



## The Ambidextrous Effects of Path Dependence

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### Abstract

The research idea of this study is to explore the ambidextrous effects of self-reinforcing mechanisms on organizational path dependence. In this paper, we present a conceptual model based on the duration of R&D intensity: the longer a firm maintains its R&D intensity, the more it will engage in diversification. In addition, we apply the effects of R&D intensity duration to the organizational slack effect. When a firm's level of organizational slack is high and is combined with duration of R&D intensity, it will create the explorative learning capability of the firm. On the contrary, if a firm's level of organizational slack is low and is combined with duration of R&D intensity, it will create the lock-in path of the firm. We can apply this idea to both the explorative learning capability and the lock-in path via the type of firm's diversification. The explorative learning capability tends to be coupled with the unrelated diversification, whereas the lock-in path tends to be coupled with related diversification.

**Keywords:** Path Dependence: Lock-in: Learning Capability: R&D Intensity: Organizational Slack: Related Diversification: Unrelated Diversification.

### 1. Introduction

Path dependence has been a topic of continuous and enduring interest in strategy research on capabilities and routines, in entrepreneurship and innovation research on technological design trajectories, and in institutional economics research on the persistence of institutions and governance structures (North, 1990; Teece, Pisano and Shuen, 1997; Garud, Jain and Kumuraswamy, 2002 cited in Anon., 2010, p.733). However, across institutional, technology, and strategy literatures, it remains unclear why path dependence sometimes occurs and sometimes not, why it sometimes lead to inefficient outcomes and sometimes not, how it differs from mere increasing returns, and how scholars can empirically support their claims on path dependence (Vergne and Durand, 2010).

Vergne and Durand (2010) argue that path dependence occurs when initial conditions are followed by a series of contingent (chance) events whose influence on the path taken is larger than the initial conditions. When this happens, it changes the initial outcome distribution, with outcomes varying with time. Indeed, once a path has been contingently selected this way, it may be self-reinforced (for example, because of increasing returns) and may be locked-in, as an important outcome, as long as there is no exogenous shock that unsettles the entire system (Anon., 2010).

With respect to the acquisition of knowledge, memory development is self-reinforcing in that the more objects, patterns, and concepts are stored in memory, the more readily acquired is the new information about these constructs and the more facile the individual will be in using them in new settings (Bower and Hilgard, 1981 cited in Cohen and Levinthal, 1990, p.129). At a firm level, economic historians have examined the importance of the development of formal research and development (R&D) as institutionalized learning mechanisms (Mowery, 1981). Cohen and Levinthal (1989) argue that learning occurs not only in the focus of R&D, but also in the process itself.

Paradoxically, while capability development is path dependent, the role of dynamic capabilities is to purposefully create, extend, or modify the firm's resource base to increase the environmental fitness and avoid lock-in (Vergne and Durand, 2010). At a theoretical level, dynamic capabilities emphasize the managerial ability to orchestrate a firm's assets so as to avoid harmful inertia in a rapidly changing environment (Teece, Pisano and Shuen, 1997 cited in Vergne and Durand, 2010, p.740). It follows that dynamic capabilities are construed simultaneously as path dependent and as a remedy to path dependence. Because of this ambiguity, the capability lifecycle framework describes path dependent capability trajectories but fails to specify when path dependence will lead to capability retirement, replication, or recombination (Helfat and Peteraf, 2003 cited in Vergne and Durand, 2010, p.740).

Upon familiarizing ourselves with the current debate line, we believe that it is time to take a stock of past research and analyze carefully the ambidextrous effects of organizational path dependence.

## 2. Theoretical Background

### 2.1 Two Different Aspects of Organizational Path Dependence

We divide the substances of organizational path dependence into two aspects. One is the lock-in perspective (constraining aspect), and the other is the explorative learning capability perspective (connecting aspect).

