisition than non-acquired projects
- Robust to target firm FEs, drug FEs

TABLE 2
OVERLAPPING ACQUISITIONS AND PROJECT DEVELOPMENT

	DEVELOPMENT EVENT = 1					
	(1)	(2)	(3)	(4)	(5)	(6)
I(Acquired) × I(Post) × Overlap	−.037***	−.033**	−.029*	−.041**	−.043**	−.054**
	(.013)	(.014)	(.015)	(.019)	(.021)	(.024)
I(Acquired) × I(Post)	−.020***	−.016**	−.017**	−.024**	−.018	−.018
	(.006)	(.007)	(.009)	(.010)	(.011)	(.013)
I(Acquired) × Overlap	.004	.009	.026**			
	(.008)	(.009)	(.011)			
I(Acquired)	−.002	−.004	−.011			
	(.004)	(.005)	(.012)			
Before(−3) × Overlap						−.031
						(.032)
Before(−2) × Overlap						.012
						(.032)
Before(−1) × Overlap						−.040
						(.030)
Before(−3)						.015
						(.017)
Before(−2)						.020
						(.017)
Before(−1)						−.003
						(.016)
Observations	143,569	143,569	143,569	143,569	134,662	143,569
R^2	.038	.252	.289	.366	.662	.370
Vintage FE	Y	Y	Y			
Age FE	Y					
Age × TC × MOA FE		Y	Y	Y	Y	Y
Originator (target company) FE			Y			
Project FE				Y	Y	Y
Propensity score reweighted					Y	

Effect is stronger in less competitive markets

Authors split the sample / run a quadruple difference(!) – takeaway: effect is entirely driven by low-competition drugs, and is more than 2x as strong in this subsample

TABLE 4
OVERLAPPING ACQUISITIONS AND PROJECT DEVELOPMENT: MARKET COMPETITION

	DEVELOPMENT EVENT = 1			NO DEVELOPMENT = 1		
	Low (1)	High (2)	Interacted (3)	Low (4)	High (5)	Interacted (6)
I(Acquired) × I(Post) × Overlap	−.065**	.017	.017	.219***	.038	.038
	(.026)	(.035)	(.035)	(.054)	(.070)	(.070)
I(Acquired) × I(Post) × Overlap × LowCompetition			−.082*			.181**
			(.044)			(.089)
Observations	74,261	69,308	143,569	5,991	3,236	9,227
R^2	.415	.399	.408	.497	.474	.489
TC × MOA FE				Y	Y	Y
Age × TC × MOA FE	Y	Y	Y			
Project FE	Y	Y	Y	Y	Y	Y

Effect is stronger when acquirer has remaining patent life

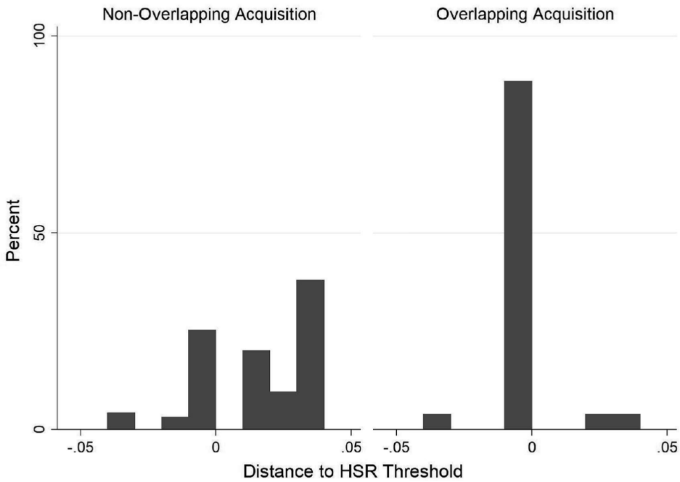
Restrict analysis to overlapping acquisitions. More likely to see development in overlapping acquisitions if acquirer's overlapping drug has < 5 years of patent life remaining

TABLE 5
OVERLAPPING ACQUISITIONS AND PROJECT DEVELOPMENT: ACQUIRER'S PATENT LIFE

	Development Event = 1	
	(1)	(2)
I(Post) × I(NearPatExpiry)	.013	.406***
	(.133)	(.090)
I(Post)	−.173*	−.210***
	(.092)	(.067)
I(NearPatExpiry)	−.104**	−.147***
	(.043)	(.043)
Observations	6,398	6,398
R^2	.212	.450
Vintage FE	Y	Y
Age FE	Y	
TC × MOA FE	Y	
Age × TC × MOA FE		Y

Overlapping acquisitions likely to just avoid regulatory review

This is a beautiful piece of supporting evidence. Overlapping acquisitions are likely to be *just* small enough ($<$ 200 million valuation) such that they don't trigger FTC review



Projects just below the threshold more likely to be killed

Consistent with trying to avoid scrutiny, it's exactly these "below-the-threshold" acquisitions that are most likely to be killer acquisitions

TABLE 7
INTENSITY OF PROJECT DISCONTINUATION AROUND FTC REVIEW THRESHOLD

	5% below Threshold (%)	5% above Threshold (%)	Difference (%)	*T*-Statistics	Statistical Significance
			A. Real HSR Threshold		
Active	3.57	7.58	−4.00	−1.18	Not significant
Launched	1.79	9.09	−7.31	−2.29	5% level
Discontinued	94.64	83.33	11.31	2.51	5% level
			B. Pseudothreshold		
Active	7.41	2.63	4.78	1.20	Not significant
Launched	3.70	4.39	−.69	−.16	Not significant
Discontinued	88.88	92.98	−4.10	−.71	Not significant

This paper has been very influential in shaping policy

- Cited in the EU's Digital Market Act, which was an effort to reign in market power of key internet players
- Cited in Biden's Executive Order on Promoting Competition in the American Economy
- Cited in an FTC order to examine past acquisitions that were not investigated due to the Hart-Scott-Rodino threshold