Innovative Intangible Assets in M&As: The Impact of Radical and Incremental Innovations on Acquirers

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Idea

M&As are a crucial strategy for companies aiming to secure a competitive advantage and boost R&D activity.(see, e.g., Betton et al., 2008; King et al., 2008; Bena and Li, 2014)

Can acquirers put purchased innovations to good use?

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Can acquirers put purchased innovations to good use?

Does innovation heterogeneity play a role?

My paper:

- Propose empirical measures to distinguish radical vs incremental innovations.
- Who pursues radical vs incremental innovations?
- Is the adoption of purchased innovations successful?

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Innovations: Radical vs Incremental

- **Innovation** is the process of translating new ideas or inventions into production factors that create economic value. (Kogan and Papanikolaou, 2019)
- "... **radical innovation**, which involves combining diverse ideas to generate a technological improvement in a new area." (Acemoglu et al., 2022)
  - Prosthetic Repair Fabric with Erosion Resistant Edge — implantable prosthesis for repairing anatomical weaknesses. (US 6736854)
- "...firms can engage in **incremental innovation** by building on their existing leading-edge products." (Acemoglu et al., 2022)
  - New system of prosthesis based on the new fabric.

How to measure innovations?

- Measuring inputs: R&D expenditures *(skewed output, smoothing in R&D exp.)*
- Measuring outputs: Patent-based metrics *(only patentable innovations)*
  - Number of patents ($\times$ citations), number of *highly-cited* employees, etc.
  - Dollar value of patents (KPSS) - *market reaction on granted patents*
- **New Approach:** measuring output beyond patents
  - **Hand-collected** detailed deal-level information on acquired intangible assets, Purchase Price Allocation information (PPA)

PPA files $\Rightarrow$ Market value of purchased Innovations

Based on PPA data: Ewens et al., 2024, He, 2024, Beneish et al., 2022

In a nutshell

- Research questions:
  - Determinants of purchasing radical vs incremental innovations
  - Performance of a joint entity: ability to adopt technologies (market expansion and cost reduction), innovativeness (radicality of the future patents), and market reaction (CARs)
- Data and Methodology
  - SDC and *unique* data: PPA data + KPSS $\Rightarrow$ \$*Radical* vs \$*Incremental* innovations

Key results:

Before				After				
				Innovations	$\nearrow \Rightarrow$	Sales Growth		$\nearrow$
Cash	$\nearrow \overset{corr}{\Longrightarrow}$	Pr(buy *Incremental*)	$\nearrow$	Incremental	$\nearrow \Rightarrow$	Costs		$\searrow$
Scale	$\nearrow \overset{corr}{\Longrightarrow}$	Pr(buy *Radical*)	$\nearrow$	Radical	$\nearrow \Rightarrow$	Value of patents		$\nearrow$

Contribution to the Literature

- M&A is the mechanism through which technology is adopted by firms (e.g., Ma et al., 2022, Beaumont et al., 2022)
  My paper: the purchasing of radical and incremental innovations exhibit distinct incentives and consequently vary in their adoption by the acquiring party
- Heterogeneity (radical vs incremental) of innovation activity (Kerr and Nanda 2015, Acemoglu et al., 2022, Kogan et al., 2020, Caggese, 2019)
  My paper: radical and incremental innovations stimulate business model changes in distinct manners
- A measurement of innovation activities: (Kogan et al., 2017, Beneish et al., 2022, Glaeser et al., 2020)
  My paper: a new empirical measure of incremental innovations, comprehensive data on acquired intangible assets

PPA file: public-to-public US M&A 2001-2022

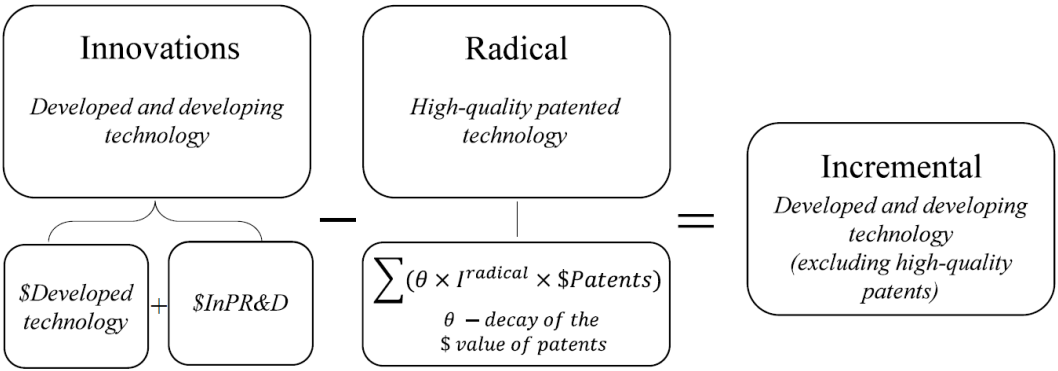
- PPA - fair value of acquired intangible assets.