#### 2.1.1 Lock-In Perspective: Constraining Aspect

The general perspective (i.e. lock-in perspective) claims that over time, a strategic process can eventually lead to a lock-in situation, where change will be very hard, costly, or even impossible (David, 1985; Arthur, 1989 cited in Siedentopp and Söllner, 2009, p.75). Taking path dependence theory as a rigorous perspective, it can be understood as an approach to explaining emerging-process-related phenomena, thereby focusing on self-reinforcing mechanisms and forming specific strategic practices (a combination of routines and resources) which can eventually lead to lock-in situation (Sydow, Schreyögg and Koch, 2009 cited in Siedentopp and Söllner, 2009, p.75). Therefore, the first perspective explains how strategic scopes narrow down over time based on six types of self-reinforcing mechanisms: economies of scale and scope (main focus: cost), direct and indirect network externalities (utility), learning (skills and capabilities), adaptive expectations (standardization), coordination effects (interaction), and complementary effects (connectivity) (Koch, 2006 cited in Siedentopp and Söllner, 2009, p.75).

From the viewpoint of the lock-in mechanism, it can be synthetically explained by the concepts of imprinting, escalating commitment, sunk cost, structural inertia, reactive sequences, and institutionalizing (Sydow, Schreyögg and Koch, 2009). Figure 1 illustrates the constraining aspect of the lock-in mechanism.

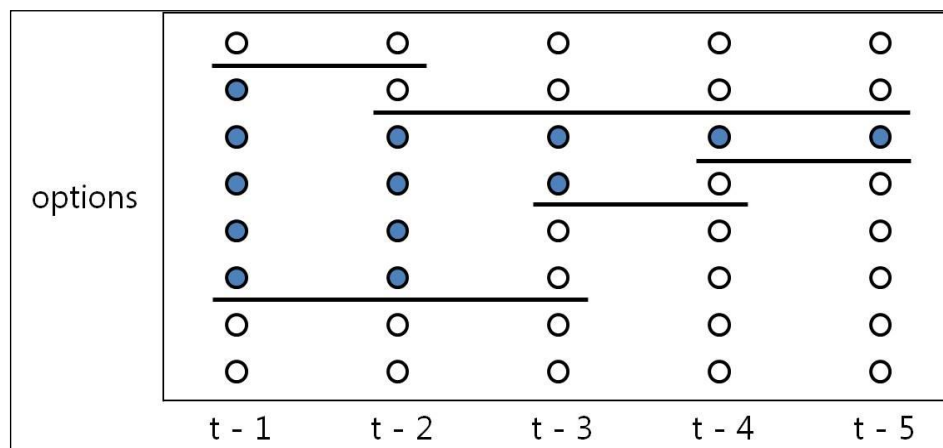


Figure 1 Constraining aspect of the lock-in mechanism<sup>1</sup>

The scope of choices is broad in the initial stage in t1. It is difficult to find the pattern of choices of options. However, once a decision is made, the restriction of choices appears from stage t2 due to the past choices of options. As time goes by, a dominant action pattern is likely to emerge, which renders the whole process all the more irreversible. This implies that the range of options narrows down, making it progressively difficult to reverse the initial choice or the initial pattern of action—that is a path is evolving (Sydow, Schreyögg and Koch, 2009).

In the lock-in stage in t5, the choice of option is restricted by one dominant pattern of action. It means that all actions are bound to a specific path which is potentially inefficient and inflexible.

#### 2.1.2 Explorative Learning Capability Perspective: Connecting Aspect

Explorative learning capability perspective views that the organizational path dependence is a necessary condition of learning capabilities such as absorptive capacity, dynamic capability, and other intangible resources.

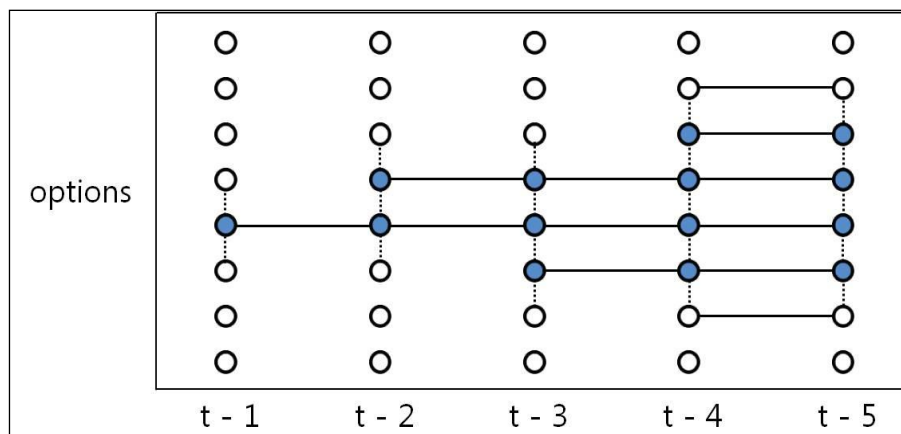
Several economists have developed models of firm performance that rely heavily on unique historical events as determinants of subsequent actions. Employing path dependent models of economic performance, these authors suggest that the performance of a firm does not depend simply on the industry structure within which a firm finds itself at a

