Killer Acquisitions

Colleen Cunningham[†] Florian Ederer[‡] Song Ma[‡]

[†]London Business School [‡]Yale School of Management

Autoridade da Concorrência Webinar

Killer Acquisitions

- **The idea:**
  - Market incumbents have incentives to acquire and "kill" innovative targets
  - Preempt the "gale of creative destruction" to protect existing profits
- **Theoretical framework:**
  - Setting: a simple model of acquisition, innovation, and competition
  - Killer acquisitions can be optimal for incumbents
- **Empirical evidence:**
  - Setting: acquisition and drug development (1989-2010)
  - Evidence: test for existence and pervasiveness of "killer acquisitions"

Do "Killer Acquisitions" Exist? FTC Against Mallinckrodt (Questcor)

- "By acquiring Synacthen, Questcor harmed competition by preventing another bidder from trying to develop the drug ... to challenge Questcor's monopoly over ACTH drugs."
- "Questcor has extinguished a nascent competitive threat to its monopoly."

Do Killer Acquisitions Occur Elsewhere?

FTC to Examine Past Acquisitions by Large Technology Companies

Agency Issues 6(b) Orders to Alphabet Inc., Amazon.com, Inc., Apple Inc., Facebook, Inc., Google Inc., and Microsoft Corp.

SHARE THIS PAGE

FOR RELEASE

February 11, 2020

Well, Don't We Already Know...

Well, Don't We Already Know...

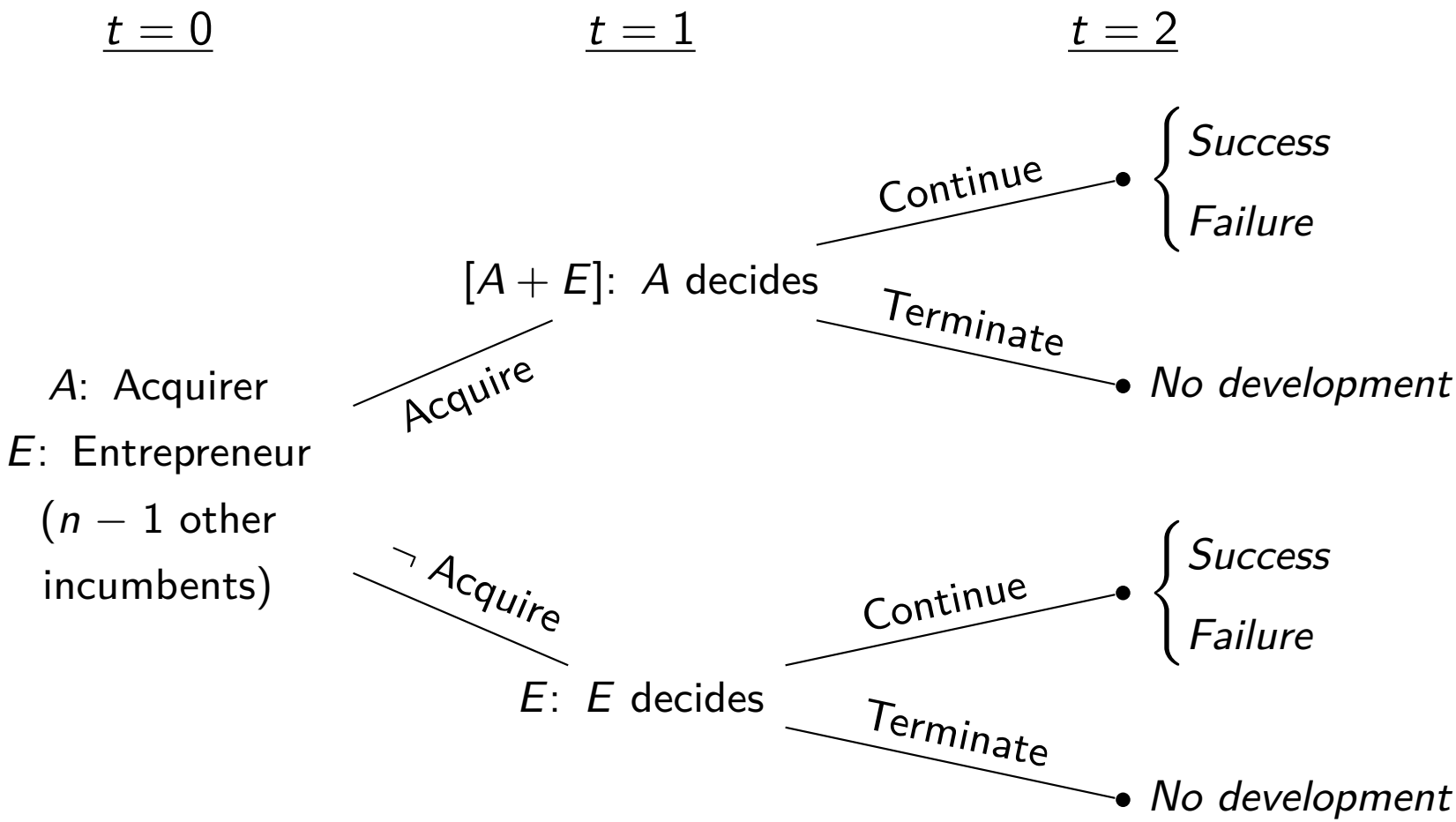
- ... **that acquisitions can be anti-competitive**?
  - Yes! Mostly focusing on horizontal mergers of **existing products** and **pricing implications**—ignoring innovation.
  - We argue that anti-competitive acquisitions can happen pre-market.

Well, Don't We Already Know...

- ... **that acquisitions can be anti-competitive**?
  - Yes! Mostly focusing on horizontal mergers of **existing products** and **pricing implications**—ignoring innovation.
  - We argue that anti-competitive acquisitions can happen pre-market.
- ... **about cannibalization and innovation**?
  - Yes! Arrow's (1962) famous "replacement effect" shows that incumbents are disincentivized to **conduct internal R&D**.
  - We argue that disincentives to innovate are more extreme and incumbents may acquire to kill innovation.

Theoretical Framework

Setup and Timeline



Intuition

- Development decision ($t = 1$)
  - Entrepreneur has stronger incentive to continue project ...
  - ... because successful development cannibalizes incumbent's profit
  - Difference larger if little existing or future competition