It is required to be disclosed after the passage of Statement of Financial Accounting Strands No. 141 and No. 142 in 2001.

	(in thousands)
....	
Identifiable intangible assets:	
Core-developed technology	**$81,900**
Customer contracts and relationships	$134,000
Trademark and trade names	$231
Total identified intangible assets subject to amortization	$226,700
In-process research and development (IPR&D)	**$14,400**
Total identified intangible assets	$241,100
Goodwill	$575,750
Current liabilities	($99,406)
Total net assets acquired	$809,216

- It allows to determine the common classification for all firms (e.g., in-process R&D, technology, trademarks, and customer relationship) and offers fair values of these intangible assets.

Innovations: Radical and Incremental



θ is linear decay factor as in Beneish et al., 2022. My findings are robust to models using exponential decay as well.

Example: KPSS & USPTO

Table: Examples of the patents granted by Silver Spring Network between IPO and M&A.

Publication Date	Citations	Cites q_{25}	ξ^{real}	$V^{t,T}(\text{patent}_j)$
16.04.13	20	5	5.10	9.16
08.07.14	8	5	4.27	8.34
24.03.15	2	3	2.61	0
27.10.15	4	3	3.39	7.19
03.11.15	1	3	3.66	0
...	...	...	...	...

- *$Innovations = $96.3 million* (PPA)
- $\sum V^{t,T}(p_{SSNI}) =$ *$47.54 million* $\Rightarrow$ \$47.54 million attributed to *$Radical* and (\$96.3-\$47.54) \$48.76 million to *$Incremental* innovations.

$V^{t,T}(p_{patent_j}) = I^{radical} \times \frac{T-t}{20} \xi^{adjusted}$, where t is the year when patent was granted, T is the M&A year, and $\xi^{adjusted}$ is $\xi^{real} \times \pi_{1982,t}$.

Example: The acquisition of Netegrity, Inc. by Computer Associates International, Inc.

	(in millions)
Cash and marketable securities	$97
Deferred income taxes, net	$4
Liabilities assumed, net	($12)
Software products	**$37**
Customer relationships	$45
Trademarks/tradenames	$26
Goodwill	$258
Purchase price	**$455**

- *$Innovations* = $37 million
- USPTO: 0 patents
- $Incremental = $37 million, $Radical = $0 million

My Sample

- 1,844 US public-to-public M&A deals by 1,191 unique acquirers
- 1,416 have complete PPA, KPSS, and Compustat data
- 314 (17.1%) companies have missing Total Intangibles and 86 (4.7%) have zero Total Intangibles and Goodwill
- 310 firms reported non-zero Other Intangibles and Goodwill
- 62.8% of the sample reports positive fair value of technology-related intangible assets, excluding trademarks, and 77.9% with trademarks

Innovation Measures: Summary Statistics

Panel A: Main statistics

	Obs.	Mean	Sd	Median
	(1)	(2)	(3)	(4)
Incremental Innovations ($ mil)	1415	374.22	2872.99	0
Radical Innovations ($ mil)	1415	374.68	2599.04	0
Incremental Inn./$Innovations	1415	0.41	0.46	0
Radical Inn./$Innovations	1415	0.16	0.33	0
$Innovations/Value of Trans.	1415	0.16	0.34	0.03

Panel B: Correlation between measures

	(1)	(2)	(3)	(4)	(5)
(1) *Incremental Inn./$Innovations*	1.000				
(2) *Radical Inn./$Innovations*	-0.255***	1.000			
(3) *$Innovations/Value of Trans.*	0.449***	0.003	1.000		
(4) # of radical patents$_{target}$	-0.088***	0.307***	0.034	1.000	
(5) # of patents$_{target}$	-0.079***	0.283***	0.040	0.935***	1.000

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Example: the acquisition of Zyla Life Sciences by Assertio Holdings, Inc.