<sup>1</sup> modified from Sydow et al., 2009, p. 692.

particular point in time, but also on the path a firm followed through history to arrive at its current state. If a firm obtains valuable and rare resources because of its unique path through history, it will be able to exploit those resources in implementing value-creating strategies that cannot be duplicated by other firms, for firms without that particular path through history cannot obtain the resources necessary to implement the same strategy (Barney, 1991).

Prior knowledge permits the assimilation and exploitation of new knowledge. Some portion of that prior knowledge should be closely related to the new knowledge to facilitate assimilation, and some fraction of that knowledge must be fairly diverse, although still related, to permit effective, creative utilization of the new knowledge. This simple notion that prior knowledge underlies absorptive capacity has important implications for the development of absorptive capacity over time and, in turn, for the innovative performance of organizations (Cohen and Levinthal, 1990).

The basic role of prior knowledge suggests two features of absorptive capacity that will affect innovative performance in an evolving, uncertain environment (Cohen and Levinthal, 1989). First, the accumulating absorptive capacity in one period will permit its more efficient accumulation in the next. By having already developed some absorptive capacity in a particular area, a firm may accumulate more readily what additional knowledge it needs in the subsequent periods in order to exploit any critical external knowledge that may become available. Second, the possession of related expertise will permit the firm to better understand and therefore evaluate the import of intermediate technological advances that provide signals as to the eventual merit of a new technological development. Thus, in an uncertain environment, absorptive capacity affects expectation formation, permitting the firm to predict more accurately the nature and commercial potential of technological advances. These revised expectations, in turn, condition the incentive to invest in absorptive capacity subsequently. These two features of absorptive capacity—cumulativeness and its effect on expectation formation—imply that its development is domain-specific and is path or history dependent (Cohen and Levinthal, 1990). Figure 2 shows the connecting aspect of the explorative learning capability building.



**Figure 2 Connecting aspect of the explorative learning capability**

The dotted line of each stage shows the firm’s scope of choice related to options that a firm already has from the past choices. If a firm chooses the boundary option within the scope in a certain stage, selected option enables the firm to choose new one, another boundary option, in the next stage. As time passes, the scope to choose potential options will be extended through this connecting mechanism. In this way, a path dependent process reinforces the development of the explorative learning capabilities.

## 2.2 Duration of R&D Intensity

Scholars of technological change have observed that firms invest in their own R&D to be able to utilize information available externally (Tilton, 1971; Allen, 1977; Mowery, 1983 cited in Cohen and Levinthal, 1989, p.569). For example, Tilton (1971) states that one of the main reasons why firms invested in R&D in the semiconductor industry was that an R&D effort provided an in-house technical capability that could keep these firms abreast of the latest semi-conductor developments and facilitate the assimilation of new technology developed elsewhere (Cohen and Levinthal, 1989). Cohen and Levinthal (1989) also argue that while R&D obviously generates innovations, it also develops the firm’s ability to identify, assimilate, and exploit knowledge from the environment—what they call a firm’s learning or absorptive capacity. They suggest that the long-run cost of learning may be substantial and most of this cost is borne via the development of a stock of prior knowledge which constitutes the firm’s absorptive capacity. A significant benefit of R&D is its contribution to this knowledge base. Therefore, the incentives to learn should influence R&D spending. Those incentives will be shaped by the quantity of knowledge to be assimilated and by the ease with which learning may occur.

However, organizations are turned into frenzies of experimentation, search, change, and innovation in failure trap, in

which new ideas and technologies fail and are replaced by other new ideas and technologies, which also fail in turn. That is, a failure will lead to the continuous cycle of explorations. This failure trap puts an organization in a vicious cycle of failures and unrewarding changes (Levinthal and March, 1993). In the same context, R&D expenditures are specific types of investments, in that their outcomes are neither immediate nor certain. Indeed, R&D expenditures may not result in any payoff (they may be entirely unproductive) or may translate into profits only after many years (Lee and O'Neill, 2003).

