Buy, Invent, or Both?

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AFA 2023

Outline

How do firms decide to either invent or buy innovation?

- Firms innovate to obtain technologies that enhance productivity and boost firm value
- To do so, firms either develop technology in-house or acquire it via M&As
- A nuanced question due to mutiple reasons behind technology acquisitions
  - **reason one**: achieve synergies by combining complementary assets
  - **reason two**: terminate or preempt the innovation from rival firms

Empirical Challenges

- **Unobservables.** Many variables are hard to measure.
  - R&D costs
  - acquisition costs
  - technological synergies etc.

- **Identification.** Corporate decisions are endogenous and exogenous variation is rare.

- **A Structural Approach: Estimate a Dynamic Model**
  - two types of investments: physical (grow capital) & R&D (boost productivity)
  - two acquisition motives: synergies or anti-competitive reasons
  - two sources of uncertainty: risky profit shocks & risky R&D outcomes

Main Results

- **Organic Growth or Outsource?**
  - the key determinant is the firm's profit shock volatility
  - higher volatility leads to more acquisitions and less R&D
- **Synerges or Anti-Competitive?**
  - the key determinant is profitability of the firm's physical investment
  - less profitable firms acquire competitors while more profitable ones look for synergies
- **Acquisitions do NOT crowd out in-house R&D**
- **The Acquisition Market is important**
  - Shutting down synergy acquisition reduces R&D and total patents by 7.28% and 4.72%
  - Shutting down competition acquisition reduces R&D and total patents by 7.22% and 5.90%

Literature on Technology Acquisitions

- Synergies
  - **asset complementarity**: Rhodes-Kropf and Robinson (2008), Bena and Li (2014)
  - **innovative targets and increased R&D spending**: Sevilir and Tian (2012), Phillips and Zhdanov (2013)
- Anti-Competition
  - **current targets & future entrants**: Cunningham, Ederer, and Ma (2021), Segal and Whinston (2007), Kamepalli, Rajan, and Zingales (2020), Fulghieri and Sevilir (2009)
  - **inefficiencies that harm innovation**: Seru (2014), Federico, Langus, and Valletti (2017), Cabral (2018)
  - **market consolidation that creates synergies**: Blundell, Griffith, and Van Reenen (1999), Aghion, Bloom, Blundell, Griffith, and Howitt (2005), Letina, Schmutzler, and Seibel (2020)
- Innovation Post Acquisition
  - Li and Wang (2020), Li, Qiu, and Wang (2019), Zhao (2009), Sevilir and Tian (2012), Li (2017)

Outline

A Dynamic Model of Innovation & Acquisition

- Discrete time, infinite horizon, partial equilibrium model
- A typical firm i (as a potential acquirer) in high-tech industries
- At the beginning each period t, the firm observes
  - a realization of the profit shock (z_{it})
  - its endowment of capital (k_{it}) & technology (h_{it})
- Given these factors, the firm decides simultaneously
  - physical investment (I_{it})
  - R&D (w_{it})
  - acquistition for synergies (m_s) or anti-competitive reasons (m_c)

Two Types of Acquisitions

- Stand-alone Firm

$$\Pi(k_t, h_t, z_t) = (1 - \tau_c)e^{z_t} {h_t}^{\phi}(1 - m_c)k_t^{\alpha}$$

- Synergy Acquisitions

$$\Pi(k_t, h_t, z_t) = (1 - \tau_c)e^{z_t} {h_t}^{\phi + m_s}(1 - m_c)k_t^{\alpha}$$

- Competition Acquisitions

$$\Pi(k_t, h_t, z_t) = (1 - \tau_c)e^{z_t} {h_t}^{\phi} k_t^{\alpha}$$

Optimization

- External Financing

$$-e(.) = Financing\ Gap_t = C(w_t) + [k_{t+1} - (1-\delta)k_t] + \Psi(k_t, k_{t+1}) + D * k_t * \mathbb{1}_{m_t=1} + P_t \mathbb{1}_{m_t=1} - \Pi(k_t, h_t, z_t) - \delta k_t \tau_c$$