	Final PPA to Fair Value $ thousands
Cash	7,585
Account receivable	23,133
Inventories	14,261
Property and equipment	1,469
Intangible assets	193,400
Developed products (rights)	
INDOCIN	154,100
SPRIX	39,000
OXAYDO	300
Other assets	7,665
Total identifiable assets acquired	**247,540**
Accounts payable	21,574
Accrued rebates, returns, and discounts	33,254
Other accrued liabilities	23,858
Contingent consideration	39,900
Debt	111,300
Total liabilities assumed	**229,886**
Net identifiable assets acquired	17,654
Goodwill	17,432
Net assets acquired	**35,086**

Intangible assets = \$193.4 million;
Net Assets Acquired = \$35.1 million
$\Rightarrow$ **551%!**

Hypotheses: Determinants of acquired innovations

	Acquirer decision (innovations produced by target)		
Acquirer characteristics	Buy Innovations	Buy Radical	Buy Incremental
Cash/ Total Assets	≥ 0	—	> 0 (inf. asymmetry, adoption)
Scale business model *Foreign Inc./Total Assets*	> 0 (non-rivalrous; diversification)	> 0 (marginal effect ↑) (BUT: adverse effect of size)	— (non-excludability)
Radical Inn./Total Assets	≥ 0 (comprehension)	> 0 (same business model)	— (strategic difference)

Model: Tobit

$$\textbf{Purchased Innovations}_{t,i} = \textbf{Acquirer Characteristics}_{t-1,i} + \textbf{Target Characteristics}_{t-1,i} + \textbf{Deal Controls}_{t,i} + \epsilon_i$$

Dependent Variables *Purchased Innovations*:

$$\textit{Incremental Fraction}_{t,i} = \frac{\$\textit{Incremental}}{\$\textit{Innovations}}; \quad \textit{Radical Fraction}_{t,i} = \frac{\$\textit{Radical}}{\$\textit{Innovations}}$$

$$\textit{Innovations/VT}_{t,i} = \frac{\$\textit{Innovations}}{\textit{Value of Transaction}}.$$

Determinants of acquired innovations: Tobit (Margins)

	Innovations/Val.ofTrans.	Radical Fraction	Incremental Fraction
	(1)	(2)	(3)
Cash/Total Assets	0.022	0.007	0.223**
	(0.725)	(0.867)	(0.025)
Debt/Total Assets	-0.051**	-0.069*	-0.098
	(0.038)	(0.086)	(0.140)
CAPEX/Total Assets	-0.625*	-0.047	-0.870**
	(0.097)	(0.898)	(0.018)
Foreign Income/Total Assets	0.244***	0.501***	0.305
	(0.000)	(0.000)	(0.147)
R&D exp./Total Assets	0.265	0.410***	0.129
	(0.117)	(0.001)	(0.698)
Radical Inn./Total Assets	0.003	0.014***	-0.017**
	(0.390)	(0.008)	(0.040)
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes
Target$_{t-1}$ Controls	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes
Industry&Year FE	Yes	Yes	Yes
Observations	1,393	1,393	1,393

P-values based on industry-level clustered standard errors

Determinants of acquired innovations: Tobit (Margins)

	Innovations/Val.ofTrans.	Radical Fraction	Incremental Fraction
Unconditional mean	*(0.164)*	*(0.163)*	*(0.410)*
Cash/Total Assets	0.022	0.007	0.223**
(std 0.14)	(0.725)	(0.867)	(0.025)
Debt/Total Assets	-0.051**	-0.069*	-0.098
	(0.038)	(0.086)	(0.140)
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$\mathbf{0.14 \times 0.223 = 0.03}$
$\uparrow \boldsymbol{std} \Rightarrow \mathbf{8\%}$
$(\boldsymbol{of\ unc.mean})$

$\mathbf{0.06 \times 0.501 = 0.03}$
$\uparrow \boldsymbol{std} \Rightarrow \mathbf{18\%}$
$(\boldsymbol{of\ unc.mean})$

Hypotheses: Consequences of acquired innovations

Acquirer decision	Combined Entity Charectersitics		
	Adoption of acquired innovations		Value of patents
	Sales Growth	Costs/Sales	
Buy Innovations	> 0 (efficiency, market expansion)	— (hurdles in adoption)	—
Buy Radical	> 0 (efficiency, market expansion)	— (hurdles in adoption)	> 0 (same innovation strategy)
Buy Incremental	> 0 (efficiency, market expansion)	< 0 (swift adoption)	—