Intuition

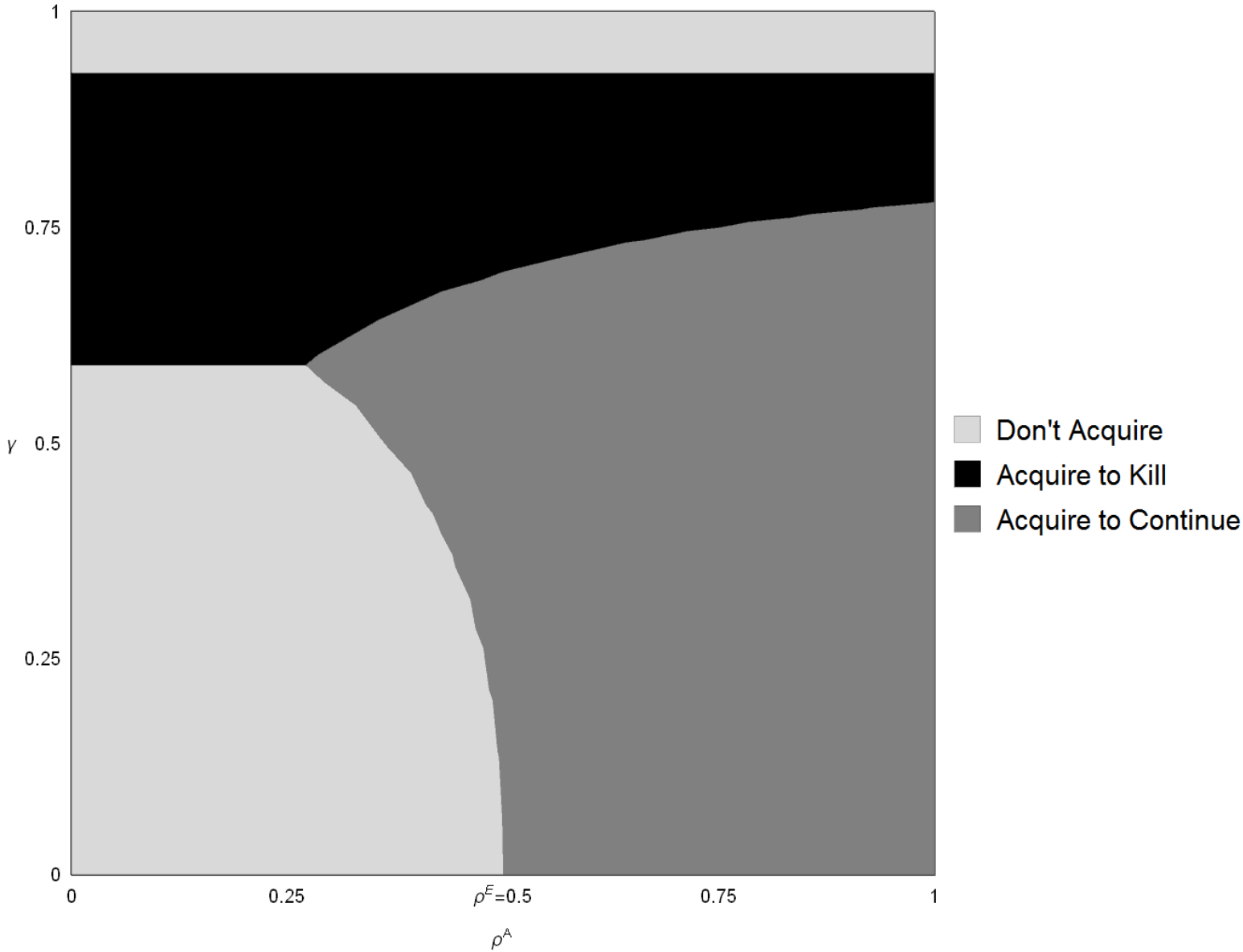
- Development decision ($t = 1$)
  - Entrepreneur has stronger incentive to continue project ...
  - ... because successful development cannibalizes incumbent's profit
  - Difference larger if little existing or future competition
- Incumbent's economic trade-off at acquisition ($t = 0$)
  - Acquiring the entrepreneur is costly (pay endogenous P), but ...
  - ... it prevents competition and business stealing relative to successful development by the entrepreneur
  - Replacement (Arrow 1962) vs efficiency (Gilbert & Newbery 1982) effect

Intuition

- Development decision ($t = 1$)
  - Entrepreneur has stronger incentive to continue project ...
  - ... because successful development cannibalizes incumbent's profit
  - Difference larger if little existing or future competition
- Incumbent's economic trade-off at acquisition ($t = 0$)
  - Acquiring the entrepreneur is costly (pay endogenous P), but ...
  - ... it prevents competition and business stealing relative to successful development by the entrepreneur
  - Replacement (Arrow 1962) vs efficiency (Gilbert & Newbery 1982) effect
- **Theoretical takeaways:** Killer acquisitions
  - Can arise as an optimal strategy for incumbents
  - Particularly when products overlap and current/future competition is low

▸ More on Theory

Optimal Acquisition Strategies



Robustness and Extensions

- Incumbent development advantages
  - Additional motive for acquisition and development
  - Killer acquisitions exist even when incumbent advantages are large

Robustness and Extensions

- Incumbent development advantages
  - Additional motive for acquisition and development
  - Killer acquisitions exist even when incumbent advantages are large
- Vertical differentiation
  - Allow new product to be superior to existing products
  - No qualitative changes to results

Robustness and Extensions

- Incumbent development advantages
  - Additional motive for acquisition and development
  - Killer acquisitions exist even when incumbent advantages are large
- Vertical differentiation
  - Allow new product to be superior to existing products
  - No qualitative changes to results
- Multiple bidders
  - Freeriding incentive exists (auction with externalities)
  - But acquisitions are more likely

Robustness and Extensions

- Incumbent development advantages
  - Additional motive for acquisition and development
  - Killer acquisitions exist even when incumbent advantages are large
- Vertical differentiation
  - Allow new product to be superior to existing products
  - No qualitative changes to results
- Multiple bidders
  - Freeriding incentive exists (auction with externalities)
  - But acquisitions are more likely
- Asymmetric bidders
  - Will the least differentiated incumbent acquire?
  - Has highest acq'n value (with synergy more diff'd firm may acquire)

Main Conceptual Tests

- Test #1: Existence
  - Termination is more likely when incumbent and target products overlap.

Main Conceptual Tests

- Test #1: Existence
  - Termination is more likely when incumbent and target products overlap.
- Test #2: Existing Competition
  - ... is more likely when products overlap and there is little competition.

Main Conceptual Tests

- Test #1: Existence
  - Termination is more likely when incumbent and target products overlap.
- Test #2: Existing Competition
  - ... is more likely when products overlap and there is little competition.
- Test #3: Patent Protection (Future Competition)
  - ... is more likely when products overlap and patent further from expiry.

Main Conceptual Tests

- Test #1: Existence
  - Termination is more likely when incumbent and target products overlap.
- Test #2: Existing Competition
  - ... is more likely when products overlap and there is little competition.
- Test #3: Patent Protection (Future Competition)
  - ... is more likely when products overlap and patent further from expiry.
- Test #4: Acquisition Motives
  - Acquisition is more likely when products overlap.

Main Conceptual Tests

- Test #1: Existence
  - Termination is more likely when incumbent and target products overlap.
- Test #2: Existing Competition
  - ... is more likely when products overlap and there is little competition.
- Test #3: Patent Protection (Future Competition)
  - ... is more likely when products overlap and patent further from expiry.
- Test #4: Acquisition Motives
  - Acquisition is more likely when products overlap.
- Empirical challenges
  - Projects and their development decisions
  - Market overlap and competition

Empirical Design & Results

Data Sources and Sample Structure

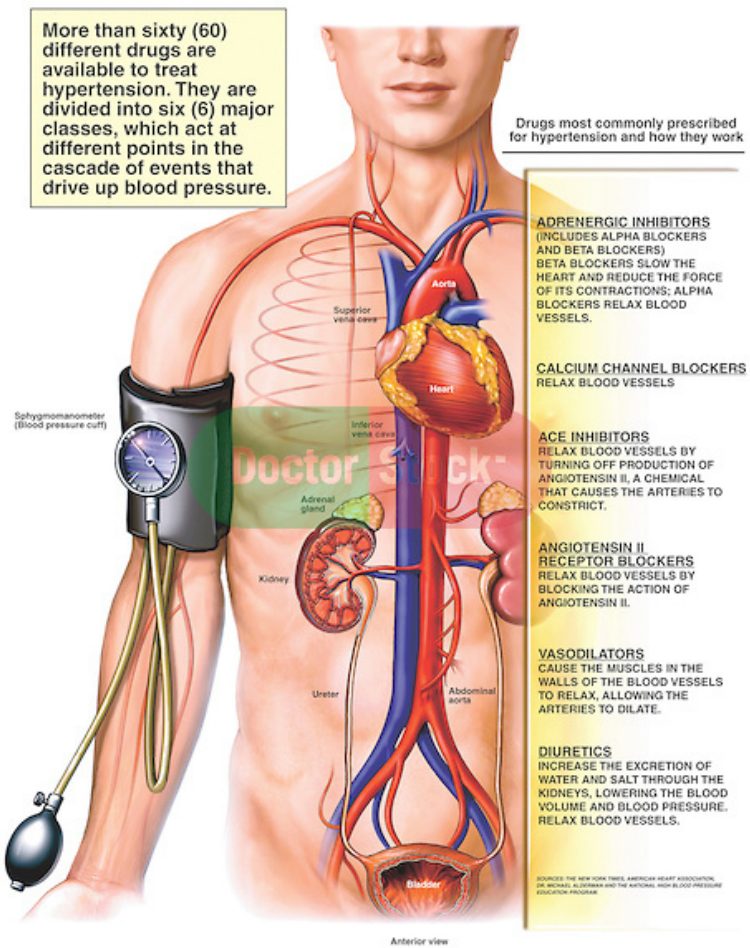
- Drug development record from Pharma Intelligence
  - 16,000+ drug development projects between 1989 and 2010
  - From origination to outcome, including clinical trial information
- Project-level profile
  - Chemical structure, therapeutic and mechanism of action
  - Drug patent and human capital obtained from USPTO data
- Acquisition data
  - SDC Platinum, Thomson Reuters Recap IQ (now Cortellis), VentureXpert
  - Each source is important in our final dataset

