Entrepreneurial SMEs and Inter-Organizational Network Embeddedness

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COMAC C919 Made in China

- China’s first large passenger jet COMAC C919 was rolled out off the assembly line in November 2015, and expects its first commercial flight in 2017

- Made in China? Composition of highly integrated systems and components manufactured across the globe.
  - Dispersion of production location
  - Dispersion of business sectoral specialization
  - Active engagement of various types of organizations

- Do domestic entrepreneurial SMEs also play an active part in the Chinese aerospace industry? What factors contribute to their competitiveness?
Entrepreneurship and Network Embeddedness

• Network embeddedness
  - Effect of actor’s dyadic relations and hierarchical structure on its action, performance and institution. (Granovetter, 1985; Hagedoorn, 2006; Cantwell et al. 2010)
  - Relational embeddedness and Structural embeddedness (Gulati 1998)

• Network-based entrepreneurship (Hoang & Antoncic, 2003)
  - Content: forms of relationship
  - Governance: control and coordination of resources and information
  - Structure: Hierarchical pattern of linkages

• Inter-personal vs inter-organizational network in entrepreneurship (Miller, 1983 & 2011)
  - Inter-personal network: the personality, leadership, capacity of entrepreneurs
  - Inter-organizational network: market strategies, organic structures, external environment

• Global Value Chain and horizontal and vertical integration (Gereffi et al. 2005)
  - Hierarchy of value adding activities and competitiveness of firms
Entrepreneurial SMEs and Network Embeddedness

• Entrepreneurial SMEs’ competitiveness in inter-organizational network
  ➢ Strategic resources acquisition (Barney, 1991; Lavie, 2006)
  ➢ Behavioral influence on partners: status, legitimacy, reputation (Uzzi, 1997; Podolny, 2001; Hagedoorn, 2006)

• Entrepreneurial SMEs – age and size
  ➢ Age
    (+) Latecomer advantages – sunk cost avoidance, linkage-leverage-learning
    (-) Liability of newness – inexperience, resistance to change, reliance on partners
  ➢ Size
    (+) Simplicity and efficiency
    (-) Liability of smallness – constraints in resources and information
Egocentric Diversity of Entrepreneurial SMEs

• **Egocentric Diversity:**
  - Diversity of dyadic partners and ties in an actor’s first-order neighbourhood (Marsden, 2002)
  - Diversity of dyadic partner composition (Goerzen & Beamish, 2005)
  - Diversity of direct linkages (content and strength) (Granovetter, 1973; Shhipilov, 2012)

• Egocentric diversity positively contribute to entrepreneurial SMEs’ innovation capacity and market competitiveness (Pittaway, et al., 2004; Macpherson & Holt, 2007; Roper, et al., 2008)

• **Index of Qualitative Variation (IQV) (Blau et al. 1982)**

\[
IQV_r = \frac{1 - \sum_{i=1}^{n} p_i^2}{1 - \frac{1}{n}}
\]

\(p_i\) represents the proportion of each type of alter-partners’ presence, and \(n\) represents the total number of categorized
Hypotheses

• **Negative impacts of age and size:**
  - **Hypothesis 1.1** Younger entrepreneurial SMEs are less well-connected in inter-organizational network
  - **Hypothesis 1.2** Smaller entrepreneurial SMEs are less well-connected in inter-organizational network

• **Positive impacts of age and size**
  - **Hypothesis 2.1** Younger entrepreneurial SMEs are better connected in inter-organizational network
  - **Hypothesis 2.2** Smaller entrepreneurial SMEs are better connected in inter-organizational network

• **Impact of egocentric diversity**
  - **Hypothesis 3:** An entrepreneurial SME with high degree of dyadic partner diversity are better connected in inter-organizational network

• **Measures for tie diversity** (geographic location, governance structure, industrial specialization) are included as control variables
Data Collection

Step 1. Ego selection
140 commercial aviation business units with revenue above 20 million Yuan in 2013 (Civil Aviation Industrial Yearbook 2014).

Step 2. Alter selection
Business units (firms, universities, research institutes and governmental institutions) that have direct formal linkages with 140 ego business units.

Step 3: Attributes collection
- Year of foundation/market entry, Registered capital, Industrial specialization, Location Governance structure etc.
- National Enterprise Credit Information Disclosure System (NECIDS), Official portal of business units, News and analytical reports.