Hypotheses: Sales Growth

Acquirer decision	Combined Entity Charectersitics: Adoption of acquired innovations		Value of patents
	Sales Growth	Costs/Sales	
Buy Innovations	> 0 **(efficiency, market expansion)**	— (hurdles in adoption)	—
Buy Radical	> 0 **(efficiency, market expansion)**	— (hurdles in adoption)	> 0 (same innovation strategy)
Buy Incremental	> 0 **(efficiency, market expansion)**	< 0 (swift adoption)	—

OLS Model: Sales Growth

$$\Delta Sales^{n}_{t+1,t+j} = \text{Purchased Innovations}_{t-1,i} + \Delta Sales^{a,t}_{t-1,t-j} + \text{ New Entity Controls}_{t+1,i} + \text{ Acquirer (Target) Controls}_{t-1,i} + \text{Deal Controls}_{t,i} + \epsilon_i$$

Dependent Variables:

$$\Delta Sales^{n}_{t+1,t+j} = \frac{Sales_{t+j} - Sales_{t+1}}{Sales_{t+1}}, \quad j \in \{2,3\}.$$

Independent Variables *Purchased Innovations* and *Artificial Sales Growth*:

$$Incremental\ Fraction_{t,i} = \frac{\$Incremental}{\$Innovations}; \quad Radical\ Fraction_{t,i} = \frac{\$Radical}{\$Innovations}$$

$$Innovations/VT_{t,i} = \frac{\$Innovations}{Value\ of\ Transaction};$$

$$\Delta Sales^{a,t}_{t-1,t-j} = \frac{(Sales^{a}_{t-1} + Sales^{t}_{t-1}) - (Sales^{a}_{t-j} + Sales^{t}_{t-j})}{Sales^{a}_{t-j} + Sales^{t}_{t-j}}, \quad j \in \{2,3\}.$$

Sales growth or adoption of acquired assets

	$\Delta Sales^{n}_{t+1,t+2}$				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.041***	0.043***	0.033***		
	(0.003)	(0.001)	(0.007)		
Radical Fraction		0.033*		0.031	
		(0.083)		(0.112)	
Incremental Fraction			0.020		0.027
			(0.256)		(0.135)
$\Delta Sales^{a,t}_{t-1,t-2}$	-0.010***	-0.010***	-0.010***	-0.011***	-0.010***
	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)
New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,030	1,030	1,030	1,030	1,030
Adj. R2	0.11	0.11	0.11	0.11	0.11

P-values based on industry-level clustered standard errors

Sales growth or adoption of acquired assets

	$\Delta Sales^{n}_{t+1,t+2}$, $\overline{\Delta Sales_{t+1,t+2}} = 0.07$				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.041***	0.043***	0.033***		
(std 0.34)	(0.003)	(0.001)	(0.007)		
Radical Fraction		0.033*		0.031	
		(0.083)		(0.112)	
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New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,030	1,030	1,030	1,030	1,030
Adj. R2	0.11	0.11	0.11	0.11	0.11

Sales growth or adoption of acquired assets

$\Delta Sales^{n}_{t+1,t+2}$, $\overline{\Delta Sales_{t+1,t+2}} = 0.07$

	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.041***	0.043***	0.033***		
(std 0.34)	(0.003)	(0.001)	(0.007)		
Radical Fraction		0.033*		0.031	
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$\Delta Sales^{a,t}_{t-1,t-2}$	-0.010***	-0.010***	-0.010***	-0.011***	-0.010***
	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)
New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,030	1,030	1,030	1,030	1,030
Adj. R2	0.11	0.11	0.11	0.11	0.11

$\mathbf{0.34 \times 0.041 = 0.014}$
$\uparrow$ ***std*** $\Rightarrow$ **20%**
(***of mean***)

Hypotheses: Costs

Acquirer decision	Combined Entity Charectersitics: Adoption of acquired innovations		Value of patents
	Sales Growth	**Costs/Sales**	
Buy Innovations	> 0 (efficiency, market expansion)	— **(hurdles in adoption)**	—
Buy Radical	> 0 (efficiency, market expansion)	— **(hurdles in adoption)**	> 0 (same innovation strategy)
Buy Incremental	> 0 (efficiency, market expansion)	< 0 **(swift adoption)**	—

OLS Model: Costs

$$\textbf{\textit{Costs}}_{t+1} = \textbf{Purchased Innovations}_{t-1,i} + \textbf{\textit{}}\Delta\textbf{\textit{Sales}}^{a,t}_{t-1,t-j} + \textbf{ New Entity Controls}_{t+1,i} + \textbf{ Acquirer (Target) Controls}_{t-1,i} + \textbf{Deal Controls}_{t,i} + \epsilon_i$$

