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The Impact of Capability Reconfiguration on Latecomer Firms' Innovation Performance: Catch-up Stage as a Moderator

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Abstract: The study draws on capability perspective to investigate the relationship between latecomer firm's capability reconfiguration and firm innovation performance. Date was collected from 290 manufacturing enterprises in China. The hierarchical regression analysis shows that capability evolution and capability substitution are both positively associated with firm innovation performance, the catch-up stage is the key moderator between capability reconfiguration and firm innovation performance and the effects of the capability evolution and capability substitution on innovation performance vary in different catch-up stages. In the early stage of catch-up, capability evolution is positively associated with the firm innovation performance and capability substitution is negatively associated with firm innovation performance; while in the later stage of catch-up, capability evolution is negatively associated with the firm innovation performance and capability substitution is positively associated with firm innovation performance. The results present a deeper understanding of how latecomer firms improve the innovation performance by reconfiguring their capability. These findings have also important implications whether the managers need to make a trade-off between the two ways of capability reconfiguration and how they adjust the capability strategy as the firm is in different stages of catch-up.

Keywords: Capability evolution, Capability reconfiguration, Capability substitution, Catch up, Innovation performance

1 Introduction

Latecomer firms often face a real problem: how to overcome the technology and market disadvantage and catch up to the leading enterprises. This phenomenon has been widely concerned by papers. A great number of researchers have studied how the latecomer firms catch up to the leading firms by technological learning (Kim, 1980; Hobday, 1995; Lee & Lim, 2001; Hobday, 2005)[1-4] and other papers related to the firm capability show the process and mechanism acquire and maintain the competitive advantage through resource or capability reconfiguration (Hamel & Prahalad, 1990; Teece et al., 1997; Teece, 2007; Lavie, 2006)[5-8].To shorten the technological gap by technological learning often proves to be keep-up rather than catch-up. Because the gradual changes in capability often encounter bottlenecks, especially when the enterprise is close to the leading enterprises, it becomes more and more difficult to obtain their technology, and to catch up by reconfiguring its resources and capabilities is a better way.

Capability reconfiguration refers to the activity to change inertia elements of capability and interdependent relationships between them which is strategic act to maintain or enhance competitiveness in a dynamic environment. We can recommend two ways to reconfigure the capability: capability evolution which refers to the diachronic adjustment of special routine and capability; while capability substitution which offers an immediate response at the level of the overall capability portfolio (Teece et al., 1997; Teece, 2007; Lavie, 2006; Anderson & Tushman, 1990) [6-9].

Although theoretical researches prove capability evolution and capability substitution are the key drivers of enterprise innovation (Lavie, 2006; Anderson & Tushman, 1990; Isobe et. al., 2008)[8-10], there is a lack of empirical evidence. Also, no research shows that, with the firm in a different catch-up stage, how the capability reconfiguration affect innovation performance.

We answer the above question through an empirical study based on the moderator of catch-up stage between capability reconfiguration and innovation performance. Fig.1 presents the research model in this study. The hypotheses and discussion presented in subsequent paragraphs gives the rationale for these variables.

2 Theory and hypotheses

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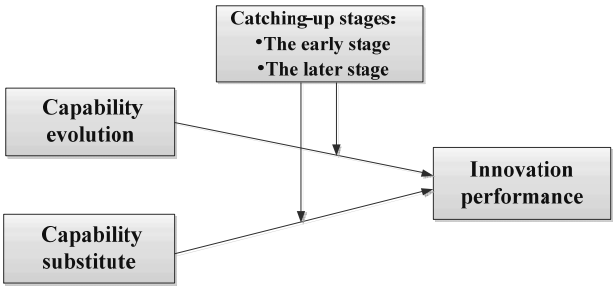

Fig.1 Research model

2.1 Capability reconfiguration

Capability reconfiguration mechanisms are distinct from the notion of dynamic capability, which measures the incumbent's capability to modify existing capabilities in response to technological change (Lavie, 2006) [8]. Some scholars have claimed that firms can configure their capability by the way of either competence enhancing or competence destroying when facing with a technological change or discontinuity (Nelson & Winter, 1982; Tushman & Anderson, 1986) [11, 12] . Their research suggests a substitution mechanism by which obsolete capabilities are replaced by newly acquired ones and an evolution mechanism by which existing capabilities can be adapted (Teece et al., 1997; Anderson & Tushman, 1990; Tushman & Anderson, 1986; Tushman & Romanelli, 1985; Eisenhardt & Martin, 2000) [6,9,12-14]. Lavie 2006)[8] argued that substitution and evolution may be considered as the two extremes of the same continuum. The former is defined as incremental competence enhancement based on the old ability while the latter means outdated competence destruction or new competence acquisition.

