Corporate Innovation Linkages and Firm Boundaries

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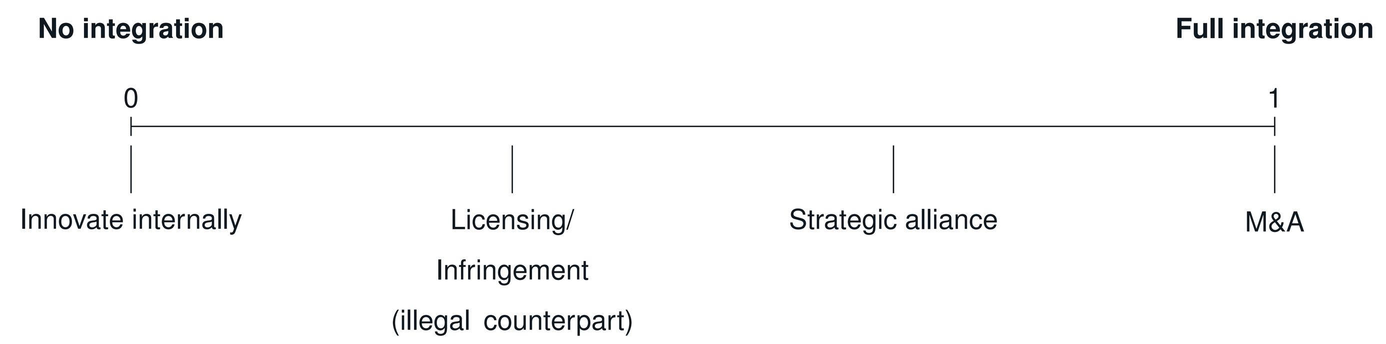
Abstract

Innovation matters for firm boundaries. Companies are more likely to integrate with peers with connected innovation. In this paper, I study how follow-on innovation determines the degree of integration between firms. I construct a measure of relative innovation proximity between firms, based on patent citations. I find companies are more likely to acquire peers with closer follow-on innovation, rather than build strategic alliances with them or license/buy their patents. Furthermore, the measure of relative innovation proximity between firms reflects firms' bargaining power and not the size of the synergies. In M&A transactions, a bidder with closer follow-on innovation pays a greater premium and exhibits lower announcement returns. On the other hand, in strategic alliance, a firm with closer follow-on innovation experiences greater announcement returns. These results are consistent with a hold-up model in which companies bargain over the type and terms of the contract.

Motivation

Firms can innovate in house, or in collaboration with other firms via M&As, strategic alliances, and patent licensing deals. We can see **different corporate strategies as a continuum** from no integration to full integration:



Every year about 5% of valid patents change owners

Example of patent holdup: Google – Motorola Mobility (2011)

- $12.5bn acquisition at a premium of 63% above Motorola's market closing price
- Main motivation – Motorola's patent portfolio to defend Android as a whole
  - More than 17,000 mobile-related patents worldwide and 7,000 patents pending globally. Patent portfolio value is $4.25bn
- Google sold Motorola Mobility (all but patents) to Lenovo for $2.91bn in 2014

How do innovation linkages affect integration between firms?

Two channels:

1 Source of synergies
  - Affect the probability of companies to interact
  - Affect long-term operating performance

2 Bargaining power
  - Affect the price and terms of contract

Firms' bargaining power based on patent citations can cause patent holdup. This can happen in several ways:

- Patent holders can extract excessive patent licensing royalties or refuse to provide licensing
- This can be exacerbated when a firm relies on a patented innovation that is essential to respect an industry standard

Data

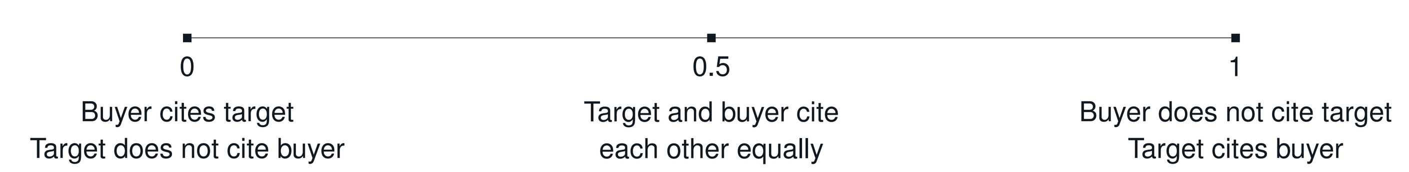
Sources: Patent database (Kogan et al. (2017)) • SDC Platinum • USPTO assignment dataset • Stanford NPE litigation database • Patent litigation docket reports data (Marco et al. (2017)) • CRSP • Compustat

Sample: 7,545 public firms with at least one patent. Around 40% of them were involved in the integration at least once:

	M&As	License	Litigation	Alliance	Total
Period	1978–2010	1975–2010	1985–2010	1975–2010	
N transactions	932	2,479	2,507	2,963	8,881
N firms	1,386	1,140	1,160	1,250	2,895