Dependent Variables:

$$Costs_{t+1} = \frac{COGS_{t+1}}{Sales_{t+1}}.$$

Independent Variables *Purchased Innovations* and *Artificial Sales Growth*:

$$Incremental\ Fraction_{t,i} = \frac{\$Incremental}{\$Innovations}; \quad Radical\ Fraction_{t,i} = \frac{\$Radical}{\$Innovations}$$

$$Innovations/VT_{t,i} = \frac{\$Innovations}{Value\ of\ Transaction};$$

Costs reduction or adoption of acquired innovations

	$Costs_{t+1}$				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.001*	0.001	0.001**		
	(0.096)	(0.129)	(0.018)		
Radical Fraction		0.002*		0.002*	
		(0.080)		(0.056)	
Incremental Fraction			-0.001***		-0.001***
			(0.001)		(0.009)
$\Delta Sales^{a,t}_{t-1,t-2}$	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
New Entity_{t+1} Controls	Yes	Yes	Yes	Yes	Yes
Acquirer_{t-1} Controls	Yes	Yes	Yes	Yes	Yes
Target_{t-1} Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,029	1,029	1,029	1,029	1,029
Adj. R2	0.25	0.25	0.25	0.25	0.25

P-values based on industry-level clustered standard errors

Costs reduction or adoption of acquired innovations

	$Costs_{t+1}$, $\overline{Costs_{t+1}}$ =0.002				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.001*	0.001	0.001**		
	(0.096)	(0.129)	(0.018)		
Radical Fraction		0.002*		0.002*	
		(0.080)		(0.056)	
Incremental Fraction			-0.001***		-0.001***
(std 0.46)			(0.001)		(0.009)
$\Delta Sales^{a,t}_{t-1,t-2}$	0.002***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
New $Entity_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
$Acquirer_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
$Target_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,029	1,029	1,029	1,029	1,029
Adj. R2	0.25	0.25	0.25	0.25	0.25

Costs reduction or adoption of acquired innovations

	$Costs_{t+1}$, $\overline{Costs_{t+1}}$ =0.002				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	0.001*	0.001	0.001**		
	(0.096)	(0.129)	(0.018)		
Radical Fraction		0.002*		0.002*	
		(0.080)		(0.056)	
Incremental Fraction			-0.001***		-0.001***
(std 0.46)			(0.001)		(0.009)
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	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
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$Acquirer_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
$Target_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,029	1,029	1,029	1,029	1,029
Adj. R2	0.25	0.25	0.25	0.25	0.25

$-0.46 \times 0.001 = -46 \times 10^{-5}$
$\uparrow std \Rightarrow \downarrow 23\%$ $(of\ mean)$

Hypotheses: Radical Innovation of New Entity

Acquirer decision	Combined Entity Charectersitics: Adoption of acquired innovations — Sales Growth	Combined Entity Charectersitics: Adoption of acquired innovations — Costs/Sales	**Value of patents**
Buy Innovations	> 0 (efficiency, market expansion)	— (hurdles in adoption)	—
Buy Radical	> 0 (efficiency, market expansion)	— (hurdles in adoption)	> 0 **(same innovation strategy)**
Buy Incremental	> 0 (efficiency, market expansion)	< 0 (swift adoption)	—

Tobit Model: Radical Innovations

$$\textbf{Radical Innovation of New Entity} = \textbf{Purchased Innovations}_{t-1,i} + \textbf{ New Entity Controls}_{t+1,i} + \textbf{ Acquirer (Target) Controls}_{t-1,i} + \textbf{Deal Controls}_{t,i} + \boldsymbol{\epsilon_i}$$

Dependent Variables:

$$\text{Radical Innovation of New Entity} = \frac{\sum_t^{t+3} V(patent_{\tau,i})}{\text{Total Assets}_{t+1}^{new\ entity}} = \frac{\sum_t^{t+3} I^{radical} \times \$Patents}{\text{Total Assets}_{t+1}^{new\ entity}}$$

Independent Variables *Purchased Innovations*:

$$Incremental\ Fraction_{t,i} = \frac{\$Incremental}{\$Innovations}; \quad Radical\ Fraction_{t,i} = \frac{\$Radical}{\$Innovations}$$

$$Innovations/VT_{t,i} = \frac{\$Innovations}{Value\ of\ Transaction}.$$

The dollar value of granted patents by joint entity

	Radical Innovations$^{New\ Entity}$				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	-0.016	0.006	-0.030		
	(0.836)	(0.923)	(0.704)		
Radical Fraction		0.200***		0.200***	
		(0.000)		(0.000)	
Incremental Fraction			0.034		0.027
			(0.247)		(0.361)
New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Radical Inn./Total Assets	0.122***	0.111***	0.123***	0.111***	0.123***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,089	1,089	1,089	1,089	1,089