Step 4. Identification of types of ties
- Horizontal partnership linkages (Strategic alliance, Joint-Venture and R&D program, Intensive cooperation)
- Vertical supply chain linkages (Supplier-buyer relationships)

Step 5. Integration to multiplex networks
## Proportion of Business Units by Region and Type

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>By Region</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic</td>
<td>543</td>
<td>59.02%</td>
</tr>
<tr>
<td>Foreign</td>
<td>377</td>
<td>40.98%</td>
</tr>
<tr>
<td><strong>By Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic Entrepreneurial SMEs</td>
<td>299</td>
<td>32.50%</td>
</tr>
<tr>
<td>Large Domestic Firms</td>
<td>97</td>
<td>10.54%</td>
</tr>
<tr>
<td>Foreign Firms</td>
<td>335</td>
<td>36.41%</td>
</tr>
<tr>
<td>Universities and Research Institutes</td>
<td>132</td>
<td>14.35%</td>
</tr>
<tr>
<td>Governmental Institutions</td>
<td>57</td>
<td>6.20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>920</td>
<td>100.00%</td>
</tr>
</tbody>
</table>
Multiplex Network of Chinese Aerospace Industry

- Domestic entrepreneurial SMEs (yellow)
- Domestic large firms (red)
- Foreign firms (blue)
- Universities and research institutes (green)
- Governmental institutions (white)

Index of Qualitative Variation (Blau, et al., 1982)

$$IQV_r = \frac{1 - \sum_{i=1}^{n} p_i^2}{1 - \frac{1}{n}}$$

$p_i$ = proportion of each type of alter-partners’ presence
$n$ = total number of categorized (in this study, equals 5)
Measuring Network Embeddedness

• Network Centrality:
  Actor’s prominent position to take control of resources and information flows and influence the behavior of other players. (Freeman, 1978; Wasserman & Faust., 1994).

• Measurements of Network Centrality
  ➢ Degree Centrality
    ▪ Number of direct ties
    ▪ Range of direct sources of resources and information flows
  ➢ Betweenness Centrality
    ▪ Frequency of appearance between other actors’ geodesics
    ▪ Brokerage control and bargaining power
  ➢ Closeness Centrality ("nearness")
    ▪ Inverse of sum of steps of all geodesics in the connected components
    ▪ Reachability and efficiency of communication
  ➢ Eigenvector Centrality
    ▪ Connection to other well-connected actors
    ▪ Proximity to centrality located well-connected market leaders

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Empirical Analysis

• 299 domestic SMEs with registered capital less than 1000 million RMB Yuan (approximately 150 million US dollars)

• **Dependent Variables** – Multifaceted Network Centralities
  - **Degree centrality** – Range of neighbourhood
  - **Betweeness centrality** – Brokerage control and bargaining power
  - **Closeness centrality** – Reachability and efficiency
  - **Eigenvector centrality** – Connection to the market leaders

• **Independent variables**
  - **Age**: Year of foundation
  - **Size**: Registered capital – Limited liability of capital contributions from all shareholders on account
  - **Diadic Partner Diversity**: Index of Qualitative Variation (IQV, Blau, 1982)
    - (1) Domestic entrepreneurial SMEs; (2) Domestic large firms; (3) Foreign firms; (4) University and research institutes; (5) Governmental institutions

• **Control Variables**
  - Number of foreign connections
  - Number of connections to non-incorporated units
  - Number of connections to units specialized in non-manufacturing sectors
  - Number of horizontal linkages
# Multiple Regression Models on Network Centrality

