BOARD DIVERSITY AND DISRUPTIVE INNOVATION

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OBJECTIVES

1. To examine the effect of board diversity on innovation outcomes, we estimate the following specification at the firm-year level:

\[ \text{log}(Y_{it} + 1) = \beta_0 + \beta_1 + \beta_2 + \cdots + \beta_D + \text{Board Diversity}_{it} + \beta_F + \varepsilon_{it} \]

- \( Y_{it} \): firm i’s patents applied in year t, total # of patent citations gained from year t to t+5; total # of disruptive patent citations gained from year t to t+5; economic value of firm’s patent portfolio in year t;
- \( \alpha_i, \alpha_t, \alpha_p, \alpha_y \): year, firm and county fixed effects, respectively.
- \( \text{Board Diversity}_{it} \): % of Female + Std of Age + HHI in Ethnicity + HHI in Financial Expertise + HHI in Bachelor Institutions;
- \( X_{it} \): a vector of firm-year characteristics (size, age, market-to-book, ROA, asset tangibility, cash-to-asset, etc.).
- \( \text{CEO} \): tenure, board size, whether CEO is the chairman and/or president.
- \( \text{Disruptive} \): the diversity of the supply of potential directors residing one non-stop flight away from the firm headquarters.

BASELINE RESULTS

Table 1. Board diversity and innovation outcomes

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: OLS</td>
<td>0.119***</td>
<td>0.145***</td>
<td>0.126***</td>
</tr>
<tr>
<td>Board diversity</td>
<td>(3.267)</td>
<td>(3.104)</td>
<td>(2.779)</td>
</tr>
<tr>
<td>Panel B: 2SLS</td>
<td>0.795***</td>
<td>2.102***</td>
<td>2.447***</td>
</tr>
<tr>
<td>Instrumented board diversity</td>
<td>(2.000)</td>
<td>(2.759)</td>
<td>(3.071)</td>
</tr>
<tr>
<td>Observations</td>
<td>4,842</td>
<td>4,842</td>
<td>4,842</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Industry FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>County FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Note: Standard errors are clustered at the firm level. The corresponding t-statistics are reported in parentheses. ***, ** and * represent 10%, 5% and 1% significance level, respectively.

METHODOLOGY

1. Aims
   - We construct a unique panel data of multi-dimensional board diversity, technological innovation outcomes, firm financial characteristics and measures for corporate governance and management effectiveness.
   - We identify the causal relationship between board diversity and firm innovation.
   - We examine multiple innovation outcomes that reflect different aspects in the development of disruptive technology, including patent count and citation, disruptive technological impact, and economic value.
   - We examine the mechanisms that explain why board diversity may facilitate disruptive innovation by (1) enhancing resource availability, including human, social, and financial resources; (2) improving corporate governance and management effectiveness; and (3) increasing risk tolerance for technological exploration.

DATA

1. Board members’ demographic characteristics, educational background, records of serving on other firms’ boards, financial expertise and other board characteristics.
2. Innovation outcomes.

METHODOLOGY

1. To explain the effect of board diversity on innovation outcomes, we estimate the following specification at the firm-year level:

\[ \text{log}(Y_{it} + 1) = \beta_0 + \beta_1 + \beta_2 + \cdots + \beta_D + \text{Board Diversity}_{it} + \beta_F + \varepsilon_{it} \]

- \( Y_{it} \): total # of patent citations gained from year t to t+5; total # of disruptive patent citations gained from year t to t+5; economic value of firm’s patent portfolio in year t;
- \( \alpha_i, \alpha_t, \alpha_p, \alpha_y \): year, firm and county fixed effects, respectively.
- \( \text{Board Diversity}_{it} \): % of Female + Std of Age + HHI in Ethnicity + HHI in Financial Expertise + HHI in Bachelor Institutions;
- \( X_{it} \): a vector of firm-year characteristics (size, age, market-to-book, ROA, asset tangibility, cash-to-asset, etc.).
- \( \text{CEO} \): tenure, board size, whether CEO is the chairman and headquarter county-year characteristics (GDPCapita and GDP growth rate).

2. To identify a causal relationship between board diversity and innovation outcomes, we conduct two-stage least squares analysis. Specifically, we follow Bernile et al. (2018) and instrument Board Diversity_{it} by the diversity of the supply of potential directors residing one non-stop flight away from the firm headquarters.

MECHANISMS

We investigate three potential mechanisms that may explain why board diversity facilitates firm disruptive innovation.

1. Resources-based mechanism. We propose that a diverse director board spurs firm innovation by appointing inter-firm collaborations and retaining financial constraints. We find that board diversity increases firm engagement in strategic alliances, especially for R&D and technological exploitation.
2. Governance-based mechanism. We propose that board diversity fosters firm innovation by appointing upper echelon managers with high skills and improving the effectiveness of corporate monitoring. Custódio et al. (2019) shows that managers with higher general skills can foster innovation beyond the company’s current domain. We provide evidence that firms with high board diversity tend to appoint CEOs, managerial executives with high general abilities.
3. Risk-based mechanism. We propose that board diversity promotes firm innovation by increasing its tolerance towards risky investments for long-term value creation—namely, R&D expenditure. We find evidence that firms with high board diversity tend to display high R&D intensity, measured as the ratio of R&D expenditure to book assets.

CONCLUSION

This study examines the effects of board diversity on disruptive innovation at the firm, and the underlying mechanisms for these effects. Using an instrument approach, we identified the causal relationship between board diversity and firm innovation. Specifically, board diversity in demographics and cognitive characteristics can increase the quantity, impact, disruptiveness, and value of firm innovation. We probe resource-, governance-, and risk-based mechanisms to explain the baseline results. We document evidence that a diverse director board spurs disruptive innovation by encouraging inter-firm technological collaborations, appointing skilled upper echelon managers, and increasing firm risk tolerance to pursue R&D investments.

REFERENCE


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