P-values based on industry-level clustered standard errors

The dollar value of granted patents by joint entity

	Radical Innovations$^{New\ Entity}$, *mean = 0.13*				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	-0.016	0.006	-0.030		
	(0.836)	(0.923)	(0.704)		
Radical Fraction		0.200***		0.200***	
(std 0.33)		(0.000)		(0.000)	
Incremental Fraction			0.034		0.027
			(0.247)		(0.361)
New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Radical Inn./Total Assets	0.122***	0.111***	0.123***	0.111***	0.123***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,089	1,089	1,089	1,089	1,089

The dollar value of granted patents by joint entity

	Radical Innovations$^{New\ Entity}$, *mean = 0.13*				
	(1)	(2)	(3)	(4)	(5)
Innovations/Val.ofTrans.	-0.016	0.006	-0.030		
	(0.836)	(0.923)	(0.704)		
Radical Fraction		0.200***		0.200***	
(std 0.33)		(0.000)		(0.000)	
Incremental Fraction			0.034		0.027
			(0.247)		(0.361)
New Entity$_{t+1}$ Controls	Yes	Yes	Yes	Yes	Yes
Acquirer$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Radical Inn./Total Assets	0.122***	0.111***	0.123***	0.111***	0.123***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Target$_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,089	1,089	1,089	1,089	1,089

$\mathbf{0.33 \times 0.2 = 0.066}$
$\uparrow \boldsymbol{std} \Rightarrow \mathbf{50\%}$
$(\boldsymbol{of\ mean})$

Innovation acquisitions and market reactions

Panel A: Market model-adjusted CARs

	Full Sample (N=1,180) (1)	Innovations = 0 (N=486) (2)	Innovations > 0 (N=694) (3)	Difference (2)-(3)
CAR[-1,+1]	-0.007**	0.006	-0.015***	0.020***
p-value	0.021	0.284	0.000	0.000
CAR[-2,+2]	-0.005*	0.006	-0.014***	0.020***
p-value	0.078	0.284	0.000	0.002

Panel B: Fama-French 3 factors model-adjusted CARs

	Full Sample (N=1,180) (1)	Innovations = 0 (N=486) (2)	Innovations > 0 (N=694) (3)	Difference (2)-(3)
CAR^{FF} [-1,+1]	-0.027***	-0.016***	-0.034***	0.018***
p-value	0.000	0.001	0.000	0.002
CAR^{FF} [-2,+2]	-0.039***	-0.029***	-0.046***	0.017***
p-value	0.000	0.000	0.000	0.007

Innovation acquisitions and market reactions

	$CAR^{FF[-1,+1]}$			$CAR^{FF[-2,+2]}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Innovations/Val.ofTrans.	-0.010	-0.010	-0.002	-0.006	-0.007	0.000
	(0.273)	(0.237)	(0.805)	(0.590)	(0.525)	(0.997)
Radical Fraction		-0.010			-0.016*	
		(0.238)			(0.088)	
Incremental Fraction			-0.017**			-0.014*
			(0.024)			(0.085)
$Acquirer_{t-1}$ Controls	Yes	Yes	Yes	Yes	Yes	Yes
Deal Controls	Yes	Yes	Yes	Yes	Yes	Yes
Payment-includes stock	-0.038***	-0.036**	-0.037**	-0.038**	-0.036**	-0.038**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,006	1,006	1,006	1,006	1,006	1,006

Results: innovations are heterogeneous

Motivation and incentives to purchase different types of innovations vary:

- Acquirers with substantial cash reserves tend to target firms with a higher proportion of *incremental* innovations. (Legal protection/Quick adaptability)
- Acquirers leveraging scale or network effects, high R&D expenditures are more inclined to acquire firms with *radical* innovations. (Non-rivalrous)

Results: innovations are heterogeneous

The distinction between purchased innovation has varying effects on the innovation success and underlying business models:

- Adoption Impact: When all purchased innovations are considered collectively, their influence on marginal sales becomes positive and economically significant. (Complement effect)
- Adoption Impact: Purchased incremental innovations positively correlate with cost reduction of the newly formed entity. (Costs effect)
- Future Radical Activity: Acquiring *radical* technology predicts a higher value of granted patents for the joint entity. (Similarity)

