

## Mediating Effect of Dynamic Capability between Board Capital and Innovation Performance

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### Abstract

*In the existing literature, there is no consensus about the effect of the board capital on innovation performance. This study strive to find the reason by testing the testing the mediating effect of dynamic capability between the two variables. Data was collected from 385 Chinese listed manufacturing companies. The hierarchical regression analysis results confirmed the research hypotheses.*

**Keywords:** *Board capital, dynamic capability, innovation performance, breadth of board capital, board capital depth*

### 1. Introduction

Innovation performance can reflect the ability of an enterprise to face competition, and it is also a representative of development potential and ability to face the challenges. Therefore, many enterprises want to enhance their innovation performance. Establishing an effective board, by selecting the right people or changing the structure of the board, is one way that some companies employ to improve the innovation performance, because the board is an important source of resources and capabilities (Hillman and Dalziel 2003). Typically, the board of directors acts not only on behalf of shareholders to supervise the management and operation, but also provide a variety of resources for the enterprise. They play an important role on the enterprise's innovation, including innovation investment, establishment of innovation culture, innovation output and so on.

Board capital is “the capability that the board can provide resource to the enterprise”(Hillman and Dalziel 2003). It comes from the social network of the board members. Based on resource-based view, board capital is an important resource for enterprises, since it is valuable, scarce, nonsubstitutable and inimitable. Therefore, scholars want to investigate the effect of board capital on innovation performance.

Although in the past two decades, many scholars had conducted research on the impact of board capital on the company innovation performance, different scholars come to different conclusions. On the one hand, some scholars (such as Rothwell and Dodgson, 1991) advocated that board capital, to a certain extent, can help companies to improve innovation performance. Kale *et al.* (2000) believed that the foundation of board capital—relationship—can help companies solve the difficulties encountered in the process of innovation. At the same time, it can provide a variety of resources in favor of innovation for the company, including complementary technology, legitimacy to enter a new markets or adopt a new technologies, obtaining innovations information that have been obtained by others, so as to build

and maintain a competitive edge. On the other hand, there are some scholars (such as Cushing, Florida *et al.* (2002)) showed that, at least in some respects, the board capital may become the company's innovative barrier. When analyzing the literature, we found that conflicting results were found due to two reasons. First, the existing studies concerning board capital treated it as a two-dimension construct—human capital and social capital. However, it is difficult to distinguish these two dimensions in many cases, since they are between highly correlated to each other. Second, the existing research basically only consider the direct effect of the board capital on innovation performance, however, researchers had point that board capital cannot affect business performance directly, but indirectly by changing business strategy, decision-making and the abilities. This indicates that there is a mediator between the board capital and business performance. It is why some researchers cannot find the significant effect of board capital on innovation.

Therefore, in this study, we will reinvestigate the dimension of board capital and test the relationship between board capital and innovation performance by proposing the mediator—dynamic capabilities.

## **2. Theoretical Background**

### **2.1. Board Capital**

The concept of board capital is proposed by Hillman and Dalziel in 2003, and is defined "as the ability of board to provide resources for the company"(Hillman and Dalziel 2003). However, different scholars have different understandings of board capital and discuss it from different angles. Hillman and Dalziel divided board capital into human capital and social capital, where human capital refers to collective of all the board members to bring the knowledge, skills and abilities to the company; social capital refers to all the relationships of the board members and the resources or capabilities from those relationships. Fischer and Pollock divided board social capital into internal and external social capital based on the boundaries and functions of the board. Internal social capital refers to the social capital built among all the board members and that between the board and management through mutual understanding; external social capital is established by the board members through working in the industry or forming a good relationship with other actors in the industry (including suppliers, distributors and major customers, *etc.*). Haynes and Hillman (2010) tried to understand board capital from the breadth and depth angles. Board capital breadth refers to the heterogeneity of the board member in education and professional background, age interlocking with other sectors of industry; the depth of the board capital is the extent that the board member embedded in the industry by interlocking directorates or employment background.

In this study, we will also investigate board capital from breadth and depth dimensions, and the impact of the two dimensions on innovation performance.

### **2.2. Dynamic Capabilities**

Teece (1997) conclude that dynamic capability is the capability to integrated, build and re-configure internal and external resources and capabilities. While, Eisenhardt and Martin believed that dynamic capability is an identified routines process. Baobao Dong (2011) proposed that dynamic capability is the capability to integrate and configure the resources constantly and reconfiguring them according to the changes in the external environment.

