Research on the influence of alliance portfolio network characteristics on enterprise innovation performance: Based on the empirical analysis of automobile manufacturing industry

Xiao-yue Zhang 1,*, Meng-meng Ji 1
1School of Economics and Management, Nanjing Tech University, Nanjing, China

Abstract. This paper selects the formal standard formulation information of Chinese listed automobile manufacturing enterprises, uses the standard co-drafting unit to construct the technical standard alliance network, and uses negative binomial regression to discuss the influence of network characteristic indicators of alliance combination on enterprise innovation performance. The results show that alliance portfolio scale, alliance portfolio diversity and alliance relationship strength all have a positive impact on enterprise innovation performance, which has important reference value for enterprises to better create and manage standard alliances.

1. Research Background
Successful technological innovation depends on mature technical standards. Technical standards can give direction to technology development and are the foundation for enterprises to carry out continuous technological innovation. Technical standard alliance has become the first choice for enterprises to implement standardization strategy because of its excellent synergy effect, and the competition among enterprises has become the competition among technical standard alliance.

Most studies on the effect of standard alliance focus on the industrial level and macroeconomic level, such as the impact of technical standard alliance on the formation and diffusion of technical standards, leading design evolution, industrial innovation, alliance performance, etc[1, 2]. However, few articles discuss how to gain benefits from technical standard alliance at the micro level of enterprises[3]. Although some scholars have found the networking trend of technology standard alliances, there is still a lack of alliance portfolio studies focusing on the egocentric network perspective, lacking a comprehensive study on the impact of alliance portfolio on enterprise innovation performance.

2. Research Hypothesis

2.1 Relationship between alliance portfolio size and enterprise innovation performance
Alliance portfolio scale refers to the scale of the focus enterprise egocentric alliance network, which refers to the number of partners the focus enterprise has[4]. More actors are involved in joint efforts to develop and spread standards[5]. Focus companies will have opportunities and channels to market patented technologies[6]. Expanding the scale of the network can not only increase the flow stock of knowledge and information resources, but also enrich the types of knowledge resources[7]. The flow and diffusion of knowledge elements expands the space of innovation. Accordingly, the following hypothesis is proposed:

H1: Alliance portfolio size has a positive impact on enterprise innovation performance.

2.2 The relationship between alliance portfolio diversity and firm innovation performance

The diversity of standard alliance portfolio focuses on the distribution differences of alliance partners in organizational types and reflects the heterogeneity of knowledge and technology resources available to focus enterprises[8]. Different types of organizations have different backgrounds and resource advantages[9]. Universities and research institutes offer customized, cutting-edge technology. The supplier has knowledge related to the production process and input characteristics[10]. Users are often the source of ideas for new products. Partnerships with competitors provide access to industry-specific technology resources[11]. Accordingly, the following hypothesis is proposed:

H2: Alliance portfolio diversity has a positive impact on enterprise innovation performance.
2.3 The relationship between standard alliance relationship strength and firm innovation performance

The relationship capital accumulated in the interaction between enterprises and partners affects the efficiency of knowledge integration between organizations[12]. The strength of alliance relationship describes the frequency of contact between partners and the degree of commitment of organizational resources to the connection[13]. Frequent and continuous cooperation between focus enterprises and partners is conducive to the transfer and utilization of deep knowledge and tacit knowledge between alliance partners, thus improving the innovation ability of enterprises[14, 15]. Accordingly, the following hypothesis is proposed:

H3: Alliance relationship strength has a positive impact on enterprise innovation performance.

3 Research Design

3.1 Data sources

All the standard literature information of China Standard Classification number T from 2008 to 2020 is from CNKI Standard Database. When two or more units jointly act as drafters of a technical standard, they cooperate in an alliance to develop the standard. Standard partnerships typically last 24 to 36 months. Construct the enterprise calendar year standard alliance portfolio with 3 years as the time window.

The focus of the research is the automobile manufacturing enterprises. Obtain the list of listed companies in the automotive industry from Shenyin & Wanguo's industry classification. Download enterprise patent application information from "National Key Industry Patent Information Service Platform". The nature, age and other financial data of the business come from CSMAR.