2.2 Latecomer firms' catch-up

According to Hobday (1995) [2], a latecomer firm is a manufacturing company which faces two sets of competitive disadvantages in attempting to compete in export markets. The first is technological in character. Dislocated from the main international sources of technology and research and development (R&D), a latecomer is behind in engineering, technical skills and R&D. The second disadvantage concerns leading-edge markets and demanding users. To succeed in international markets, the latecomer firm must overcome these technological disadvantages and entry barriers by technological assimilation, adaptation and innovation. Kim (1980)[1]presents a model of development stages that shows how local firms in a developing country acquire foreign technologies, and strengthen their competitiveness by the subsequent assimilation and gradual improvements of foreign technology. Mathews (2002)[15]utilizes the case of latecomer firms engaged in semiconductor manufacturing from the Asia-Pacific region to illustrate how they overcome competitive disadvantages through linkage, resource leverage, and learning. The literatures come to the same conclusion: through learning to enhance firm's capability is a key to catch up successfully (Zhu et al.，2011) [16]. However, latecomer firm's catch-up through technical learning will also encounter some problems. First, technological learning tends to gradual improvements of technological capabilities. It is not so effective when enterprises try to achieve technological leapfrogging (Lee & Lim，2001; Hobday，2005) [3,4]. Second, technological learning does not necessarily lead to building up of innovative technological capabilities, and sometimes it only lead to improvement of simple manufacturing or imitation competence (Dutrénit, 2004) [17].So some literatures turn to the research on the capability of the latecomer firms. Firm capability theory claims that the capability to integrate and reconfigure its internal and external resources is the source of sustainable competitive advantage of enterprise (Teece et al., 1997) [6].The innovation performance of the latecomer firm is associated with its own capabilities, competitor's capabilities and the efforts of reconfiguring their capabilities and narrowing capability gaps. (Lavie, 2006;Barney, 1991; Castanias & Helfat, 1991) [8,18-19].

2.3 Innovation performance

According to Coombs and Bierly (2006) [20], the innovation performance, which is a multidimensional measure, reflects the achievement of the enterprise innovation goal. Scholars have recommended the use of multiple indicators to measure innovation performance (Lane et.al.，2001；Alegre et al.，2006；Alegre & Chiva ，2008) [21-23]. Technological innovation is divided into product innovation and process innovation, and the former is of great significance to the long-term development of the enterprise, which has been widely recognized (Montalvo, 2006; Mary & Marina, 2010) [24-25]. Therefore, we use multidimensional indicators to measure product innovation performance based on subjective evaluation.

2.4 Hypotheses and model

2.4.1 Capability reconfiguration and innovation performance

Resource based view and dynamic capability view argue that the competence to continuously restructure the resources and upgrade capabilities is the driving force for sustainable innovation (Teece et al.，1997; Eisenhardt & Martin，2000；Barney, 1991;Penrose, 1959; Wernerfelt, 1984) [6,14,18,26,27,].

Both evolutionary economics and capability theory emphasize that firm capabilities has a certain stability and inertia, which will affect subsequent capabilities (Nelson & Winter，1982；Leonard-Barton，1992) [11,28]. On the one hand, when the environment changes, structural inertia and core rigidity make some key skills and capabilities out of date, so it is necessary for the firm to invest and update the resources and capabilities continuously (Teece et al.，1997；Teece，2007) [6,7] .On the other hand, as a result of path dependence, gradual modifying and improvement of the existing resources and capabilities can greatly reduce the uncertainty and

cost compared with the drastic change of capabilities. Therefore, capability evolution can integrate and optimize enterprise's resource base, organizational routines and capability structure, overcome the organizational inertia and cognitive bias，reduce the novelty obstacles of innovation and ensure the smooth implementation of innovation.