Summary statistics: PPA file

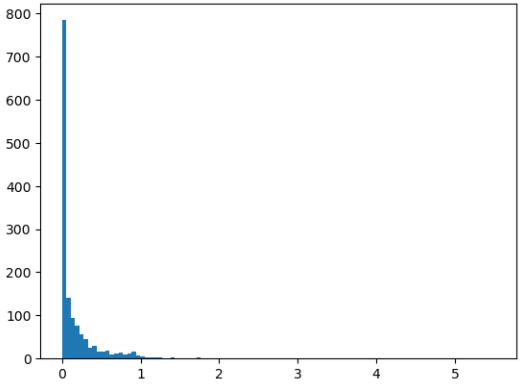
	Obs	Mean	Std	25th Pct.	Median	75th Pct.	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Aggregate Purchase Price ($mln)	1,584	2,711.1	7,510.8	119.7	525.3	1,991.5	0.79	80,269
Total Intangibles ($mln)	1,530	1,242.9	5,007.6	14.7	107	541.5	-7.9	69,080
Innovations ($mln)	1,410	503.6	3,501.7	0	0	4.1	80.1	69,080
IPR&D ($mln)	1,474	148.8	1,030.8	0	0	2.6	0	19,500
Developed Technology ($mln)	1,418	270.2	2,382.3	0	0	34	0	67,330
Developed Rights ($mln)	1,435	78.1	1,492	0	0	0	0	44,500
Rights & Licenses ($mln)	1,440	162.2	2,016.8	0	0	0	0	54,085
Patent ($mln)	1,426	4.8	52.7	0	0	0	0	1,495
Trademark ($mln)	1,400	186.3	1,309.3	0	0	16.9	0	27,443
Other Intangibles ($mln)	1,403	483.8	2,186.4	0	21	178.6	0	39,146
Goodwill ($mln)	1,546	1,397.6	4,053.8	29.1	202.7	932.3	-12.1	49,085

Summary statistics:

	Obs	Mean	Std
	(1)	(2)	(3)
Cash/Total Assets	1,665	0.135	0.141
Foreign Inc./Total Assets	1,686	0.022	0.050
Innovations/VT	1,410	0.164	0.338
Incremental Fraction	1,410	0.163	0.331
Radical Fraction	1,410	0.407	0.463
Sales Growth	1,773	0.070	0.212
COGS/Sales	1,523	0.002	0.012
Radical Inn.$^{New\ Entity}$	1,761	0.130	0.311