Empirical Specification

- Dependent variables
  - Pharmaprojects: development, termination, and neutral events
  - FDA clinical trials: trial phase progression
- Independent variables
  - Need to measure **the degree that new innovation affects incumbents**
  - This is **difficult in general**: demand, preferences, etc.
- Measurement: exploiting market delineations in the pharma industry
  - Same target market: the same therapeutic class (TC)
  - Similar technology: the same mechanism of action (MOA)

▸ More Discussion

Example for Overlap



- **1 Therapeutic class**: Hypertension, or Antihypertensives
- **6 Mechanism of Actions**: how can we treat hypertension?
  - Adrenergic Inhibitors
  - Calcium Channel Blockers
  - ACE Inhibitors
  - Angiotensin II Receptor Blockers
  - Vasodilators
  - Diuretics

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Main Result: Project Development Post Acquisition

	Development Event = 1			
	(1)	(2)	(3)	(4)
I(Acquired) × I(Post) × Overlap	-0.037***	-0.033**	-0.029*	-0.041**
	(0.013)	(0.014)	(0.015)	(0.019)
I(Acquired) × I(Post)	-0.020***	-0.016**	-0.017**	-0.024**
	(0.006)	(0.007)	(0.009)	(0.010)
I(Acquired) × Overlap	0.004	0.009	0.026**	
	(0.008)	(0.009)	(0.011)	
I(Acquired)	-0.002	-0.004	-0.011	
	(0.004)	(0.005)	(0.012)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

- Takeaway: "Killer acquisitions" reduce development.

▸ Propensity Reweighting ▸ Pre-trends ▸ Broader Overlap

Further Results: Effect of Competition

- **Competition:** number of drugs in the same therapeutic class & MOA

	Development Event = 1		
	(1)	(2)	(3)
	Low Competition	High Competition	Interacted
I(Acquired) × I(Post) × Overlap	-0.065**	0.017	0.017
	(0.026)	(0.035)	(0.035)
··· × Low Competition			-0.082*
			(0.044)
Competition Measure	Existing Product Competition		
Observations	74,261	69,308	143,569
R-squared	0.415	0.399	0.408
Vintage FE	Y	Y	Y
Age FE X Therapeutic Class X MOA	Y	Y	Y
Project FE	Y	Y	Y

Further Results: Effect of Competition

- **Competition:** number of drugs in the same therapeutic class & MOA

	Development Event = 1		
	(1)	(2)	(3)
	Low Competition	High Competition	Interacted
I(Acquired) × I(Post) × Overlap	-0.065**	0.017	0.017
	(0.026)	(0.035)	(0.035)
··· × Low Competition			-0.082*
			(0.044)
Competition Measure	Existing Product Competition		
Observations	74,261	69,308	143,569
R-squared	0.415	0.399	0.408
Vintage FE	Y	Y	Y
Age FE X Therapeutic Class X MOA	Y	Y	Y
Project FE	Y	Y	Y

- Takeaway: "Killer acquisitions" are more likely in less competitive markets.

Further Results: Remaining Patent Life

	(1)	(2)
	Development Event = 1	
I(Post) × I(Near Patent Expiry)	0.013	0.406***
	(0.133)	(0.090)
I(Post)	-0.173*	-0.210***
	(0.092)	(0.067)
Observations	6,398	6.398
R-squared	0.212	0.450
Vintage FE	Yes	Yes
Age FE	Yes	Yes
Therapeutic Class X MOA FE	Yes	Yes
Age X Therapeutic Class X MOA FE	No	Yes

Further Results: Remaining Patent Life

	(1)	(2)
	Development Event = 1	
I(Post) × I(Near Patent Expiry)	0.013	0.406***
	(0.133)	(0.090)
I(Post)	-0.173*	-0.210***
	(0.092)	(0.067)
Observations	6,398	6.398
R-squared	0.212	0.450
Vintage FE	Yes	Yes
Age FE	Yes	Yes
Therapeutic Class X MOA FE	Yes	Yes
Age X Therapeutic Class X MOA FE	No	Yes

Further Results: Remaining Patent Life

	(1)	(2)
	Development Event = 1	
I(Post) × I(Near Patent Expiry)	0.013	0.406***
	(0.133)	(0.090)
I(Post)	-0.173*	-0.210***
	(0.092)	(0.067)
Observations	6,398	6.398
R-squared	0.212	0.450
Vintage FE	Yes	Yes
Age FE	Yes	Yes
Therapeutic Class X MOA FE	Yes	Yes
Age X Therapeutic Class X MOA FE	No	Yes

- Takeaway: "Killer acquisitions" are less likely if patents are close to expiry.

Further Results: Overlap and Acquisitions

	(1)	(2)	(3)	(4)
	Acquisition = 1			
Overlap	0.626***		0.577***	
	(0.009)		(0.015)	
Overlap (Disease Only)		0.356***		0.300***
		(0.005)		(0.008)
Overlap × Low Competition			0.088***	
			(0.019)	
Overlap (disease only) × Low Competition				0.103***
				(0.011)
Observations	55,374	55,374	38,430	38,430
Pseudo R-squared	0.118	0.119	0.098	0.097
Deal FE	Y	Y	Y	Y
Matching Method		Random Matching		
No of Deals	9,229	9,229	9,229	9,229
No of Control Deals	46,145	46,145	46,145	46,145

Further Results: Overlap and Acquisitions

	(1)	(2)	(3)	(4)
	Acquisition = 1			
Overlap	0.626***		0.577***	
	(0.009)		(0.015)	
Overlap (Disease Only)		0.356***		0.300***
		(0.005)		(0.008)
Overlap × Low Competition			0.088***	
			(0.019)	
Overlap (disease only) × Low Competition				0.103***
				(0.011)
Observations	55,374	55,374	38,430	38,430
Pseudo R-squared	0.118	0.119	0.098	0.097
Deal FE	Y	Y	Y	Y
Matching Method		Random Matching		
No of Deals	9,229	9,229	9,229	9,229
No of Control Deals	46,145	46,145	46,145	46,145

- Takeaway: Overlap greatly increases probability of acquisition.