For the dimensions of dynamic capabilities, different scholars had different understandings and proposed different dimensions. Wang and Ahmed (2007) proposed three dimensions of dynamic capabilities, namely adaptability, absorptive

capacity and innovation capability. Wu (2007) divided dynamic capabilities into resources integration capability, resources reconfiguration and learning capability.

In this study, we define dynamic capability as the capability of the company to integrate and reconfigure its resources and capability constantly, according to the change of environment. The results of dynamic capability are better adaptability and innovation capability. There are four dimensions of dynamic capability—organizational flexibility, resource reconfiguration, opportunity sensing capability and organizational learning.

### 2.3. Innovation Performance

In the existing research related to business innovation, innovative performance measurement methods are basically divided into two types: one method is using some of the existing financial indicators as the approximation of innovation performance, such as Baysingeretal using R&D expenditure per capita to measure the technological innovation capability of enterprises; Hansen and Hill using the ratio of R&D expenditure to sales to measure. The reason for the use of R & D expense as approximate measure of innovation performance is that scholars believed that R&D investment is a commitment to enterprise resources into the development process, and it can well improve R&D capabilities, thereby affecting the business of innovation performance(Helfat 1997). However, this measurement obvious flaws, because the relationship between R & D investment and innovation are not simple(Rothaermel and Hess 2006, Dalziel, Gentry *et al.* 2011). It also depends on whether there is a valid management guide; otherwise the business is difficult to transform R&D expense into its innovation capacity and performance.

Another method is a direct way to measure innovation performance. Scholars can develop a variety of innovative performance measurement scales, such as Zhang and Li (2010) developed a five items measurement scale for Chinese high-tech companies: the introduction of new products, the first to introduce new products, rapid release new products, develop new high-quality products and the use of new products to penetrate the market.

## 3. Research Hypotheses

Dynamic capability facilitates the company to adjust their business strategy as the environment change. It is the basis of sustainable competitive advantage (Teece 1997).

The basis for building dynamic capabilities are resources, especially that are "valuable, scarce, inimitable and irreplaceable"(Baobao Dong 2011). The board capital as an important resource has these four characteristics obviously: Firstly, the board capital has been proven its effectiveness in terms of corporate governance, and other enterprise value by many scholars, therefore, board capital is "valuable". Secondly, board capital is "scarce", because the board members with extensive experience and social network are very scarce for each enterprise. Therefore, board capital formed by those "scarce" board members is also scarce. Thirdly, the establishment process of board capital is the results of accumulation in social networks of each board member, which is difficult to imitate in a short time. Therefore, board capital has the characteristic of "inimitability". Finally, the board capital is nonsubstitutable, because the board has a nonsubstitutable role in the management and decision-making process. Almost all the decisions are made based on the experience of individual members, professional knowledge, professional background or recommend from other social network members, *etc.* Therefore, board capital is nonsubstitutable. In view of this, we proposed that:

H1: Board capital can significantly improve dynamic capabilities

Specifically,

H1a: board capital breath can significantly improve dynamic capabilities

H1b: board capital depth can significantly improve dynamic capabilities

The source of innovation is knowledge. The diversity of knowledge will lead to more innovative performance. The broader of the board capital means the more sources and types of knowledge, which will increase the innovation performance.

H2a: board capital breath can significantly improve innovation performance

Board capital depth means the high embeddedness in the industry. The board has a deeper understanding and more knowledge about the industry. With those understanding and knowledge, the board can absorb better new information or knowledge into the innovation.

H2b: board capital depth can significant improve innovation performance.