Capability evolution is conducive to innovation, however it is easy for firms to fall into a limited technology set ,confine themselves to making adaptive capability changes and ultimately hinder innovation (Tushman & Anderson，1986；Levitt & March，1988)[12,29].Capability substitution abolishes old capabilities and rebuilds new competences to respond to environmental changes rapidly through acquisition, integration, reconstruction of resources (Karim & Mitchell，2000) [30], which enhance the ability to capture new technology opportunities and market opportunities (Isobe et al., 2008 ;Eisenhardt & Martin, 2000) [10,14] and can promote innovation. However, the capability substitution is also associated with higher costs and higher risk. Due to the uncertainty in R&D and market, breaking the original capability structure and development path will not allow organization conventional to run smoothly and orderly and undermine the foundation of innovation.So based on the discussion above, we can propose the flowing hypothesis.

Hypothesis 1: Capability evolution significantly influences firm innovation performance.

Hypothesis 2:Capability substitution significantly influences firm innovation performance.

2.4.2 The moderating effect of catch-up stage

A latecomer firm's technological progress and capability upgrade are not achieved overnight, but to go through multiple stages of evolution. Chen (2006) [31]put forward the three stage model of latecomer firms' catch-up: the stage of technology introduction, technology synchronization and technological leapfrogging. In Chen (2006)'s [31] paper the technology leapfrogging means to be a technological leader in some industry. While Sun and Liu (2004) [32] consider three stages for catch-up firms to experience: following, staying abreast and leading. Bell's (2003)[33]competency levels model for technological innovation points out that enterprises should go through four stages before achieving core advantages: acquiring, assimilating, deepening and upgrading, and finally reach the international frontier. This theory essentially describes the evolution process from the initial stage to the stage of technological leading.

Based on the theory and necessary enterprise investigation, we propose that latecomer firm's catch-up can be divided into four stages: initial, following, keeping abreast, and leading stage. With enterprises in different stages of growth, the role of enterprise capability may be different (Helfat & Peteraf, 2003) [34]. In order to facilitate the research, we divided latecomer firm's catch-up into two stages. In the early stage including initial and following stage, with less accumulation of knowledge and greater capability gap, the latecomer firms have to grasp the technical know-how and improve the capability of routine operation through the combination of new knowledge and skills with existing resources and capabilities (Zhao, 2003) [35]. As the capability is dependent and continuity, breaking the original competence structure and organizational routines and enterprise, will be of high cost and risk. For this reason in the early stage of catch-up, capability substitution often hampers innovation. However, in the later stage including keeping abreast and leading stage, the latecomer firms have some knowledge base and innovation capability. But the organizational inertia formed in the process of long-term development hindered enterprise innovation (Nelson and Winter,1982)[11] .Only to replace the outdated competence with the new capability to further promote innovation (Zhao & Xu，2002)[36], and finally to realize the firm's catch-up.

So based on the discussion above, we can propose the flowing hypothesis.

Hypothesis 3: Catch-up stage is a moderator between capability evolution and innovation performance. In the early stage of catch-up, the capability evolution has a positive effect on innovation performance, while capability evolution has a negative effect on innovation performance in the later stage.

Hypothesis 4: Catch-up stage is a moderator between capability substitution and innovation performance. In the early stage of catch-up, the capability substitution has a negative effect on innovation performance, while capability substitution has a positive effect on innovation performance in the later stage.

3 Data and methods

3.1 Data collection

We gave out 750 questionnaires by way of face-to-face, mail and e-mail from August, 2014 to February, 2015 and 386 of them were taken back. The response rate was 51.47 % and 290 questionnaires were available, with valid recovery rate of 45%, in which 12.07% are from pharmaceutical and biological products firms, 10.69% are from general equipment and special equipment manufacturing firms, 9.66% are from Computer, communications and other electronic equipment manufacturing firms, and the number of the instrument and meter manufacturing enterprises is the least, only 10%. Our samples are mainly taken from enterprises in Shanghai, Beijing, Tianjin, Liaoning, Jilin, Heilongjiang and other places. Most of the samples are from the northeast region, accounting for 45.17% of the total sample, followed by Beijing and Tianjin, accounting for 33.79% of the total sample. At the level of ownership, private enterprises and foreign investment (and holding) enterprises are the majority, accounting for 43.79% and 32.41% respectively. Most of the questionnaires were

completed by the middle and senior managers (accounting for 77.58%). And 80 percent of respondents have been in the current business for more than 3 years. A wealth of management experience will ensure the accuracy of the higher response to the questionnaire.