3.2 Variable definition

3.2.1 Measurement of dependent variables

Firm innovation performance (TIN) : measured by the number of patent applications.

3.2.2 Measurement of independent variables

Alliance portfolio size (STN) : the size of the egocentric network of the focus enterprise, which is measured by the number of all the standard alliance partners of the focus enterprise.

Alliance portfolio diversity (STT) : Based on the study of De Leeuw et al.[16], alliance partners are divided into six types: suppliers, customers, competitors, universities and research institutions, government agencies and others. Use the reciprocal of Herfindahl index to measure. The calculation formula is:

$$ STT = \frac{1}{\sum (N_i/N)^2} $$

$N_i$ is the number of partners owned by the enterprise on type i, and $N$ is the total number of partners owned by the enterprise.

Alliance strength (STD) : The total number of cooperation between the focus firm and its partners in the observation year divided by the number of partners.

3.2.3 Control variables

Enterprise AGE (AGE), profitability (ROA), enterprise nature (FI), capital intensity (CAPIN), asset-liability ratio (LEV) and Tobin's Q value (TQ) are selected as control variables.

4. Empirical Research

4.1 Descriptive Analysis

As can be seen from Table 1, the innovation performance variance of sample enterprises is greater than the mean value, and the data are relatively discrete. The median values of alliance portfolio scale, alliance portfolio diversity and alliance portfolio strength are all less than 0, indicating that the participation rate of alliance portfolio of enterprises needs to be improved.

<table>
<thead>
<tr>
<th>variable</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>Med</th>
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<tr>
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<td>83.12</td>
<td>265.6</td>
<td>14.00</td>
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<tr>
<td>STN</td>
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<td>6.502</td>
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</tr>
</tbody>
</table>

4.2 Correlation Analysis

As can be seen from Table 2, the correlation coefficients between variables are all less than 0.6. The variance inflation factor is less than 2.05, so there is no multicollinearity problem.
4.3 Regression analysis

Column (1) in Table 3 studies the influence of control variables on enterprise innovation performance. Column (2), column (3) and column (4) in Table 3 add alliance combination scale, alliance combination diversity and alliance relationship intensity to column (1) respectively.

Column (2) in Table 3 shows that the regression coefficient of alliance portfolio size is 0.242, which is significant at the 1% level, indicating that alliance portfolio size has a significant positive impact on enterprise innovation performance. This verifies H1.

Column (3) in Table 3 is to test the relationship between alliance portfolio diversity and enterprise innovation performance. The regression results show that the regression coefficient of alliance portfolio diversity is 0.585, which is significant at the 1% level, indicating that alliance portfolio diversity has a significant positive impact on enterprise innovation performance. This verifies hypothesis H2.

Column (4) in Table 3 is to test the relationship between alliance relationship strength and enterprise innovation performance. The regression results show that the regression coefficient of alliance relationship strength is 0.141, which is significant at the 1% level, indicating that alliance relationship strength has a significant positive impact on enterprise innovation performance. This verifies the correctness of hypothesis H3.

5. Conclusions and Suggestions

Through empirical analysis, this paper proves that alliance portfolio scale, alliance portfolio diversity and alliance relationship strength all have significant positive effects on innovation performance. The scale of alliance portfolio can help expand resource acquisition channels and reduce the time cost of resource acquisition, thus
promoting the innovation performance of enterprises. The diversified combination of alliance makes the focus enterprises contact more heterogeneous resources, which helps to break the dilemma of repeated and single resources. The strength of alliance relationship can increase the trust between organizations, which increases the willingness of enterprises to share innovation resources and improves the utilization efficiency of resources, thus promoting the improvement of innovation performance.

This study has the following implications for the innovation practice of Chinese enterprises: alliance combination effect is very complex and uncertain, so building an appropriate alliance combination can improve the ability of independent innovation. Focus companies can leverage their network centrality to build standard partnerships with more stakeholders. Through patent layout gradually to network center position, grasp the initiative of the standard. Carry out continuous and frequent interaction with alliance partners to form a mutually beneficial relationship. Enhance innovation capability through alliance combination.

References