Further Results: Overlap and Acquisitions

	(1)	(2)	(3)	(4)
	Acquisition = 1			
Overlap	0.194***		0.209***	
	(0.010)		(0.015)	
Overlap (Disease Only)		0.214***		0.200***
		(0.008)		(0.011)
Overlap × Low Competition			-0.027	
			(0.020)	
Overlap (disease only) × Low Competition				0.025*
				(0.015)
Observations	34,005	34,005	34,005	34,005
Pseudo R-squared	0.052	0.064	0.052	0.065
Deal FE	Y	Y	Y	Y
Matching Method	Matched by Pipeline Size			
No of Deals	9,229	9,229	9,229	9,229
No of Control Deals	46,145	46,145	46,145	46,145

Further Results: Overlap and Acquisitions

	(1)	(2)	(3)	(4)
	Acquisition = 1			
Overlap	0.194***		0.209***	
	(0.010)		(0.015)	
Overlap (Disease Only)		0.214***		0.200***
		(0.008)		(0.011)
Overlap × Low Competition			-0.027	
			(0.020)	
Overlap (disease only) × Low Competition				0.025*
				(0.015)
Observations	34,005	34,005	34,005	34,005
Pseudo R-squared	0.052	0.064	0.052	0.065
Deal FE	Y	Y	Y	Y
Matching Method	Matched by Pipeline Size			
No of Deals	9,229	9,229	9,229	9,229
No of Control Deals	46,145	46,145	46,145	46,145

- Takeaway: Overlap greatly increases probability of acquisition.

Alternative Interpretations

- Is lack of development is due to **optimal project selection**?
  - **No.** Results are unchanged for single-drug targets.
- Is lack of development is due to **real termination**?
  - **Yes.** Acquired projects are quickly terminated rather than just delayed.
- Are killer acquisitions **technology acquisitions**?
  - **No.** Acquirers do not re-use tech or develop molecularly similar drugs.
- Are killer acquisitions **acquihires**?
  - **No.** Most employees leave and those that stay are less productive.
- Are killer acquisitions **salvage acquisitions**?
  - **No.** There are no differences in pre-trend or acquisition values.

Discussion

Early-stage Antitrust and FTC Review

- FTC Review – Hart-Scott-Rodino (HSR) Antitrust Improvements Act
  - No report: < 50 million (as adjusted)
  - Selected report: $[50, 200]$ million with both parties having big assets/sales
  - Mandatory report: > 200 million (as adjusted)
- Analysis design
  - Examine acquisitions and drug development decisions around the threshold

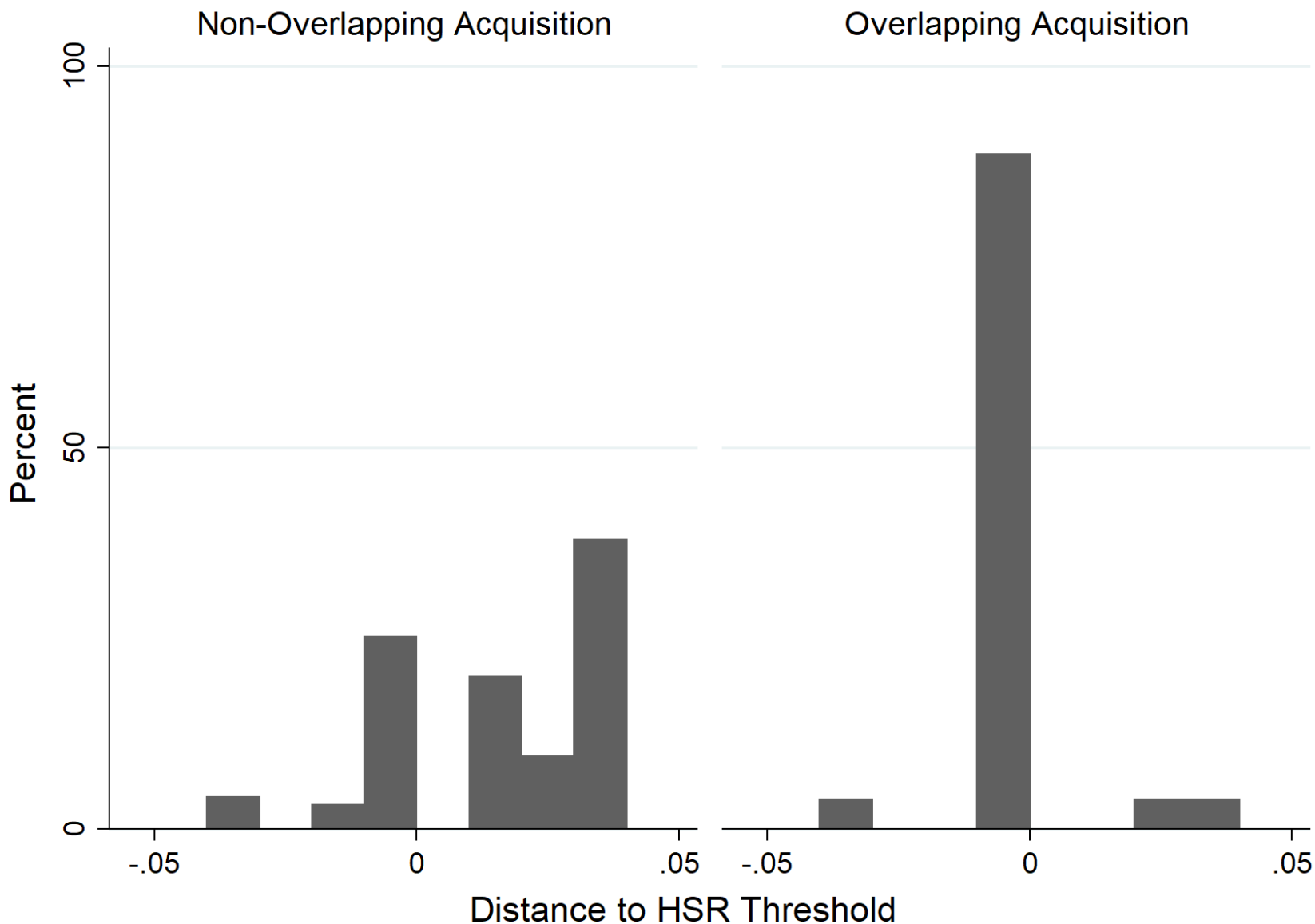
	5% Below Threshold	5% Above Threshold	Difference	t-statistic
Active	3.57%	7.58%	-4.00%	-1.176
Launched	1.79%	9.09%	-7.31%	-2.293**
Discontinued	94.64%	83.33%	11.31%	2.509**
N	112	66		

Early-stage Antitrust and FTC Review

- FTC Review – Hart-Scott-Rodino (HSR) Antitrust Improvements Act
  - No report: $<$ 50 million (as adjusted)
  - Selected report: $[50, 200]$ million with both parties having big assets/sales
  - Mandatory report: $>$ 200 million (as adjusted)
- Analysis design
  - Examine acquisitions and drug development decisions around the threshold

	5% Below Threshold	5% Above Threshold	Difference	t-statistic
Active	3.57%	7.58%	-4.00%	-1.176
Launched	1.79%	9.09%	-7.31%	-2.293**
Discontinued	94.64%	83.33%	11.31%	2.509**
N	112	66		

Do Killer Acquisitions Evade Antitrust Scrutiny?



Frequency and Importance of Killer Acquisitions

- 5.3% to 7.4% of all acquisitions are killer acquisitions
  - More than 50 acquisitions every year
  - Assumes binary type of acquisitions with overlap (pure "killer" vs non-overlapping) and equates development rate to non-overlapping acquisitions

Frequency and Importance of Killer Acquisitions

- 5.3% to 7.4% of all acquisitions are killer acquisitions
  - More than 50 acquisitions every year
  - Assumes binary type of acquisitions with overlap (pure "killer" vs non-overlapping) and equates development rate to non-overlapping acquisitions
- Eliminate all acquisitions with overlapping drugs
  - Average development rate for whole industry would increase by 4%
  - Assumes that development rate is the same as for non-acquired projects
  - Half the size of the Orphan Drug Act (13 per year)

Frequency and Importance of Killer Acquisitions

- 5.3% to 7.4% of all acquisitions are killer acquisitions
  - More than 50 acquisitions every year
  - Assumes binary type of acquisitions with overlap (pure "killer" vs non-overlapping) and equates development rate to non-overlapping acquisitions
- Eliminate all acquisitions with overlapping drugs
  - Average development rate for whole industry would increase by 4%
  - Assumes that development rate is the same as for non-acquired projects
  - Half the size of the Orphan Drug Act (13 per year)
- Impact of killer acquisitions is larger than pay-for-delay

Welfare Implications of Killer Acquisitions

Welfare Implications of Killer Acquisitions

[×] Reduce consumer surplus

- Higher prices and loss of variety—lowering consumer surplus

Welfare Implications of Killer Acquisitions

[×] Reduce consumer surplus

- Higher prices and loss of variety—lowering consumer surplus

[✓] Increase ex-ante incentives for innovation

- Additional acquisition channel may spur drug project origination
- Overall effect depends on elasticity of entrepreneur's idea generation
- ... but there are less inefficient ways to encourage new ideas!