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(1) In (Degree centrality)</th>
<th>(2) Betweenness centrality</th>
<th>(3) Closeness centrality</th>
<th>(4) Eigenvector centrality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.0012 (0.0016)</td>
<td>-1.4554 (5.5207)</td>
<td>-0.0002 (0.0002)</td>
<td>-0.0001 (0.0000) ***</td>
</tr>
<tr>
<td>Size</td>
<td>0.0180 (0.0120)</td>
<td>16.2281 (40.4329)</td>
<td>0.0017 (0.0013)</td>
<td>0.0010 (0.0003) ***</td>
</tr>
<tr>
<td>Dyadic Partner Diversity</td>
<td>1.5508 (0.1058) ***</td>
<td>831.3707 (356.9468) *</td>
<td>0.0436 (0.0115) ***</td>
<td>0.0097 (0.0027) ***</td>
</tr>
<tr>
<td>Foreign Connections</td>
<td>0.0020 (0.0036)</td>
<td>0.1310 (12.2989)</td>
<td>-0.0008 (0.0004) **</td>
<td>-0.0001 (0.0001)</td>
</tr>
<tr>
<td>Non-incorporated Connections</td>
<td>0.0838 (0.0128) ***</td>
<td>86.4048 (43.0890) *</td>
<td>0.0022 (0.0014)</td>
<td>0.0035 (0.0003) ***</td>
</tr>
<tr>
<td>Non-manufacturing Connections</td>
<td>0.1802 (0.0710) **</td>
<td>-104.7804 (239.3556)</td>
<td>0.0056 (0.0077)</td>
<td>0.0029 (0.0018)</td>
</tr>
<tr>
<td>Horizontal Linkages</td>
<td>0.1127 (0.0121) ***</td>
<td>457.4075 (40.8393) ***</td>
<td>0.0028 (0.0013) **</td>
<td>0.0007 (0.0003) **</td>
</tr>
<tr>
<td>N</td>
<td>299</td>
<td>299</td>
<td>299</td>
<td>299</td>
</tr>
<tr>
<td>F</td>
<td>139.540 ***</td>
<td>40.990 ***</td>
<td>9.200 ***</td>
<td>41.340 ***</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.771</td>
<td>0.497</td>
<td>0.181</td>
<td>0.499</td>
</tr>
<tr>
<td>Root MSE</td>
<td>0.487</td>
<td>1644.100</td>
<td>0.053</td>
<td>0.013</td>
</tr>
</tbody>
</table>

**Note:** Significance level: *<0.1;**<0.05;***<0.01
Conclusions

• **Liability of smallness** constraints entrepreneurial SMEs’ proximity to market leaders (*Hypothesis 1.1* supported)

• **Latecomer advantage** (instead of liability of newness) contributes to entrepreneurial SMEs’ connection to market leaders. (*Hypothesis 2.1* supported)

• **Diversify of dyadic partners** contribute to entrepreneurial SMEs’
  1. Range of direct sources of resources and information
  2. Brokerage control and bargaining power
  3. Communication reachability and efficiency
  4. Proximity to centrally located well-connected market leaders
  (*Hypothesis 3* supported)

• **Connection to foreign partners** may reduce SMEs’ communication reachability and efficiency (redundancy of foreign ties)

• **Connections to government, universities and research institutes** significantly contribute to neighborhood range, brokerage and bargaining power, and proximity of market leaders

• **SMEs specialized in non-manufacturing sectors** have wider range of neighborhood, but their advantages in the whole network are not evident.

• **Number of horizontal ties** significantly contributes to all measures of network embeddedness
Future research direction

• **Network embeddedness and innovation**
  How does an entrepreneurial SME’s network position affect its innovation capacity?

• **Network embeddedness and regional agglomeration**
  How do multiplex inter-organizational ties lead to regional agglomeration of entrepreneurial SMEs?

• **Inter-and Intra- regional network and competitiveness of industrial clusters**
  How do inter-and intra-regional networks affect the entrepreneurial SMEs?
Thank you!
<table>
<thead>
<tr>
<th></th>
<th>Correlations, means and standard deviations of independent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>1</td>
<td>Age</td>
</tr>
<tr>
<td>2</td>
<td>Size</td>
</tr>
<tr>
<td>3</td>
<td>Dyadic Partner Diversity</td>
</tr>
<tr>
<td>4</td>
<td>Foreign Connections</td>
</tr>
<tr>
<td>5</td>
<td>Non-incorporated Connections</td>
</tr>
<tr>
<td>6</td>
<td>Non-manufacturing Connections</td>
</tr>
<tr>
<td>7</td>
<td>Horizontal Linkages</td>
</tr>
</tbody>
</table>
Partnership Network by Region

Regions:
- Sichuan
- Hubel
- Guangdong
- Beijing
- Shaanxi
- Shanghai
- Jiangsu
- Moscow
- Paris
- Guizhou
Supply Chain Network by Region

[Diagram showing network connections between various locations such as Hong Kong, Beijing, Shanghai, Toulouse, Guangdong, Moscow, Jiangsu, and others, with circles highlighting specific regions like Bavaria, Sichuan, California, Texas, London, Guizhou, Tianjin, and Shandong.

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