Furthermore, there is a time compression diseconomy in R&D spending. The presence of time compression diseconomies implies that maintaining a given rate of R&D spending over a particular time interval produces a larger increment to the stock of R&D know-how than maintaining twice this rate of R&D spending over half the time interval (Dierickx and Cool, 1989).

Therefore, as the effect of R&D intensity is time dependent and reflects the ambidextrous effects (i.e. connecting aspect and constraining aspect), duration of R&D intensity is an appropriate proxy to explain the effects of path dependence.

### **2.3 Organizational Slack**

The meaning of organizational slack has been defined variously. For instance, "The disparity between the resources available to the organization and the payments required to maintain the coalition" (Cyert and March, 1963, p.36), "The difference between the resources of the organization and the combination of demands made on it" (Cohen, March and Olsen, 1972, p.12), "Resources which an organization has acquired which are not committed to a necessary expenditure" (Dimick and Murray, 1978, p.616), "The pool of resources in an organization that is in excess of the minimum necessary to produce a given level of organizational output" (Nohria and Gulati, 1996, p.1246), and so on. Nohria and Gulati (1996) also argue that redundant employees, unused capacity, and unnecessary capital expenditures are the most common forms of slack. These are resources which can be used in a discretionary manner (Dimick and Murray, 1978), and are associated with the adoption of the more risky strategy (Moses, 1992). Slack resources can also absorb environmental turbulence or buffer the technical core of firms from environmental influences (Thompson, 1967). Consequently, utilizing and leveraging excess resources to capture external opportunities via managerial capabilities can drive firm's growth (Chiu and Liaw, 2009).

In this sense, it can be inferred that organizational slack enables a firm to choose risky behavior which needs more resources, does not guarantee success, breaking historical routine. It means that organizational slack not only boosts exploring alternatives but also mitigates lock-in path.

### **2.4 Type of Diversification**

Diversification strategy is an important component of strategic management of a firm (Palepu, 1985). When firms are generating free cash flows with resources in excess, they need exert their free cash flows effectively to maintain their competitive advantages (Granstrand and Oskarsson, 1994; Banker, Watal and Plehn-Dujowich, 2011). Because of law of diminishing return in the existing businesses, the companies have to enter new businesses to maintain their growth and profitability (Hill and Jones, 2007 cited in Chen, Shih and Chang, 2012, p.2). In related diversification, a firm operates in businesses related to its existing products, whereas in unrelated diversification, a firm operates in business areas that may not be related (Banker, Watal and Plehn-Dujowich, 2011). However, since diversification analysis of technological classes can provide more precise information about corporate capabilities than that of product classes (Granstrand, Patel and Pavitt, 1997), we focus more on technological diversification in this study. Technological diversification, hereafter abbreviated as diversification, is defined as the extent to which a firm diversifies its technological capabilities on relevant or irrelevant technological fields (Lin, Chen and Wu, 2006).

When a firm operates in a set of related businesses, it is possible for it to exploit its 'core factors' leading to economies of scale and scope, efficiency in resource allocation, and opportunity to exploit particular technical and managerial skills (Palepu, 1985). Specifically, as firms can pool, share, and utilize R&D resources and capabilities across two or more business units to obtain economies of scope in R&D, related diversification is crucial for firms (Chen, Shih and Chang, 2012).

However, although a certain degree of specialization is required in order to achieve the necessary expertise to improve the state-of-the-art of the complex techniques in the research process, firms that are more technologically diversified can have certain advantages in competitive markets (Garcia-Vega, 2006). Although excess diversification may not perform as good as expected (Katila and Ahuja, 2002), it can prevent a lock-in effect of competence trap in one particular technology (Suzuki and Kodama, 2004) and capture more opportunities and technological possibilities. Therefore, firms often engage in unrelated diversification to seize R&D opportunities across different technological areas and to disperse R&D risk (Garcia-Vega, 2006).

From organizational learning perspective, we can apply the type of diversifications to the concept of exploitation and exploration. The related diversification can be coupled with exploitation. Exploitation is based on intensive search, which means experimentation along an existing knowledge dimension (Quintana-García and Benavides-Velasco, 2008). As the

essence of exploitation is a refinement and extension of existing competencies, the return of exploitation is more positive, proximate, and predictable (March, 1991). On the contrary, exploration is rooted in extensive search that pursues potential new knowledge, and is the experimentation with new alternatives whose returns are uncertain, distant, and often negative (March, 1991). Hence, unrelated diversification is more close to exploration.