Welfare Implications of Killer Acquisitions

[×] Reduce consumer surplus

- Higher prices and loss of variety—lowering consumer surplus

[✓] Increase ex-ante incentives for innovation

- Additional acquisition channel may spur drug project origination
- Overall effect depends on elasticity of entrepreneur's idea generation
- ... but there are less inefficient ways to encourage new ideas!

[✓] Eliminate excess entry

- Eliminate duplication of development costs (Mankiw & Whinston 1986)
- ... but only relevant in markets with many existing incumbents anyway!

Welfare Implications of Killer Acquisitions

[×] Reduce consumer surplus

- Higher prices and loss of variety—lowering consumer surplus

[✓] Increase ex-ante incentives for innovation

- Additional acquisition channel may spur drug project origination
- Overall effect depends on elasticity of entrepreneur's idea generation
- ... but there are less inefficient ways to encourage new ideas!

[✓] Eliminate excess entry

- Eliminate duplication of development costs (Mankiw & Whinston 1986)
- ... but only relevant in markets with many existing incumbents anyway!

[×] Distort direction of innovation

- Originate excessively similar "me-too" drug projects (entry for buyout)
- Without killer acquisitions entrepreneurs would focus effort elsewhere!

Conclusion

Concluding Remarks

- What this paper says
  - Incumbents acquire entrepreneurial targets and terminate innovation
  - Particularly when products overlap and there is little competition
- What this paper does **not** say
  - All acquisitions are "killer acquisitions"
  - Killer acquisitions are necessarily welfare-reducing
- Our results have implications for
  - Antitrust policy
  - Startup exit
  - Creative destruction

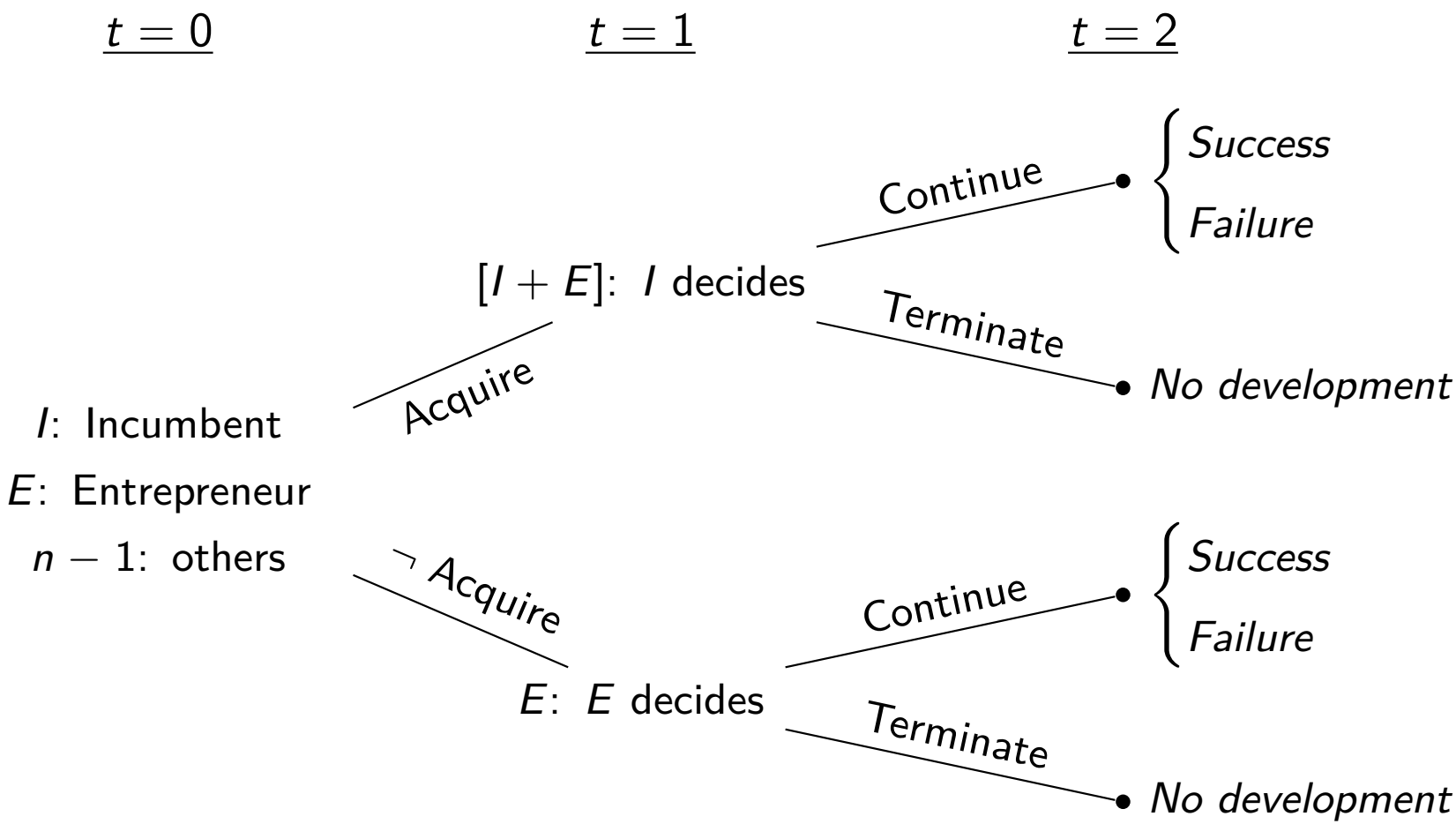
Killer Acquisitions

Colleen Cunningham[†] Florian Ederer[‡] Song Ma[‡]

[†]London Business School [‡]Yale School of Management

Autoridade da Concorrência Webinar

Setup and Timeline



Product Market Competition ($t = 2$)

- $\neg acq$: Entrepreneur remained independent
  - Killed project or failed development
    - E: $\pi(n, 0)$ I: $\pi(n, 1)$
  - Successful development
    - E: $\pi(n + 1, 1)$ I: $\pi(n + 1, 1)$

Product Market Competition ($t = 2$)

- $\neg acq$: Entrepreneur remained independent
  - Killed project or failed development
    - E: $\pi(n, 0)$ I: $\pi(n, 1)$
  - Successful development
    - E: $\pi(n + 1, 1)$ I: $\pi(n + 1, 1)$
- acq: Incumbent acquired entrepreneur at previous date
  - Killed project or failed development
    - E: n/a I: $\pi(n, 1)$
  - Successful development
    - E: n/a I: $\pi(n + 1, 2)$

Product Market Competition ($t = 2$)

- $\neg acq$: Entrepreneur remained independent
  - Killed project or failed development
    - E: $\pi(n, 0)$ I: $\pi(n, 1)$
  - Successful development
    - E: $\pi(n+1, 1)$ I: $\pi(n+1, 1)$
- acq: Incumbent acquired entrepreneur at previous date
  - Killed project or failed development
    - E: n/a I: $\pi(n, 1)$
  - Successful development
    - E: n/a I: $\pi(n+1, 2)$
- Setup is quite general
  - But, specifically, differentiated Bertrand (or Cournot) competition with linear demands, $0 < \gamma < \beta$ captures product homogeneity
  - Old and new products are the same, but easy to relax this assumption