Dynamic capability is “the capability to create capacity ”(Winter 2003), and has a very important role for the development of enterprises and achieve sustained competitiveness. This had been confirmed by many scholars, such as Baobao Dong (2011). In their study, they found that dynamic capabilities have a significant positive impact on competitive advantage. In terms of innovation, Li and Liu (2014) confirmed the results that dynamic capabilities can help enterprises to improve their innovation capability. Therefore, we propose the following hypothesis:

H3: Dynamic capacity can significantly improve innovation performance

According to the literature review above, in the prior studies, the influence of the board capital on innovation performance is not consistent. Some scholars believed that the board capital can improve innovative performance, while some scholars believed that the board capital will limit enterprise innovation. However, Deutsch (2005) proposed that the impact of board capital on business performance is not direct, it only can take effect by changing the business strategy, decision-making and the capability to change the performance. Therefore, we believe that the board capital can only impact innovative performance by changing the dynamic capabilities of enterprises. Therefore, we proposed that:

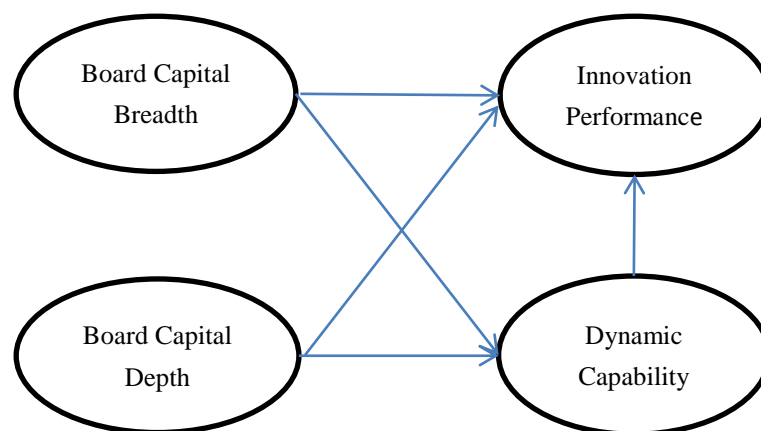
H4: dynamic capability is the mediator between board capital and innovation performance

Specifically,

H4a: dynamic capability is the mediator between breath of board capital and innovation performance

H4b: dynamic capability is the mediator between board capital depth and innovation performance

The theoretical research model was shown in Figure 1.



**Figure 1. Theoretical Research Framework**

## 4. Research Design

### 4.1. Measurement Scale

The measurement scales of the constructs were developed based on the definitions, and most of the items were adapted from the existing literature to fit the current study and Chinese context.

Board capital was measured from two dimensions—board capital breadth and depth. Board capital breadth was reflected by functional heterogeneity, occupation heterogeneity and relational heterogeneity. They were all calculated by Blau’s heterogeneity index (Blau, Blum *et al.* 1982).

Board capital depth was composited by board member work in industry and interlocks to industry. Board member work in the industry is a ratio of the number of board members who have more than three years’ experience in the focal industry and the board size; interlocks to industry was measured by the ratio of the number of interlocks focal industry and the total number of interlocks. The total number of interlocks is the number that board members worked as board of other listed companies. Then, these two ratios be summed to represent the board capital depth. The higher the value, the deeper of the board capital is.

When measuring innovation performance, we adopted the items from Zhang and Li (2010). The five items are continuous introduction of new products, the first to introduce new products, the rapid release of new products, develop new products and the use of high-quality new products to penetrate the market. This measurement scale was developed for Chinese high-tech companies, so they are well suitable for the Chinese context in this study.

For the measurement of dynamic capability, we followed the definition of Teece (1997), and measure it from four dimensions: organizational flexibility, resource reconfiguration, opportunity sensing capability and organizational learning. For each dimension, we adapted the items from several source as listed in Table 1.

**Table 1. Measurement Scales**

Constructs	Dimensions	Items	Sources
<b>Board Capital</b>	Board capital breadth	1. functional heterogeneity 2. occupation heterogeneity 3. relational heterogeneity	(Hillman, Cannella <i>et al.</i> 2000, Haynes and Hillman 2010, Ma Lianfu and Huiqun 2014)
	Board capital depth	1. board member work in industry 2. interlocks to industry	(Haynes and Hillman 2010, Ma Lianfu and Huiqun 2014)
<b>Innovation Performance</b>		1. We can introduce new products continuously 2. We usually introduce new products before our competitors 3. We can rapidly release of new products 4. We can develop new and high-quality products 5. We usually use new products to penetrate the market	(Li and Liu 2014)
<b>Dynamic Capability</b>	Organizational flexibility	1. Our employees can break the formal procedures to keep the flexibility 2. The work mode is flexible to individuals 3. We have a smooth communication channel	(Gibson and Birkinshaw 2004, Jiao, Alon <i>et al.</i> 2013)

