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Routines, Organizational Change and Organizational Reliability:
A Hidden Source of Variation

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ABSTRACT

Organizational routines have been perceived as stable targets of selection forces. This traditional assumption of the stability of routines, however, has been challenged by recent research pointing to the variability of routines. Drawing on a nuanced understanding of organizational routines, this study examines how such duality of routines influences organizational change. Using a simple theoretical model, we show that routine-level inertia, in conjunction with bounded rationality in planning changes, engenders a potential of exploration which fosters organizational adaptation. Consequently, the dual properties of routines help enhance organizational reliability and long-run performance in task environments characterized by complexity and myopic selection. We discuss how this advanced understanding of the role of routines helps elaborate the theory of economic evolution.

Keywords: Organizational Routines, Organizational Inertia, Organizational Change, Organizational Reliability, Bounded Rationality, Evolutionary Theory
INTRODUCTION

Do routines hinder or help organizational change? This is an important question to better understand the process of economic evolution because routines are related to both organizational adaptation and environmental selection. Routines retain previous solutions and enable continuous and reliable performance of organizational activities (Holland, 1975; Nelson & Winter, 1982). Besides reliability, such continuity or reproducibility also, however, generates strong inertial forces and resistance to change, which gives rise to the importance of selection as a powerful force of change (Hannan & Freeman, 1984). Organizations do, however, adapt over time. Research suggests that routines can be amongst the central mechanisms that facilitate organizational change (e.g., Adler, Goldostras, & Levine, 1999; Amburgey, Kelly, & Barnett, 1993; Feldman & Pentland, 2003; Feldman, 2000; Levitt & March, 1988). In this study, we suggest an overlooked, but prevalent, mechanism by which the inertial nature of routines helps, rather than hinders, organizational adaptation. Our theory helps understand the performance of high-reliability organizations that look inertial but keep surviving and often outperforming.

Being counter-intuitive, the stream of research on the role of routines in facilitating organizational change has received enormous attention. Several mechanisms have been documented. First, stable and standardized routines provide reliable building blocks for new, innovative combinations which facilitate organizational change (Amburgey et al., 1993; Nelson & Winter, 1982; Galunic & Rodan, 1998). Second, there are routines for change which govern the process through which organizations search for solutions to new problems, such as procedures for decision making and innovation (Adler et al., 1999; Levitt & March, 1988; Nelson & Winter, 1982). Organizations often partition roles and structures dedicated for operations and change, respectively (Adler et al., 1999; Bigley & Roberts, 2001; e.g., Tushman & O’Reilly III, 1996). Third, recent research on the nature of routines suggests that a routine itself has the potential to introduce variations over time, which serves as a source of organizational change (Feldman & Pentland, 2003; Pentland & Rueter, 1994).

Though intuitively appealing, it is important to note that these mechanisms facilitating organizational change all require some cognitive resources. This is significant because agents’ cognitive resources are widely considered to be limited (Simon, 1955). Given such bounds to agents’ cognitive resources, what impact do they have on whether routines help or hinder organizational change? Under conditions of bounded rationality, because change efforts do not always lead to improvement, allocating resources to facilitating change and to maintaining the potential of exploration can trade off organizational change with operational reliability or short-term efficiency. Therefore, better cognitive abilities or more resources dedicated to facilitating organizational change
do not necessarily lead to superior performance (Levinthal & Rerup, 2006), raising the question what impact bounds on the cognitive resources of agents have on the process and consequence of organizational change supported by the (routine-related) mechanisms.

To pursue this question, we focus on two strong empirical regularities, the inertial nature of routines and the bounded rationality of decision makers, and draw attention to the complementarity between them. The impact of this complementarity on organizational change has not yet been fully integrated into the debate. Using a simple theoretical model, we show that routine-level inertia, in conjunction with bounded rationality in planning changes, engenders the potential of exploration which pushes forward organizational adaptation.