Continuation Decision ($t = 1$)

- $\neg acq$: Entrepreneur remained independent
  - Continue development if $\rho[\pi(n+1,1) - \pi(n,0)] - k \geq L$
  - $\Delta^E \equiv \pi(n+1,1) - \pi(n,0)$ is E's marginal innovation benefit
  - Decision rule: continue if and only if $k \leq k^E$

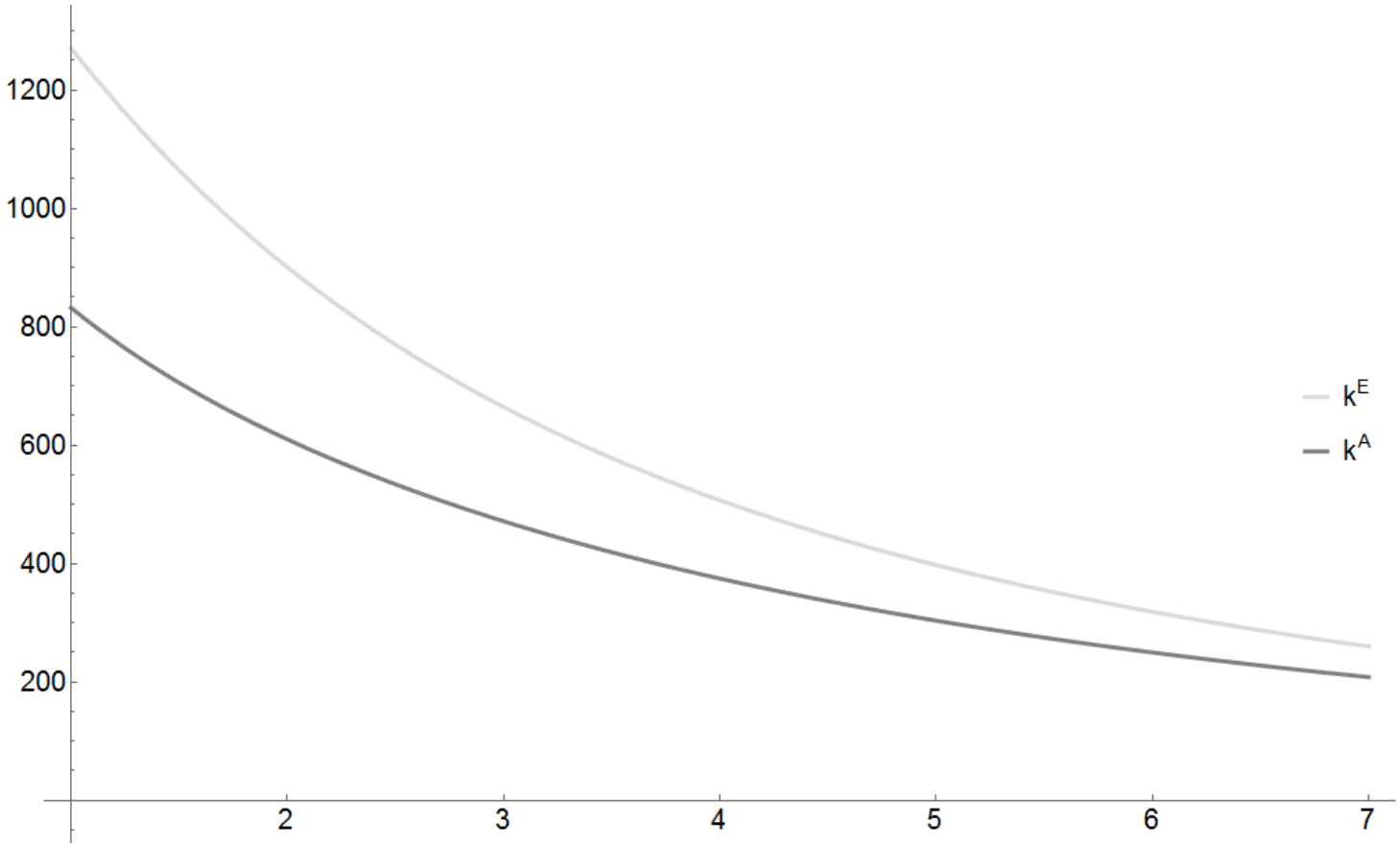
Continuation Decision ($t = 1$)

- $\neg acq$: Entrepreneur remained independent
  - Continue development if $\rho[\pi(n+1,1) - \pi(n,0)] - k \geq L$
  - $\Delta^E \equiv \pi(n+1,1) - \pi(n,0)$ is E's marginal innovation benefit
  - Decision rule: continue if and only if $k \leq k^E$
- acq: Incumbent acquired entrepreneur
  - Continue development if $\rho[\pi(n+1,2) - \pi(n,1)] - k \geq L$
  - $\Delta^I \equiv \pi(n+1,2) - \pi(n,1)$ is I's marginal innovation benefit
  - Decision rule: continue if and only if $k \leq k^I$

Continuation Decision ($t = 1$)

- $\neg acq$: Entrepreneur remained independent
  - Continue development if $\rho[\pi(n+1,1) - \pi(n,0)] - k \geq L$
  - $\Delta^E \equiv \pi(n+1,1) - \pi(n,0)$ is E's marginal innovation benefit
  - Decision rule: continue if and only if $k \leq k^E$
- acq: Incumbent acquired entrepreneur
  - Continue development if $\rho[\pi(n+1,2) - \pi(n,1)] - k \geq L$
  - $\Delta^I \equiv \pi(n+1,2) - \pi(n,1)$ is I's marginal innovation benefit
  - Decision rule: continue if and only if $k \leq k^I$
- Arrow's (1962) replacement effect
  - $\Delta^E - \Delta^I$ is the difference in marginal innovation benefits
  - Equal to 0 iff $\gamma = \{0, \beta\}$, > 0 otherwise, thus $k^E > k^I$
  - Development decision rules differ in region $[k^I, k^E]$

Competition and Continuation



Acquisition Regions

- $k > k^E$
  - E and I kill the project ($d^E = d^I = 0$)
  - Acquire if $\sigma \geq 0$

Back

Acquisition Regions

- $k > k^E$
  - E and I kill the project ($d^E = d^I = 0$)
  - Acquire if $\sigma \geq 0$
- $k^E \geq k > k^I$
  - E continues ($d^E = 1$), but I kills the project ($d^I = 0$)
  - Acquire if $\sigma + \underbrace{\rho(\pi(n,1) - \pi(n+1,1))}_{\text{prevent cannibalization}} \geq \underbrace{(\rho\Delta^E - k - L)}_{\text{valuation difference}}$

Back

Acquisition Regions

- $k > k^E$
  - E and I kill the project ($d^E = d^I = 0$)
  - Acquire if $\sigma \geq 0$
- $k^E \geq k > k^I$
  - E continues ($d^E = 1$), but I kills the project ($d^I = 0$)
  - Acquire if $\sigma + \underbrace{\rho(\pi(n,1) - \pi(n+1,1))}_{\text{prevent cannibalization}} \geq \underbrace{(\rho\Delta^E - k - L)}_{\text{valuation difference}}$
- $k^I \geq k$
  - E and I continue project ($d^E = d^I = 1$)
  - Acquire if $\sigma + \underbrace{\rho(\pi(n+1,2) - \pi(n,1))}_{\text{soften cannibalization}} \geq \underbrace{\rho(\Delta^E - \Delta^I)}_{\text{valuation difference}}$