### 3. Propositions

#### 3.1 Duration Of R&D Intensity And Diversification

From a cumulative point of view, path dependence is a central concept to the absorptive capacity and dynamic capability (Cohen and Levithal, 1990; Eisenhardt and Martin, 2000). As new information is assimilated, it promotes new learning which can increase an organization's absorptive capacity to further diversify into unrelated product markets (Bowman and Hurry, 1993; Lane, Koka and Pathak, 2006 cited in Ng, 2007, p.1483). If a firm's duration of R&D intensity is long, it indicates that the firm is trying to develop their absorptive capacity and dynamic capability. It shows that the duration of R&D intensity is combined with firm's explorative strategy, such as unrelated diversification.

On the contrary, past experiences in a given domain make future activities in the same domain more efficient. As firms develop greater and greater competencies in a particular activity, they will engage in that activity even more, thus further enhancing their existing competencies as well as the opportunity cost of exploration (Levinthal and March, 1993). It means that the duration of R&D intensity makes firms' strategic direction align with their R&D specific field.

Putting these arguments altogether, we suggest the following proposition including the two aspects of R&D intensity, i.e. connecting aspect and constraining aspect.

**Proposition 1:** The longer the firm maintains its high R&D intensity, the more it will engage in diversification, whether it is related or unrelated.

#### 3.2 Intervention of Organizational Slack on the Effects of Path Dependence

March (1991) mentions that both exploration and exploitation are essential for organizations, but they compete for scarce resources. Specifically, a broad product scope (product diversification) requires more slack resources than a narrow product scope. As we can see in figure 1, previous choices restrict subsequent scope of potential options. However, this restriction is not only the result of former choices, but also the result of resource limitation. The less organizational slack a firm has, the more is a firm likely to be constrained in available choices and falls into lock-in. Therefore, if a firm's resource availability is low, it will make the firm hesitate to take unrelated diversification.

By the same principle, at the point of explorative learning capability (figure 2), scanty organizational slack attenuates the reinforcing effect of connecting aspect. Even if a firm has large scope of option, it will be difficult to take boundary option with limited amount of organizational slack. Based on this reasoning, we can draw the following proposition:

**Proposition 2:** When a firm has small organizational slack, the duration of high R&D intensity will promote the related diversification

If firms willing to devote themselves to unrelated diversification, they would suffer from high levels of learning cost, diseconomies of scale, and scope in R&D, since unrelated technologies neither transfer technological competencies nor share R&D resources (Hill and Jones, 2007 cited in Chen, Shih and Chang, 2012, p.4). In addition, as unrelated technologies do not share common knowledge bases, managing highly heterogeneous technologies within a firm would lead to high extent of bureaucratic cost due to high extent of communication cost (Katila and Ahuja, 2002).

From this point of view, we can expect that a firm with more organizational slack will find it more comfortable to engage in unrelated diversification. Based on this logic, we develop our third proposition for the connecting aspect of path dependence as follows:

**Proposition 3:** When a firm has large amount of organizational slack, the duration of high R&D intensity will promote the unrelated diversification.

As have been noted above, there are increasing diversification costs to push forward unrelated diversification. When a firm increasingly diversifies, the number of possible resource interdependencies increases at a geometric rate (Hill and Hoskisson, 1987 cited in Ng, 2007, p.1494). Teng and Cummings (2002 cited in Ng, 2007, p.1494) argue that with increasing resource interdependencies, piecemeal or incremental changes to one resource can generate negative payoffs to other resources. As unrelated diversification consumes a lot of organizational slack, there is a limitation to engage unrelated diversification continuously. In addition, after a firm discovers new knowledge and resources through unrelated diversification, is likely to exploit them for profit maximization. Therefore, repetition of unrelated diversification will make a firm to engage related diversification due to the decreasing organizational slack and motivation for exploitation.