	<ol style="list-style-type: none"> <li>4. We can timely response to changes of environment and objectives</li> <li>5. We can more rapidly change our strategy than our competitors</li> </ol>	
Resource reconfiguration	<ol style="list-style-type: none"> <li>1. We have sufficient support to innovation</li> <li>2. We encourage innovation</li> <li>3. We have enough stimuli and rewards to innovative staff</li> <li>4. Our employees have good adventure and pioneering spirit</li> </ol>	(Lazonick and Prencipe 2005, Jiao, Alon <i>et al.</i> 2013)
Opportunity sensing capability	<ol style="list-style-type: none"> <li>1. We have a deep understanding on the operating rules of our industry</li> <li>2. We are fully aware of the changing trends</li> <li>3. In order to obtain useful and timely information frequently communicate with stakeholders (such as competitors, customers, suppliers, <i>etc.</i>)</li> <li>4. Compared to the competition, we are able to identify business opportunities faster</li> <li>5. Relative to competitors, we are able to quickly find the best practice</li> <li>6. We have established procedures to identify the target market segmentation, changes in customer demand, <i>etc.</i></li> </ol>	(Ge and Dong 2008, Jiao, Alon <i>et al.</i> 2013, Wilden, Gudergan <i>et al.</i> 2013, Li and Liu 2014)
Organizational learning	<ol style="list-style-type: none"> <li>1. We often learn from other business enterprises in the form of alliances, cooperation, <i>etc.</i></li> <li>2. We have an effective employee training and education systems within the enterprise</li> <li>3. We have established internal knowledge-sharing mechanism</li> <li>4. We often communicate with each other and learning between multi-sectors</li> <li>5. We encourage employees to self-learning</li> </ol>	(Zahra and George 2002, Chen Guo-quan 2005)

#### 4.2. Data Collection

The target sample of this study is the listed manufacturing companies based on the industry classification of China Securities Regulatory Commission (CSRC). We selected the sample for the following reasons: firstly, CSRC classified a total of 2853 listed companies into 19 industries, among which there are a total of 1799 manufacturing companies accounting for 63.1%. It indicated that the manufacturing sector accounted for the majority of listed companies and it can be a representation of the listed companies. Secondly, the main focus of this study is innovation. Compared to other industries, manufacturing companies more emphasize innovation. Thirdly, select a single manufacturing industry as the target sample can reduce the variation and control impact of industry to maximize the significance of hypothesized relationship.

After determining the initial sample, in order to avoid the influence of special or extreme cases of research findings, we further screened the initial sample was: (1)

excluding ST listed companies. Because of the emergence of financial status or other abnormal condition of these companies, it may bias the results. (2) Excluding the listed companies that did not disclosure complete information of their board members about education, occupation, background and other part-time jobs in annual report and annotation (3) excluding companies that incompletely disclose R & D expenditure information. Excluding the above (2) (3) companies can make the data collected using questionnaires comparable to secondary data and ensure the reliability of the results.

After the screening, we obtained 1132 listed companies as the target list, and then we transfer the list to a Beijing consulting firm for data collection. After a contact with the target company and confirmed the willingness to participate, the questionnaire will be send to the company by mail. Finally, a total of 580 questionnaires were distributed, with 410 questionnaires were returned, of which 385 are valid questionnaires. The response rate is 70.7%, which is acceptable.

## 5. Results

### 5.1. Reliability and Validity Analysis

Before testing the hypotheses, we tested the reliability and validity of the measurement scale. First, we conducted EFA analysis as the first step, as suggested by Worthington and Whittaker (2006). Accordingly, we also tested the reliability using Cronbach's  $\alpha$ . The factor loadings and Cronbach's  $\alpha$  coefficient for the constructs or dimensions were listed in Table 2.