Back

Discussion of the Empirical Approach

- Goal of our empirical analysis
  - Back out firms' (killer acquisition) motive from observable outcomes
  - Analyzing "randomly assigned" acquisitions is not meaningful
- Challenge (as a detective)
  - Observing an acquisition does not tell us what type of acquisition it is
  - Observing an acquisition + discontinuation does not either (euthanasia)
- Our approach: compare overlapping and non-overlapping acquisitions
  - Overlapping: combination of "killing" and "development" motives
  - Non-overlapping: only "development" motives
  - **Difference**: existence/size of the "killing" motive

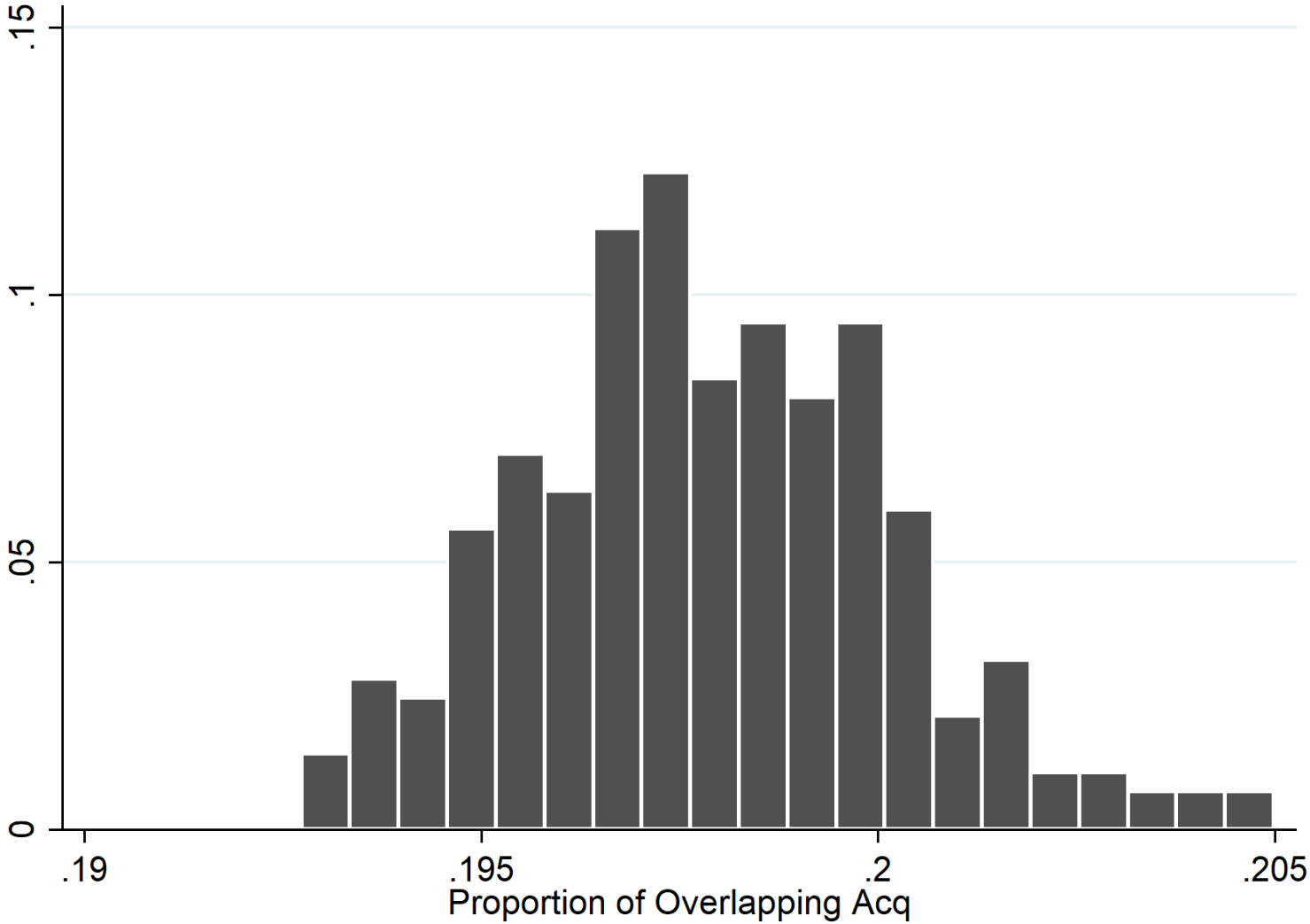
Back

What Random Variation Could We Use?

- Random variation?
  - Deal-level variation: may not be the most appropriate
  - Aggregate variation: can help "identify" the aggregate effects
- Logic: shock the "benefit" of killer acquisitions at the aggregate level
  - Shock to the benefit of suppressing competition for some firms
  - Outcomes: aggregate acquisition level; post acquisition continuation
- Which aggregate shocks alter the intention to "kill"?
  - Short answer: no perfect shock yet
  - Candidates:
    - Medicare prescription drug coverage
    - Sudden discovery of new technologies
    - FDA public health advisories to competing drugs

Back

Randomization Test of Overlapping Acquisitions



"Pre-trend"

	Continuation Event = 1			
d[t-3] × Overlap	-0.011	-0.011	-0.005	-0.031
	(-0.476)	(-0.369)	(-0.176)	(-0.982)
d[t-2] × Overlap	-0.025	0.015	0.024	0.012
	(-1.068)	(0.513)	(0.793)	(0.381)
d[t-1] × Overlap	-0.043**	-0.022	-0.018	-0.040
	(-1.988)	(-0.855)	(-0.690)	(-1.355)
d[t-3]	-0.001	0.010	0.013	0.015
	(-0.112)	(0.607)	(0.768)	(0.862)
d[t-2]	0.008	0.017	0.018	0.020
	(0.721)	(1.118)	(1.128)	(1.178)
d[t-1]	-0.010	-0.002	-0.000	-0.003
	(-0.993)	(-0.124)	(-0.030)	(-0.171)
Other variables		**Omitted**		
Observations	143,569	143,569	143,569	143,569
R-squared	0.038	0.256	0.294	0.370
Vintage FE	Y	Y	Y	Y
Age FE	Y			
Age FE X Therapeutic Class X MOA		Y	Y	Y
Originator [Target Company] FE			Y	
Project FE				Y

Back

Main Result: "Overlapping" Definition

	(1)	(2)	(3)	(4)
	Development Event = 1			
I(Acquired) × I(Post) × Overlap (TC-MOA)	–0.052***	–0.037**	–0.036**	–0.051**
	(0.014)	(0.015)	(0.016)	(0.020)
I(Acquired) × I(Post) × Overlap (TC)	–0.046***	–0.018	–0.022	–0.036*
	(0.012)	(0.017)	(0.018)	(0.021)
I(Acquired) × I(Post)	–0.005	–0.012	–0.010	–0.013
	(0.007)	(0.009)	(0.010)	(0.012)
I(Acquired) × Overlap (TC-MOA)	0.009	0.007	0.034**	
	(0.008)	(0.009)	(0.013)	
I(Acquired) × Overlap (TC)	0.013*	–0.007	0.015	
	(0.007)	(0.010)	(0.013)	
I(Acquired)	–0.007	–0.001	–0.015	
	(0.005)	(0.006)	(0.013)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.037	0.252	0.289	0.366
Vintage FE	Y	Y	Y	
Age FE	Y			
Age FE × TC × MOA		Y	Y	Y
Originator [Target company] FE			Y	
Project FE				Y

Back

Main Result: "Overlapping" Definition

	(1)	(2)	(3)	(4)
	Development Event = 1			
I(Acquired) × I(Post) × Overlap (TC-MOA)	–0.052***	–0.037**	–0.036**	–0.051**
	(0.014)	(0.015)	(0.016)	(0.020)
I(Acquired) × I(Post) × Overlap (TC)	–0.046***	–0.018	–0.022	–0.036*
	(0.012)	(0.017)	(0.018)	(0.021)
I(Acquired) × I(Post)	–0.005	–0.012	–0.010	–0.013
	(0.007)	(0.009)	(0.010)	(0.012)
I(Acquired) × Overlap (TC-MOA)	0.009	0.007	0.034**	
	(0.008)	(0.009)	(0.013)	
I(Acquired) × Overlap (TC)	0.013*	–0.007	0.015	
	(0.007)	(0.010)	(0.013)	
I(Acquired)	–0.007	–0.001	–0.015	
	(0.005)	(0.006)	(0.013)	
Observations	143,569	143,569	143,569	143,569
R-squared	0.037	0.252	0.289	0.366
Vintage FE	Y	Y	Y	
Age FE	Y			
Age FE × TC × MOA		Y	Y	Y
Originator [Target company] FE			Y	
Project FE				Y

- Takeaway: "Killer acquisitions" exist for broader overlapping definitions.