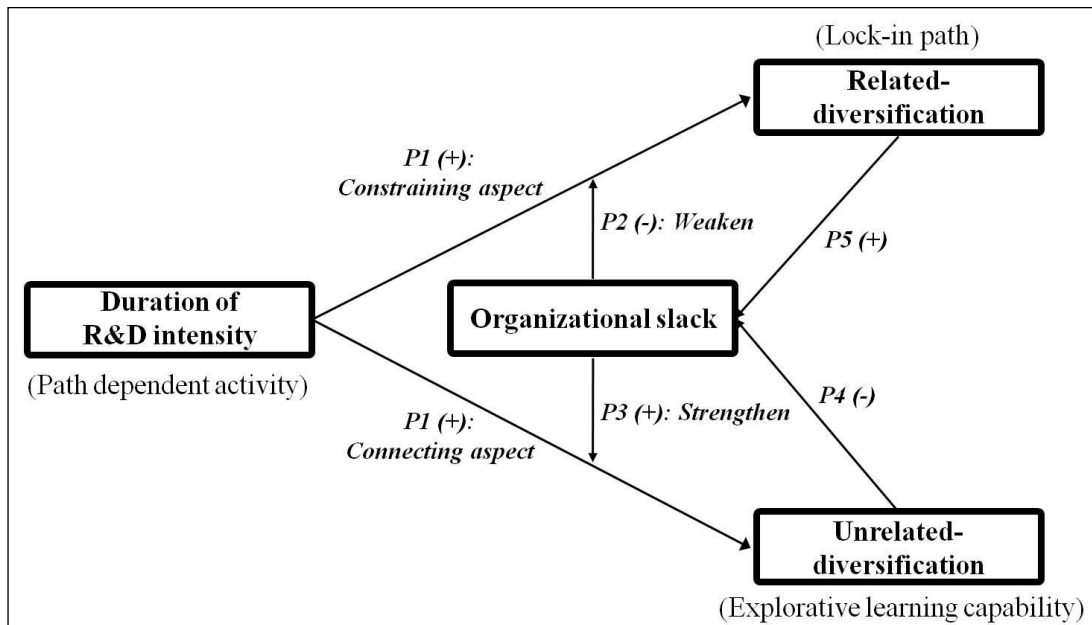
On the contrary, related diversification can make stable performance through the synergy of current resources a firm has. As related diversification consumes relatively small resources compared with unrelated diversification, it is easy for a

firm to accumulate organizational slack through repetition of related diversification. Ironically, it means that a firm can find a chance to explore unrelated diversification from related diversifications.

**Proposition 4:** Repetition of unrelated diversification decreases a firm’s organizational slack, and consequently compels a firm to engage in related diversification.

**Proposition 5:** Repetition of related diversification increases a firm’s organizational slack, and consequently enables a firm to engage in unrelated diversification.

Figure 3 illustrates the summarized model of overall perspective of propositions. This model shows that lock-in path and explorative learning capability emerge not only simultaneously but also sequentially. It means that the ambiguous phenomena of path dependence are resulted from the ambidextrous effects of self-reinforcing mechanism which possesses a circular causality.



**Figure 3** Ambidextrous effects of path dependence

#### 4. Summary and Conclusion

The existing literature on path dependence has been dominated by a focus on the phenomenon of lock-in path. Simultaneously, path dependence has been understood as a necessary condition of learning capability in the field of business strategy. Through combining these two research area, we have found an interesting implication. The organizational path dependence as a self-reinforcing mechanism causes two different consequences such as lock-in path and explorative learning capability. It is time to divide the research on path dependence into constraining approach and connecting approach. Lock-in path shows the constraining aspect of self-reinforcing mechanism, whereas learning capability shows the connecting aspect of self-reinforcing mechanism.

First contribution of this study is to demonstrate the probability of two sides of approach via our conceptual model of R&D intensity and technological diversification. As we have discussed so far, the level of organizational slack intervenes the relationship between types of diversification and duration of high R&D intensity. From this model, we have found the implication that the problematic aspect of path dependence can be tempered by slack resource management.

Second contribution is to show the mechanism of circular causality inherent in path dependence. It makes the organizational phenomena of path dependence more complicated and interesting. We believe that there are a lot of solid phenomena which can be explained by ambidextrous effects of path dependence, such as organizational routine and innovation; network inertia in strategic alliance; institutional isomorphism (organizations are integrated into a dominant institution, whereas a dominant institution spreads over organizations), and so on.

Clearly, the present paper is limited in scope. To acquire a fuller understanding of organizational path dependence’s ambidextrous effects, future studies are needed for exploring various organizational phenomena of path dependence.

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