We used Armstrong & Overton's (1977)[37] extrapolation procedure to assess non-response bias. No systematic differences were found between the early and late respondents. Thus, non-response bias is likely not an inhibitor in our analyses.

3.2 Measures

The questionnaires were scored according seven-point Likert scales, in which 1 indicating totally disagree and 7 indicating totally agree. The concept framework and constituent elements of capability configuration come from Lavie (2006)[8] ,Tushman & Anderson (1986)[12] ,Teece et al. (1997)[6]and Eisenhardt & Martin (2000)[14] . The items come from Gatignon et al. (2002)[38] . Our items are offered to measure "capability evolution": (1) To adjust the existing specific capability and routine; (2) To absorb new knowledge to develop the existing knowledge base; (3)To improve the existing technology; (4)To Seek solutions from the previous experience. Six items are given to measure "capability substitution": Innovation in our firm involved/required: (1)To explore and develop new concepts or principles; (2)To develop new skills that have not been previously; (3)To absorb and create new knowledge to replace outdated knowledge; (4) To learn new knowledge or knowledge from different knowledge base; (5)To innovate and adopt different methods ,routine or process.

About the company's innovation performance, scholars have developed mature scales. So our scale were developed from Zhang & Li (2010) [39] ,Tsai (2001) [40] ,Chen et .al.，(2011) [41], Barezak (1995) [42], Gatignon & Xuereb (1997) [43].The firm innovation performance includes:(1) The novelty of new products; (2) The number of new products; (3) The speed of new product development; (4) The ratio of sales revenue of new products to total sales; (5) New product's added value and profit margin; (6) Market share of new products.

Both technological level and technological capability indicators are adopt to measure catch-up phase. Technological development level is divided into four stages: initial, following, keeping abreast and leading stage. The development of technological capabilities also contains four stages: mechanical imitation, imitation innovation, integrated innovation and original innovation stage. Each options in each topic uses 1 to 4 points and the average of the two questions (represented by the letter D) as the basis for the final judgment. If $1 \le D < 2$, the firm is considered in initial stage; if $2 \le D < 3$ the firm is considered in following stage; if $3 \le D < 4$,the firm is considered in keeping abreast stage and if $D=4$ the firm is in leading stage. Finally, the initial and the following stage are classified as the early stage of catch-up while the keeping abreast and the leading stage belong to the later stage of catch-up.Also, firm age and firm size were included as control variables in this paper (e.g. Amburgey & Rao, 1996) [44].

3.3 Reliability and validity

Reliability. Cronbach's α were introduced to test the reliability of questionnaires. The minimum one of the values of Cronbach' s α are 0.911>0.90, which means the data are internal consistent, reliable and stable.

Validity. Two types of validity should be assessed: content validity and construct validity. Since the items of questionnaires were identified come from the existing literatures and scales, the content validity should be affirmed; we used confirmatory factor analysis(CFA) to assess the construct validity(Anderson & Gerbing， 1988) [45]. As Tab.4 shown, all of the values of factor loading are above 0.7, composite reliability (CR) are all above 0.7, and the average variance extracted(AVE) are above 0.5, which Indicates that the item has good convergent validity(Hair et al.， 2009) [46].

The square root of AVE of each variable is greater than the Pearson correlation coefficient, which means questionnaire is of good discriminant validity (Fornell & Larcker， 1981) [47].

Tab.1：Confirmatory factor analysis

Item	factor loading	CR	AVE	X_1	X_2	X_3
Capability Evolution						
CE1	0.853					
CE2	0.875	0.932	0.773	**0.879**		
CE3	0.894					
CE4	0.894					
Capability Substitution						
CS1	0.815					
CS2	0.860					
CS3	0.852	0.913	0.678	0.376	**0.823**	
CS4	0.793					
CS5	0.793					
Innovation Performance						
IP1	0.841					
IP2	0.915					
IP3	0.858	0.947	0.750	0.650	0.513	**0.866**
IP4	0.897					
IP5	0.846					
IP6	0.837					

Note: In the final three columns of the table, the figures in bold are the square root of AVE value while other figures represent Pearson correlation coefficient.