- The cost of external finance is

$$\Phi(e(.)) = \frac{1}{2}\phi_{e<0}\lambda_1 e(.)^2$$

- The Bellman equation is

$$V(k_t, h_t, z_t) = \max_{I_t, w_t, m_t} \{e(k_t, h_t, z_t, k_{t+1}, h_{t+1}, m_t) + \Phi(e(k_t, h_t, z_t, k_{t+1}, h_{t+1}, m_t)) + \frac{1}{1+r}\int V(k_{t+1}, h_{t+1}, z_{t+1}) dF(z_{t+1})\}$$

Outline

Data Sources

- Sample: over 1977-2019 with 738 deals & 7491 obs
- Financial and Stock Price Info: CRSP/COMPUSTAT/CapitalIQ
- Merger Deals: SDC Platinum
- Patents and Citations: USPTO patent assignment files (by Google Patents)
- Abnormal Returns for Each Deal: WRDS-Eventus

Estimation Moments

	Simulated Moments	Real Moments	t-stats
Serial Corr of Inc	0.8017	0.8061	-0.0076
Var of Innov to Inc	0.0105	0.0043	0.4349
Avg External Fin	0.3290	0.3382	-0.0483
Var External Fin	0.0272	0.0366	-0.1149
Avg Investment	0.0575	0.0543	0.1136
Var Investment	0.0011	0.0008	0.1775
LLH of Syn Acq	0.0660	0.0608	0.2147
LLH of Comp Acq	0.1470	0.1412	0.1213
Stock of Patents	9.2125	9.3006	-0.0051
R&D Investment	0.0830	0.0855	-0.0430
Var of R&D Inv	0.0021	0.0033	-0.1675

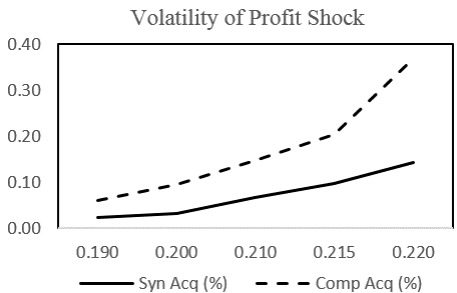
Structural Parameter Estimates

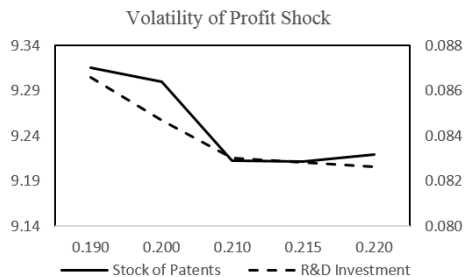
α	ρ_z	σ_z	$\lambda(10^7)$	c_w	D	m_s	m_c
0.990	0.940	0.210	0.001	0.011	0.009	0.002773	0.028750
(0.003)	(0.030)	(0.031)	(0.001)	(0.003)	(0.004)	(0.000587)	(0.011812)

Outline

Organic Growth or Outsource Innovation?

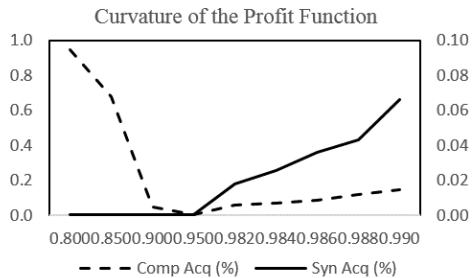
Panel C: Volatility of Profit Shock

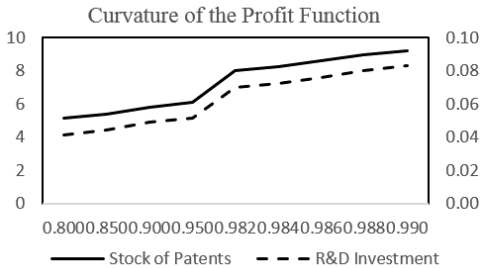




Synergies or Market Control?

Panel B: Curvature of the Profit Function





How Important is the Acquisition Market?