Back

Further Results: Clinical Trials (From Phase I to Phase II)

		Phase II = 1		
	(1)	(2)	(3)	(4)
		Low Competition	High Competition	Interacted
I(Acq'd by Overlapping Firms)	-0.177***	-0.356***	-0.142***	-0.126***
	(0.028)	(0.071)	(0.031)	(0.030)
$\cdots \times$ Low Competition				-0.221***
				(0.077)
Competition Measure		Existing Product		
Observations	1,860	511	1,348	1,860
R-squared	0.151	0.286	0.156	0.161
Phase I Start Year FE	Y	Y	Y	Y

Back

Further Results: Clinical Trials (From Phase I to Phase II)

		Phase II = 1		
	(1)	(2)	(3)	(4)
		Low Competition	High Competition	Interacted
I(Acq'd by Overlapping Firms)	-0.177***	-0.356***	-0.142***	-0.126***
	(0.028)	(0.071)	(0.031)	(0.030)
$\cdots \times$ Low Competition				-0.221***
				(0.077)
Competition Measure		Existing Product		
Observations	1,860	511	1,348	1,860
R-squared	0.151	0.286	0.156	0.161
Phase I Start Year FE	Y	Y	Y	Y

Back

Further Results: Clinical Trials (From Phase I to Phase II)

		Phase II = 1		
	(1)	(2)	(3)	(4)
		Low Competition	High Competition	Interacted
I(Acq'd by Overlapping Firms)	-0.177***	-0.356***	-0.142***	-0.126***
	(0.028)	(0.071)	(0.031)	(0.030)
$\cdots \times$ Low Competition				-0.221***
				(0.077)
Competition Measure		Existing Product		
Observations	1,860	511	1,348	1,860
R-squared	0.151	0.286	0.156	0.161
Phase I Start Year FE	Y	Y	Y	Y

- Takeaway: Acquired overlapping projects are less likely to reach Phase II.

Back

Alternative Interpretations

Alternative Interpretations

- Is lack of development due to **optimal project selection**.
  - **No.** Results are unchanged for single-drug targets.

Alternative Interpretations

- Is lack of development due to **optimal project selection**.
  - **No.** Results are unchanged for single-drug targets.
- Is lack of development due to **real termination**?
- Are killer acquisitions **technology acquisitions**?
- Are killer acquisitions **acquihires**?
- Are killer acquisitions **salvage acquisitions**?

Actual Termination

- A purposefully terminated project should incur no post-acquisition development events
  - Focus only on the sample of acquired projects and examine whether they incur **any** development events post-acquisition
  - Post-acquisition, overlapping projects are 32.9 percentage points (54%) more likely to have no development events than non-overlapping projects

Actual Termination

- A purposefully terminated project should incur no post-acquisition development events
  - Focus only on the sample of acquired projects and examine whether they incur **any** development events post-acquisition
  - Post-acquisition, overlapping projects are 32.9 percentage points (54%) more likely to have no development events than non-overlapping projects
- Confirm that main results are driven by acquired terminated projects
  - Re-run our main analyses but take out the "never-developed" projects
  - No significant differences in likelihood of development events between acquired-overlap and acquired-non-overlap projects

Alternative Specifications

	(1)	(2)	(3)
	Development Event =1		No Development = 1
I(Acquired) × I(Post) × Overlap	-0.050**	0.005	0.149***
	(0.023)	(0.035)	(0.033)
I(Acquired) × I(Post)	-0.024	-0.095***	0.401***
	(0.015)	(0.013)	(0.021)
Observations	27,784	7,916	9,227
R-squared	0.445	0.155	0.47
Sample:	Acquired Projects	w/o "never developed"	Acquired Projects
Therapeutic X MOA FE			Y
Age X Therapeutic X MOA FE	Y	Y	
Project FE	Y	Y	Y

Redeployment of Technologies

- Another alternative explanation is "project killed, technology re-used"
  - Do acquirers redeploy technologies from killed projects?

	(1)	(2)	(3)	(4)	(5)	(6)
	Chemical Similarity			Citation to Targets		
I(Post) × Overlap	0.001	0.000	0.002	-0.002	-0.002	-0.000
	(0.481)	(0.111)	(0.872)	(-1.078)	(-1.052)	(-0.788)
I(Post)	-0.002	-0.001	-0.004	0.000	0.001	-0.000
	(-0.609)	(-0.295)	(-1.364)	(0.056)	(0.931)	(-0.005)
Overlap	0.004	0.004		0.002	0.002	
	(1.263)	(1.206)		(1.078)	(0.929)	
Observations	154,896	154,896	154,896	154,896	154,896	154,896
R-squared	0.001	0.014	0.361	0.001	0.094	0.154
Acquirer FE	No	Yes	No	No	Yes	No
Case FE	No	No	Yes	No	No	Yes

Mobility and Productivity of Human Capital

- Another alternative explanation is "human capital >> project"
  - Not necessarily true in pharmaceutical and medical device industry (Gompers et al., 2017) because the project itself is key
  - Inventor data allow analysis on human capital mobility and productivity

	Before Acquisition	After Acquisition	Difference
Those Who Move to Acquirer After Acquisition (22%)	4.572	3.160	-1.412***
Those Who Move to Other Firms After Acquisition (78%)	4.357	4.089	-0.267*
Difference	-0.215	0.929***	1.144***

Mobility and Productivity of Human Capital

- Another alternative explanation is "human capital >> project"
  - Not necessarily true in pharmaceutical and medical device industry (Gompers et al., 2017) because the project itself is key
  - Inventor data allow analysis on human capital mobility and productivity

	Before Acquisition	After Acquisition	Difference
Those Who Move to Acquirer After Acquisition (22%)	4.572	3.160	-1.412***
Those Who Move to Other Firms After Acquisition (78%)	4.357	4.089	-0.267*
Difference	-0.215	0.929***	1.144***

Mobility and Productivity of Human Capital

- Another alternative explanation is "human capital >> project"
  - Not necessarily true in pharmaceutical and medical device industry (Gompers et al., 2017) because the project itself is key
  - Inventor data allow analysis on human capital mobility and productivity

	Before Acquisition	After Acquisition	Difference
Those Who Move to Acquirer After Acquisition (22%)	4.572	3.160	-1.412***
Those Who Move to Other Firms After Acquisition (78%)	4.357	4.089	-0.267*
Difference	-0.215	0.929***	1.144***

Salvage Acquisitions?

- Another alternative explanation is "salvage" of dead/dying projects
  - No significant pre-trend difference in development for overlap acquisitions
  - Plus: overlapping acquisitions **are not** significantly cheaper

	(1)	(2)	(3)
	Ln(Acquisition Value)		
Overlap	0.126	0.025	-0.082
	(0.101)	(0.067)	(0.114)
Observations	14,660	14,660	14,660
R-squared	0.844	0.905	0.940
Acquirer FE	Y	Y	Y
Age FE	Y	Y	
Therapeutic Class X MOA FE		Y	
Age X Therapeutic Class X MOA FE			Y