4 Results

We use the hierarchical regression method to test the moderating effect, and the equation used is as follows.

$$Y=\alpha_0+\alpha_1X_1+\alpha_2X_2+\alpha_3X_3+\alpha_4X_4+\alpha_5M+\alpha_6MX_3+\alpha_7MX_4+\varepsilon$$

Where Y=firm innovative performance, α_0 = intercept, X_1=firm age, X_2=firm size, X_3 =capability evolution, X_4=capability substitution, ε =random disturbance terms. M is a moderator, and the firm is in later stage of catch-up when M=1.

Tab.2 The moderating effects of catch-up stage

Variables	Step 1:Control variables	Step 2:Main effects	Step 3: Moderators
Constant	2.828***	0.409	1.350***
Firm age	0.012	0.010	0.003
Firm size	0.288 ***	0.158***	0.127***
Catch-up stage(M)		0.077	0.076
Capability evolution(CE)		0.458***	0.682***
Capability substitution(CS)		0.298***	-0.115*
M*CE			-1.162***
M*CS			1.172***
R^2	0.116	0.493	0.668
ΔR^2	0.116	0.377	0.176
ΔF	18.789***	70.395***	74.662***

Note:*p<0.05,**p<0.01,***p<0.001,N=290

The technique of least squares was used with the control variables entered in step1, followed by the main effects in step 2, and the moderators in step 3.

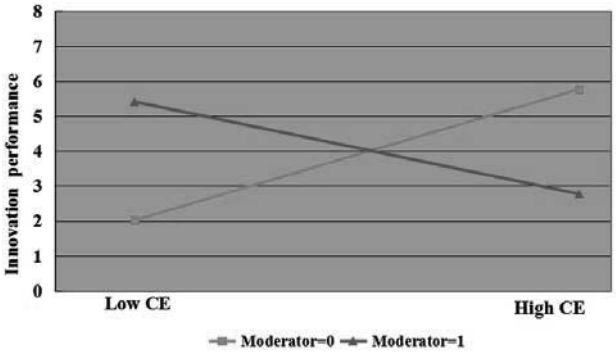

Fig.2 The moderating effect of catch-up stage between capability evolution and innovation performance

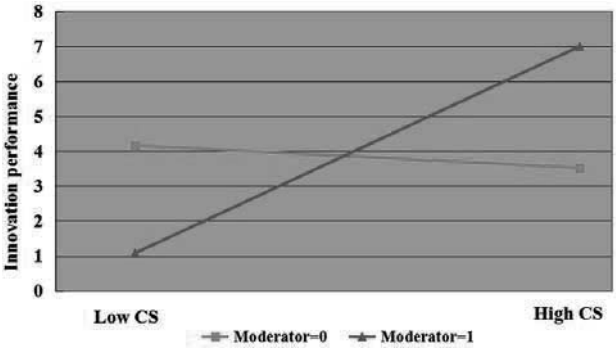

Fig.3 The moderating effect of catch-up stage between capability substitution and innovation performance

The coefficients and the test results are shown in Table 3. The minimum value of R2 in all three models is 0.116 is much greater than the 3% level proposed by scholars (Wen & Ye, 2014) [48] and the significant level of F change was lower than 0.001.So we can safely draw the conclusion that our overall model is good.

The control variables regression results show that, the firm size has a positive effect on innovation performance (α_{12} =0.288, p<0.001), but the firm age has no significant impact on innovation performance. The main effect regression results show that, regardless of the moderating effect of catch-up stage, capability evolution is significantly associated with the firm innovation performance (α_{23}=0.458, $p < 0.001$) , capability substitution is significantly associated with firm innovation performance (α_{24}=0.298, $p<0.001$), so hypotheses1 and 2 are supported.