Panel A: The Acquisition Market

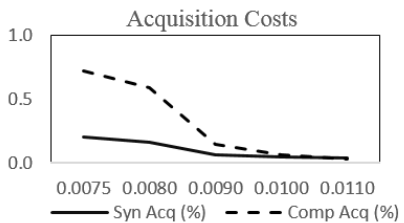
	No Synergy Acquisitions			No Competition Acquisitions		
	Before	After	Changes	Before	After	Changes
Stock of Patents	10.7266	10.2198	-4.73%	10.1243	9.5270	-5.90%
R&D	0.1003	0.0930	-7.28%	0.0898	0.0860	-7.22%
Tobin's Q	8.4283*	7.3720*	-12.53%	6.6990*	5.3430*	-20.24%

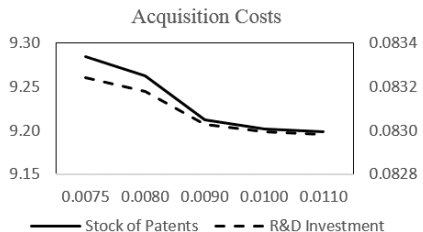
Panel B: Internal R&D

	No Peer Competition			No R&D		
	Before	After	Changes	Before	After	Changes
Stock of Patents (Tobin's Q)	9.2125	9.4107	2.15%	4.4288*	3.8534*	-14.93%
Synergy Acquisitions	0.0660	0.1855	180.92%	0.0660	0.0120	-81.81%
R&D ($Comp$ Acquisitions)	0.0830	0.0853	2.72%	0.1470	0.0736	-49.93%

Does Acquisition Crowd Out In-House R&D?

Panel A: Acquisition Costs





Outline

Why Acquire Technology Instead of Developing It In-House?

- We study two main motives behind technology-driven acquisitions: synergies and competition.
- We argue that the key determinant for the choice of organic growth vs acquisition is the firm's profit shock volatility.
  - Higher volatility leads to more acquisitions and less in-house R&D.
- In addition, profitability from the product market influences the types of benefits the firm achieves from acquisitions.
  - It is possible for a poorly-performing firm to acquire its competitors but only the good performers search for synergies from the market.
- Acquisition provides acquiring firms stronger incentives for in-house R&D as acquired innovation magnifies the benefits of R&D.

Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt (2005). Competition and innovation: An inverted-u relationship. *Quarterly Journal of Economics 120*(2), 701–728.

Bena, J. and K. Li (2014). Corporate innovations and mergers and acquisitions. *Journal of Finance 69*(5), 1923–1960.

Blundell, R., R. Griffith, and J. Van Reenen (1999). Market share, market value and innovation in a panel of british manufacturing firms. *Review of Economic Studies 66*(3), 529–554.

Cabral, L. (2018). Standing on the shoulders of dwarfs: Dominant firms and innovation incentives. CEPR Discussion Paper No. DP13115.

Cunningham, C., F. Ederer, and S. Ma (2021). Killer acquisitions. *Journal of Political Economy 129*(3), 649–702.

Federico, G., G. Langus, and T. Valletti (2017). A simple model of mergers and innovation. *Economics Letters 157*, 136–140.

Fulghieri, P. and M. Sevilir (2009). Organization and financing of innovation, and the choice between corporate and independent venture capital. *Journal of Financial and Quantitative Analysis 44*(6), 1291–1321.

Kamepalli, S. K., R. Rajan, and L. Zingales (2020). Kill zone. NBER Working Paper 27146.

Letina, I., A. Schmutzler, and R. Seibel (2020). Start-up acquisitions and innovation strategies. Universitaet Bern, Departement Volkswirtschaft.

Li, K. (2017). Mergers and acquisitions and corporate innovation. ADBI Working Paper Series.

Li, K., J. Qiu, and J. Wang (2019). Technology conglomeration, strategic alliances, and corporate innovation. *Management Science 65*(11), 5065–5090.

Li, K. and J. Wang (2020). How do mergers and acquisitions foster corporate innovation? Inventor-level evidence. University of British Columbia.

Phillips, G. M. and A. Zhdanov (2013). R&d and the incentives from merger and acquisition activity. *Review of Financial Studies 26*(1), 34–78.

Rhodes-Kropf, M. and D. T. Robinson (2008). The market for mergers and the boundaries of the firm. *Journal of Finance 63*(3), 1169–1211.

Segal, I. and M. D. Whinston (2007). Antitrust in innovative industries. *American Economic Review 97*(5), 1703–1730.

Seru, A. (2014). Firm boundaries matter: Evidence from conglomerates and R&D activity. *Journal of Financial Economics 111*(2), 381–405.

Sevilir, M. and X. Tian (2012). Acquiring innovation. Indiana University.

Zhao, X. (2009). Technological innovation and acquisitions. *Management Science 55*(7), 1170–1183.