**Table 2. Factor Loadings and Cronbach's A**

Construct	Dimensions	Items	Factor loadings	Cronbach's $\alpha$	
<b>Board Capital</b>	Board capital breadth	Item 1	0.68	0.72	
		Item 2	0.73		
		Item 3	0.78		
	Board capital depth	Item 1	0.80		0.79
		Item 2	0.77		
		Item 3	0.78		
<b>Innovation Performance</b>		Item 1	0.84	0.90	
		Item 2	0.86		
		Item 3	0.89		
		Item 4	0.80		
		Item 5	0.82		
<b>Dynamic Capability</b>	Organizational flexibility	Item 1	0.78	0.81	
		Item 2	0.82		
		Item 3	0.76		
		Item 4	0.89		
		Item 5	0.84		
	Resource reconfiguration	Item 1	0.90	0.88	
		Item 2	0.83		
		Item 3	0.79		
		Item 4	0.82		
	Opportunity sensing capability	Item 1	0.80	0.80	
		Item 2	0.75		
		Item 3	0.85		
		Item 4	0.82		
		Item 5	0.74		
		Item 6	0.73		
Organizational learning	Item 1	0.86	0.82		
	Item 2	0.84			
	Item 3	0.80			

Item 4	0.79
Item 5	0.78

Moreover, we conducted the second-order confirmatory factor analysis with AMOS to test the unidimensionality of dynamic capability. The results showed that Chi-square= 188.6, df=81, GFI=0.92, NFI=0.94, AGFI=0.93, CFA=0.99, RMSEA=0.03. Therefore, we can draw the conclusion that dynamic capability is composited by the four dimensions.

## 5.2. Hypotheses Testing

To test the hypotheses, we run the hierarchical regression analysis. In all the analysis, we select the industry, company size and board size as the control variable. The results are listed in Table 3 and 4. The dependent variable of model 1 and 4 is dynamic capability, while the dependent variable of model 2, 3, 5 and 6 is innovation performance. From model 1 in Table 3, we can see that board capital breadth can significantly influence dynamic capability as shown in model 1, that is, H1a is supported. The results of model 4 showed that board capital depth can improve dynamic capability as well, that is, H1b is supported. The results of the model 2 and model 5 both confirmed the effectiveness of dynamic capability on innovation performance improvement. Therefore, hypothesis 3 is supported.

**Table 3. Mediating Effect of Dynamic Capability between Board Capital Breadth and Innovation Performance**

IV	Model 1	Model 2	Model 3
Board capital breadth	.30***	.31***	.16*
Dynamic capability	--	--	.49***
R <sup>2</sup>	.13***	.09***	.31***
ΔR <sup>2</sup>	--	--	.22***

\* significant at .05; \*\* significant at .01; \*\*\* significant at .005

**Table 4. Mediating Effect of Dynamic Capability between Board Capital Depth and Innovation Performance**

IV	Model 4	Model 5	Model 6
Board capital depth	.25***	.23***	.06 <sup>n.s.</sup>
Dynamic capability	--	--	.52***
R <sup>2</sup>	.09***	.05**	.35***
ΔR <sup>2</sup>	--	--	.29***

\* significant at .05; \*\* significant at .01; \*\*\* significant at .005

The mediation effects of dynamic capability were tested following the three steps suggested by Baron and Kenny (1986), as shown in Table 3 and 4. When comparing model 1 to 3, we can concluded that dynamic capability only partially mediates the relationship between board capital breadth and innovation performance. Therefore, the hypothesis 4a is partially supported. However, when comparing model 4 to 5, we found that dynamic capability can full mediate the relationship between board capital depth and innovation performance. Therefore, and hypothesis 4b is supported.

For the effect of board capital on innovation performance, we run the regression model 7 and 8. The results were shown in Table 5. From the Table, we can see that both board capital breadth and depth can improve innovation performance. Thus, hypothesis 2a and 2b were supported.



**Table 5. Effect of Board Capital on Innovation Performance**

IV	Model 7	Model 8
Board capital breadth	.35***	-
Board capital depth	-	0.15**
R2	.20***	.11**

\* significant at .05; \*\* significant at .01; \*\*\* significant at .005

## 6. Conclusion and Discussion

This study was conducted to investigate the relationship between board capital and innovation performance. Based on the data collected from Chinese manufacturing listed company, the positive effect of board capital breadth and depth on both dynamic capability and innovation performance were confirmed. Moreover, this study also confirm the mediating effect of dynamic capability between board capital and innovation performance, when dividing board capital into the two dimensions-board capital breadth and board capital depth.

This study can make contribution to the existing literature by answering how board capital influence innovation performance, and explain why the existing literature found the conflicting results. Moreover, practically, the study can help the companies to improve the innovation performance by selecting the right board member and improving the board governance structure.

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