The moderators regression results indicate that the effects of the capability evolution and capability substitution on innovation performance vary in different catch-up stage as are shown in Fig.2 and Fig.3. Specifically speaking, in the earlier stage of catch-up, capability evolution is positively associated with the firm innovation performance (α_{33}=0.682, $p<0.001$), and capability substitution is negatively associated with firm innovation performance (α_{34}= -0.115, $p<0.05$); while in the later stage of catch-up, capability evolution is negatively associated with the firm innovation performance (α_{33}= -0.480, $p<0.001$), and capability

substitution is positively associated with firm innovation performance (α_{34}=1.057, p＜0.05), so hypotheses 3 and 4 are supported.

5 Conclusions and discussion

5.1 Findings and implications

The purpose of this paper is to explore the relationship between latecomer firm's capability reconfiguration and innovation performance and if the influence of capability reconfiguration on innovation performance varies with the firms in different growth stage. The results of our analyses present three sets of key findings. First, the significant effects of both capability evolution and capability substitution on firm innovation performance are verified. From the results of the main effect model, we can find capability evolution and capability substitution are positively associated with innovation. This finding is consistent with the theory of dynamic capabilities who argued that the capability to integrate, build, and reconfigure their internal and external resources are the key to maintain competitive advantage (Teece et al.，1997) [6].

Second, the comparison of path coefficient indicates that capability evolution exerts a greater impact on firm innovation compared with capability substitution. This view is consistent with the theory of punctuated equilibrium. Punctuated equilibrium theory argued that a firm's capability or technology evolves in a nonlinear way. There is an alternation between long periods when stable infrastructures permit only incremental adaptations, and brief periods of revolutionary upheaval and long-term evolution is the main power of innovation (Gersick,1991) [49] .

Third, the two ways of capability reconfiguration have different effects on innovation in different periods. These differences are due to the heterogeneity in capability structure and knowledge base when firm is in difference catch-up stages. The main causes of these differences are likely to be as follows. In the early stage of catch-up ,with the weak base of capability, the firm has to master technical know-how and develop "zero order capability" by learning and imitating (Zollo & Winter，2002) [50]. Then, neither can the latecomer firms get rid of the path dependence of the old capability, nor they should make drastic changes of capability. Due to cost and uncertainty，to break the original knowledge structure, organizational routine will likely hinder firm's innovation. It may be the only right choice to continuously adjust and improve the organizational routines in the way of capability evolution. Through absorption and integration of external resources and capabilities based on the original knowledge and competence, latecomer firms can continue to promote innovation and to keep the capability structure stable and the organizational routines smoothly (lavie，2006；Wu，1995) [8,51]. While in the later stage of catch-up, firms already have considerable capabilities, and the outdated knowledge system and organizational inertia will form the capability rigidity and become the fetters of the capability to upgrade (Nelson & Winter，1982)[11]. To breaking the organizational inertia and core competence rigidity in the way of capability substitution is more conducive to the realization of the capability leapfrogging and breakthrough innovation (Zhao & Xu, 2002; Wu, 1995) [36, 51] . This finding further proves the viewpoint that the ability evolves over time (Helfat & Peteraf, 2003) [34].

This study has two implications for practitioners. For one thing, capability reconfiguration is the key driving force of innovation and in order to catch up, managers should not only simply collect resources but also accelerate the process of capability reconstruction and upgrade. For another, flexible capability strategy is the guarantee of the success of the latecomer enterprises. By identifying and locating their own development stages, the latecomer firms can enhance the innovation performance effectively. In the initial and following stage, the more limited resources should be allocated to the capability evolution; while in the keeping abreast and leading stage, it seems to be more effective to carry out capability substitution.

5.2 Limitations

Despite its contributions, this study also has some potential limitations. First, we focus only on capability evolution and capability substitution as key elements of innovation performance, and other elements that affect performance, such as organizational culture, leadership, marketing competence, and other factors, are ignored.

A second limitation is that our samples are mainly from the firms in northeast, Beijing, Tianjin and Shanghai, not yet verified in other regions and to study with large samples collection is the direction of further study in the future.

A third limitation is that the capability evolution and capability substitution might co-effect each other in some ways, their interaction could be discussed in future researches.

Finally, there are different patterns of catch-ups: path-creating catch-up, path-skipping catch-u and path-following catch-up (Lee & Lim, 2001) [3].The relationship between the capability reconfiguration and innovation performance will be different for distinguishing catch-up enterprises.

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