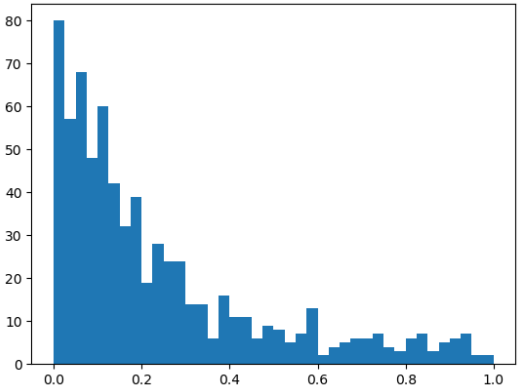
Distribution

$Innovation/VT



Frequency

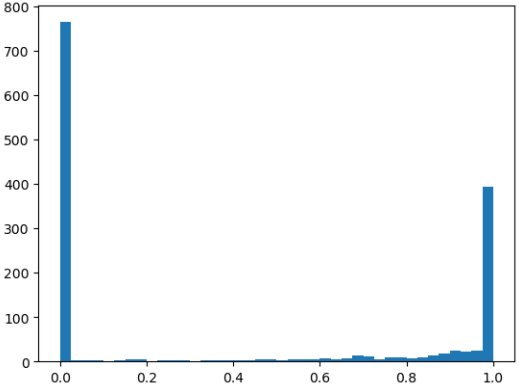
$Innovation/VT: $Innovation/VT > 0



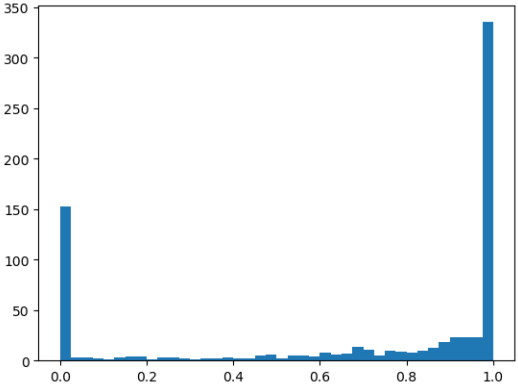
Frequency

Distribution

Incremental Fraction

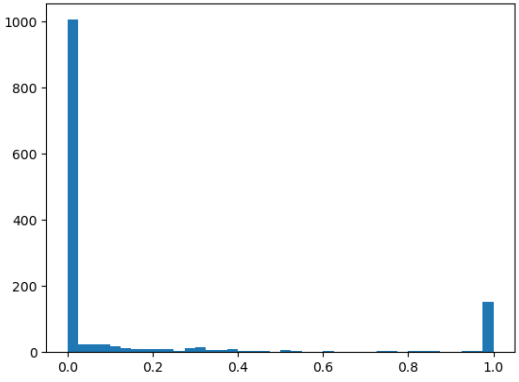


Incremental Fraction: *$Innovation/VT* > 0

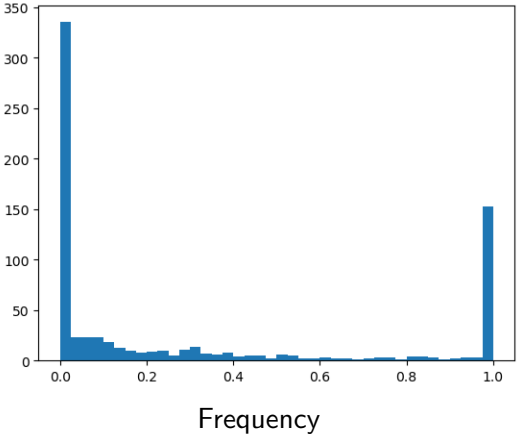


Distribution

Radical Fraction



Radical Fraction: *$Innovation/VT > 0*



Example: KPSS & USPTO

Table: Examples of the patents granted by Silver Spring Network between IPO and M&A.

Publication Date	Filing date	CPC section	Citations	ξ^{real}	Cites $q25$	Cites $q10$	Cites $q1$	$I^{radical}_{q25}$	$T-t$	inflation	$V^{t,T}(patent_j)$
16.04.13	06.08.10	H	20	5.10	5	14	97	1	5.04	2.57	9.16
31.12.13	22.12.11	H	4	6.54	5	14	97	0	4.33	2.57	0
17.06.14	24.11.10	H	7	2.27	4	10	79	1	3.87	2.57	4.42
17.06.14	06.08.08	H	2	2.27	4	10	79	0	3.87	2.57	0
08.07.14	16.12.11	G	8	4.27	5	15	113	1	3.81	2.57	8.34
29.07.14	20.12.11	H	1	3.56	4	10	79	0	3.76	2.57	0
06.01.15	22.12.11	Y	2	2.15	3	8	42	0	3.32	2.57	0
10.02.15	24.05.07	H	3	2.28	3	8	57	1	3.22	2.57	4.63
24.02.15	15.04.13	Y	2	2.73	3	8	42	0	3.18	2.57	0
24.03.15	31.01.12	B	2	2.61	3	9	34	0	3.10	2.57	0
31.03.15	16.04.13	H	2	2.48	3	8	57	0	3.09	2.57	0
14.07.15	17.11.11	H	2	3.06	3	8	57	0	2.80	2.57	0
27.10.15	28.12.11	H	4	3.39	3	8	57	1	2.51	2.57	7.19
03.11.15	20.10.14	H	1	3.66	3	8	57	0	2.49	2.57	0
19.12.17	02.12.16	G	0	3.38	3	7	45	0	0.36	2.57	0

- *$Innovations = $96.3 million* (PPA)
- $\sum V^{t,t}(p_{SSNI}) =$ *$47.54 million* $\Rightarrow$ \$47.54 million attributed to *$Radical* and (\$96.3-\$47.54) \$48.76 million to *$Incremental* innovations.

Accounting regulations

Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date (ASC 820-10-20). This is essentially market value for economists. (He, 2024)

SFAS 141:
`https://www.fasb.org/page/PageContent?pageId=/reference-library/superseded-standards/summary-of-statement-no-141.html&bcpath=tff`

SFAS 142:
`https://www.fasb.org/page/PageContent?pageId=/reference-library/superseded-standards/summary-of-statement-no-142.html&bcpath=tff`

Provide more complete financial information—the explicit criteria for recognition of intangible assets apart from goodwill and the expanded disclosure requirements of this Statement provide more information about the assets acquired and liabilities assumed in business combinations.

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