**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:

<table>
<thead>
<tr>
<th>No integration</th>
<th>Full integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovate internally</td>
<td>Licensing</td>
</tr>
<tr>
<td>Licensing</td>
<td>Strategic alliance</td>
</tr>
<tr>
<td>Strategic alliance</td>
<td>M&amp;A</td>
</tr>
</tbody>
</table>

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 database • 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:

<table>
<thead>
<tr>
<th>Period</th>
<th>M&amp;A</th>
<th>License</th>
<th>Litigation</th>
<th>Alliance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978–2010</td>
<td>24,952</td>
<td>2,479</td>
<td>2,507</td>
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<td>8,881</td>
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</table>

**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:

   - Buyer cites target
   - Target does not cite buyer
   - Target and buyer cite each other equally
   - Buyer does not cite target

**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 \( P(M&A) \) ↑ by 21%, \( P(\text{license}) \) ↓ by 38%, and \( P(\text{litigation}) \) ↓ 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

**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

**Acknowledgments**

I thank my advisors Alberto Manconi and Stefano Rossì for their invaluable guidance and support. I also thank Sugato Bhattacharyya, Nicola Gennaioli, Uday Rajan, David Robinson, Merih Sevilir, Tom Schmitz, Julien Sauvagnat, Stefan Zeume, as well as participants at Bocconi University, ECA 2020, ENM 2020, OFCE Sciences Po, Ross School of Business, and Vienna School of Economics and Business for their useful comments and suggestions. All errors are my own.

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