Innovation Spillovers and Merger Decisions: Evidence from a Panel of U.S. Firms

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Merger in Innovative Industries

Mergers in Innovative Industries
Chirgui (2009); De Man and Dysters (2005)

- Mergers Provide Resources for Innovation
  Katz and Shelanski (2005); Becketti (1986)
- Combining R&D and Research Pipeline
  Huck et al. (2000); Henderson (2000)
- Innovation Spillovers
  (Entezarkheir and Moshiri (2017);
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Merger and Spillover

Spillover of Firms' Innovative Ideas $\Rightarrow$

- Aghion and Howitt (1992, 1998); Jaffe (1998)
- Discourages Innovation
- Private Return $\neq$ Social Returns

$\Rightarrow$ Firms Merge to Capture Spillover

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Outward Innovation Spillover

- Firms' Innovation Generates Knowledge
  Driffield et al. (2010); Driffield (2001); Oulton (1997)
- Firms Gain Competitive Advantage from Knowledge
  Alcacer and Chung (2007)
- Firms can not Easily Prevent Leakage of Knowledge

$\Rightarrow$ Outward Innovation Spillover
$\Rightarrow$ Rivals' Free-Riding
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Inward Innovation Spillover

- Other's Innovation Increase Receiving Firms' Productivity
  Jaffe (1986); Alcacer and Zhao (2012)
- Other's Innovation Increase Their Efficiency
  Alcacer and Chung (2007)
- Other's Innovation Limit Receiving Firms' Market
  Alcacer and Chung (2007)

$\Rightarrow$ Receiving Firms' Merge to Regain Competitive Edge

Our Contributions and Analysis

Panel of Merging and Non-Merging Firms

Empirical Evidence for the Impact of

- Outward Innovation Spillover on Merger
- Inward Innovation Spillover on Merger

Instrumented Impact of Outward Spillover on Merger

Our Contributions and Analysis

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Our Contributions and Analysis

Driving Factors of Merger Waves (Brealey et al., 2012)

- Business Cycles
  Komlenovic et al. (2011)
- Neoclassical Theory
  Harford (2005)
- Behavioural Theory
  Shleifer and Vishny (2003)
- Q Theory
  Jovanovic and Rousseau (2002)

Our Contributions and Analysis

- Within Industry Inward Spillover
- Between Industry Inward Spillover

Panel Logit Regression

$$
\begin{aligned}
Prob(Merger_{it}) = {} & \beta_0 + \beta_1 logR\&DStock_{it-1} + \beta_2 logSpillR\&D_{it-1} \\
& + \beta_3 BC_{t-1} + \beta_4 AssetTurnover_{it} + \beta_5 EmployGrowth_{it} \\
& + \beta_6 SaleGrowth_{it} + \beta_7 Profitability_{it} + \beta_8 ROA_{it} \\
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Measuring Outward Spillover

Outward Spillover is Measured by

- Stock of R&D
  ($R\&DStock_{it}$)
  Noel and Schankerman (2013); Hall et al. (2005)

- Stock of Citation-Weighted Patents
  ($CitationPatent_{it}$)
  Entezarkheir and Moshiri (2017); Hall et al. (2005)

Measuring Inward Spillover

Literature Suggests Two Methods:

- Aggregated R&D of Other Firms
  Bernstein and Nadiri (1989)

- Aggregated and Weighted R&D of Other Firms
  Weights are Technological Distance
  Entezarkheir (2017); Bloom et al. (2013);
  Noel and Schankerman (2013); Jaffe (1986)

Measuring Inward Spillover

Inward Spillover is Measured by

- $SpillR\&D_{it} = \sum_{j \neq i} \rho_{ij} \times R\&DStock_{jt}$
- $SpillCitePat_{it} = \sum_{j \neq i} \rho_{ij} \times CitationPatent_{jt}$

$$Technological\ Proximity = \rho_{ij} = \frac{S_i' S_j}{(S_i' S_i)^{1/2}(S_j' S_j)^{1/2}}$$

$$S_i = s_{i1}, s_{i2}, ..., s_{iN}$$

Data Sources

Updated NBER Patent and Citation Data

- From 1976 to 2006

Compustat (Standard and Poors)