Innovation measures

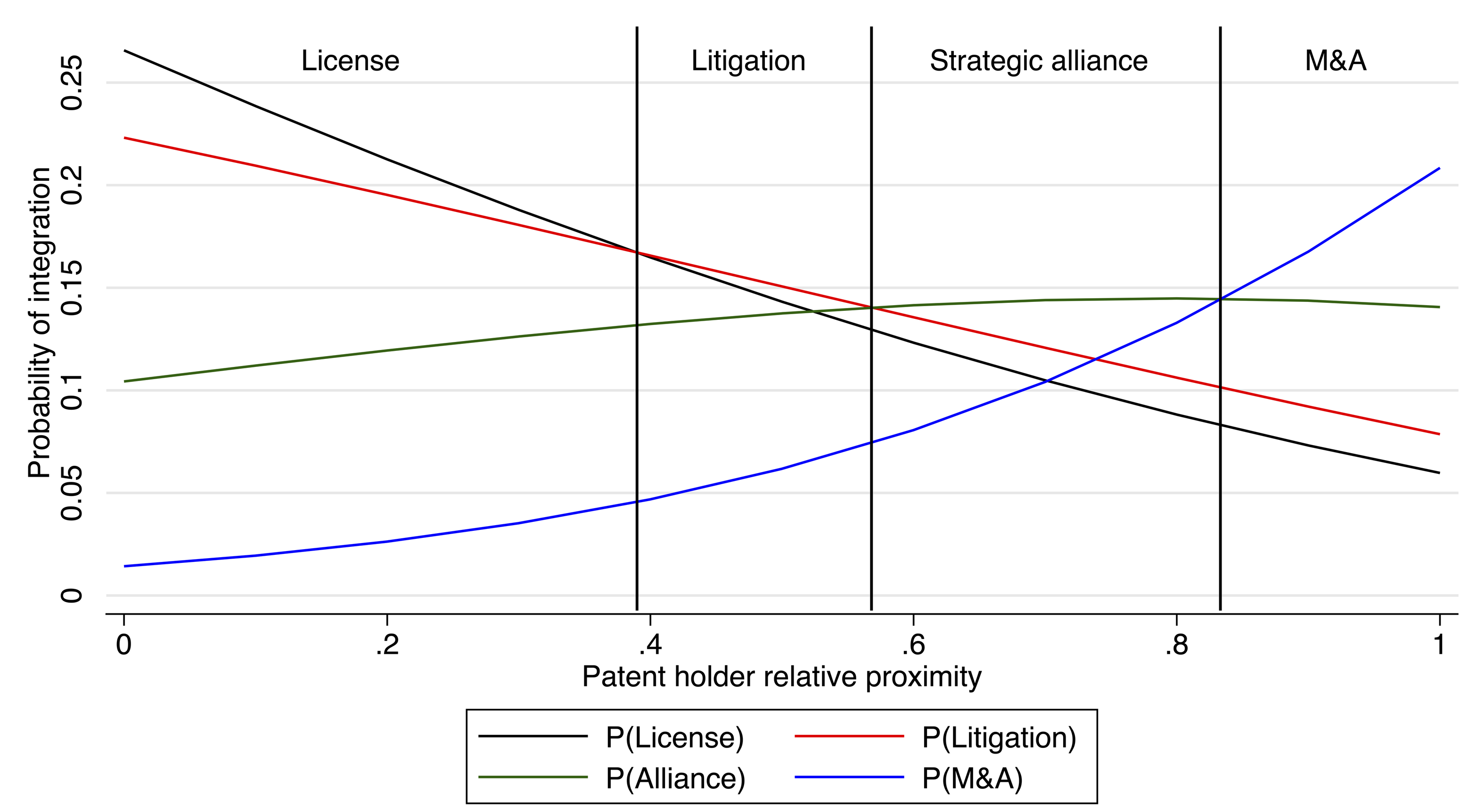
1. Average "cross-patent citations"
2. "Asymmetry in cross-patent citations" identifies the extent to which the "target" firm is the innovation follower of the "buyer" firm compared to the "buyer" firm is the innovation follower of the "target" firm. It varies between 0 and 1:



Predicting firms' integration

⋆ Firms with more "cross-patent citations" are **more likely** to integrate
  - One st.dev. increase in *average cross-patent citations* doubles the likelihood of firms' integration, compared to their average deal probability

⋆ The asymmetry in "cross-patent citations" between firms describes the degree of integration between firms:
  → Firms **integrate more tightly** with peers with closer follow-on innovation
    - One st.dev. increase in *patent holder relative proximity* leads to $\mathbf{P(M\&A)}\uparrow$ by 21%, $\mathbf{P(license)}\downarrow$ by 38%, and $\mathbf{P(litigation)}\downarrow$ by 20%, compared to their average deal probability
  → Firms are more likely to acquire and enter strategic alliance with peers with closer follow-on innovation, rather than license or infringe original innovation



Deal performance

⋆ The asymmetry in "cross-patent citations" between firms describes the **split of deal surplus** between firms and not the size of the surplus:
  → Firms' combined returns are not driven by the asymmetry of "cross-patent citations"
  → In M&As, bidders with closer follow-on innovation pay a greater premium and exhibit lower announcement returns (consistent with Lambrecht (2004), Gorton et al. (2009), Edmans et al. (2012))
  → In strategic alliances, firms with closer follow-on innovation gains more from entering strategic alliance

Alternative explanations and robustness checks

I rule out the following alternative explanations:

- Geographic proximity
- Industry concentration
- Product-market relatedness

I also do robustness checks, using alternative innovation measures:

- Citation-weighted patent value
- Stock-weighted patent value
- Considering only up to 7-, 10- or 15-year patents
- Other types of innovation (Capex and total value of intangible capital (Ewens et al (2020)))

Conclusion

⋆ I construct a measure of relative innovation proximity between firms

⋆ Firms are more likely to acquire peers with follow-on innovation rather than to create strategic alliance or license/buy their patents

⋆ Firms' relative innovation proximity does not affect total synergies of the firms but only the way how they are split

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