- From 1976 to 2006

Company Identifier Data

Thompson Financial SDC Platinum Merger Data

- 877 Merger Pairs from 1980 to 2003

Bloomberg

Sample

Unbalanced Panel of 6,030 Merging and Non-Merging

Publicly Traded U.S. Manufacturing Firms from 1980 to 2003

with 60,736 Observations and 877 Pairs of Merging Firms

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Merger Decision and Innovation Spillover

DV	(1)	(2)(RE)	(3)	(4)
$Merger_{it}$				
$logR\&DStock_{it-1}$	0.380***	0.0.454***	0.402**	
	(0.088)	(0.049)	(0.126)	
$logSpillR\&D_{it-1}$	0.661 ***	0.320***		
	(0.169)	(0.082)		
$logSpillR\&DInd_{it-1}$			0.629**	
			(0.228)	
$logCitePatent_{it-1}$				0.083**
				(0.034)
$logSpillCitePat_{it-1}$				0.761***
				(0.125)
Firm FE	Yes	No	Yes	Yes
Other Controls	Yes	Yes	Yes	Yes

Measuring Patent Thicket as Instrument

$$F_{it} = 1 - \sum_{j=0}^{J} \left(\frac{cite_{ijt}}{cite_{it}} \right)^2$$

i-Citing Firm

j-Cited Firm

t-Year

Panel IV Estimates of Merger and Innovation Spillover

First Stage IV **Panel Fixed Effects Estimator**			
DV: $logR\&DStock_{it-1}$	(1)	(2)	(3)
F	19.62 [0.000]	157.19 [0.000]	144[0.000]
$logF_{it-1}$	-0.295***		-0.124***
	(0.038)		(0.025)
$logF_{it-2}$		-0.154***	-0.150***
		(0.025)	(0.025)
Second Stage IV **Panel Logit Estimator**			
DV: $Merger_{it}$			
$logR\&DStock_{it-1}$	0.376***	0.358**	0.357**
	(0.101)	(0.123)	(0.119)
Firm FE	Yes	Yes	Yes
J-test			2.09[5.024]

Measuring Intra Industry R&D Spillover

$$intraSpillR\&D_{izt} = \sum_{j=1, j\neq i}^{n_z} \rho_{ij} \times R\&Dstock_{jzt}$$

ρ_{ij}: Technological Proximity

z: Stands for 6 Industries

n_z: Number of Firms in Industry z Except for Firm i

Measuring Inter Industry R&D Spillover

$$inerSpillR\&D_{izt} = \sum_{h=1,h\neq z}^{6} \sum_{j=1,j\neq i}^{n_h} \rho_{ij} \times R\&Dstock_{jht}$$

ρ_{ij}: Technological Proximity

h: Other Industries Except for Industry of Firm i

n_h: Number of Firms in Other Industries

Intra and Inter R&D Spillovers and Merger

DV	(1)	(2)	(3)
$Merger_{it}$	All	Horizontal Non-Merging	Non-Horizontal Non-Merging
$logR\&DStock_{it-1}$	0.349***	0.412***	0.296
	(0.105)	(0.111)	(0.252)
$logintraSpillR\&D_{iz-1}$	0.608**	0.552**	
	(0.256)	(0.215)	
$loginterSpillR\&D_{iz-1}$	0.075		0.718
	(0.302)		(0.510)
Firm FE	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes

Conclusions

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- Instrumented Outward Spillover ↑ Merger
- Inward Spillover ↑ Merger
- Within Industry Inward Spillover ↑ Merger
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Future Research

- Mergers and R&D Advancements
- Mergers and Attainment of Intangible Assets