A strong empirical regularity in many different fields of human behavior is that agents who follow habits and organizational routines resist changing their behavior (e.g., Marteau et al., 2012). This is the case not merely as long as such behavior leads to satisfactory results (March and Simon 1958; Cyert and March 1963), but also in the face of negative performance feedback (Hannan & Freeman, 1984). Such resistance to change at the routine level delays the implementation of planned changes (a more general feature of human behavior, Marteau et al., 2012). Such implementation delay introduces unplanned variations into the organization of interdependent routines. To the extent to which decision makers are bounded in figuring out desirable changes for the long run, there is room for such unplanned variations to become a source of rewarding exploration in organizational search. Consequently, routines not only foster organizational reliability and facilitate organizational change; they also facilitate organizational change through the interaction of routine-level inertia and bounded rationality in planning changes. Our theory therefore provides a nuanced angle that adds to our understanding of the competitive advantage of reliable organizations characterized by formal routines – they lead not just to low variance in performance (conferring an advantage in selection processes) but also to increasing average performance (conferring an advantage in organizational adaptation).

The paper is organized as follows. In the next section, we discuss extant theories on routines and their impact on organizational change. In the following section we develop a formal model of organizational search to examine how the process and consequences of organizational adaptation are influenced by organizational routines, as identified in prior research. In the subsequent simulation section, we investigate the consequences of routines for organizational adaptation and (dis)advantage in the process of environmental selection which works on a population of organizations. The last section provides discussions on the theoretical implications of our results and opportunities for future research.

THEORY

Routines as a Source of Organizational Reliability and Inertia

The traditional view of organizational routines portrays them as a source of reliability and inertia.
Organizational routines are seen as stable over time, exposing low variance between one iteration and the next (Birnholtz, Cohen, & Hoch, 2006; Cohen & Bacdayan, 1994; Cohen, 2007; Pentland, Hærem, & Derek Hillison, 2010; Pentland, 2003). To the extent to which selection forces and processes favor low variance in performance, organizational reliability provides survival advantages (Hannan & Freeman, 1984; Levinthal & Posen, 2007; Singh, House, & Tucker, 1986). This advantage, however, comes at the cost of organizational inertia. This is because high reproducibility, by nature, implies resistance or robustness to change pressures (Hannan & Freeman, 1984). Resistance against changing behavior even in the face of negative performance feedback is indeed a strong empirical regularity in human behavior more generally (e.g., Marteau et al., 2012).

**Routines as a Source of Organizational Change**

The view of routines as sources of reliability and inertia is, however, contrasted by a more nuanced view that also portrays organizational routines as sources of change. This alternative view has identified several mechanisms by which routines can lead to organizational change.

*Recombination of Routines.* Routines can be sources of change through recombination – routines are ways of accomplishing tasks with high reliability, and they can be recombined in response to environmental conditions (e.g., Amburgey et al., 1993; Becker, Knudsen, & March, 2006; Bigley & Roberts, 2001; Nelson & Winter, 1982; Winter & Szulanski, 2001). There are many different potential combinations of reliable routines, thus providing a potential explanation of how routines can enhance organizational flexibility in adapting to changed circumstances while maintaining reliability. Bigley & Roberts (2001), for instance, find that fire brigades allowed constrained improvisation. In this way, recombination led to change while maintaining some stable direction (see also Kyriakopoulos & Ruyter, 2004). The idea of stable building blocks that provide flexibility through recombination also features prominently in the literature on improvisation, which generally points to recombination as a powerful source of variation (Moorman & Miner, 1998).

*Routinizing change tasks.* While organizational routines are usually associated with exploitation tasks, some scholars have pointed out that tasks which are routinized can also comprise exploration or change tasks. Nelson & Winter (1982: 134) already argued that ‘organizations have well-defined routines for the support and direction of their innovative efforts’ and discussed ‘routine-changing processes’ that are themselves ‘routine-guided’ (Nelson & Winter, 1982: 18). Routines can, accordingly, generate change when change tasks are accomplished in a systematic, reliable fashion. Adler et al. (1999) provide empirical support for this idea in their investigation of the causes of the exceptional flexibility/efficiency combination achieved by NUMMI, a car manufacturing joint venture of GM and Toyota. They identify ‘meta-routines’ (routines for changing other routines) that facilitated the efficient performance of non-routine tasks. Similarly, investigating the mechanisms underlying the success of IDEO, a product design firm in California, Hargadon & Sutton (1997) identify some
internal routines for systematic exploration, such as specific routines for carrying out brainstorming meetings. Whenever IDEO staff get together to start a new innovation project, they follow the same brainstorming routine – an important contribution to IDEO’s innovation success, according to Hargadon & Sutton (1997). Extending these empirical findings, one might consider any routinized approach to product development, such as going through the series of decisions according to stage-gate models (Cooper & Kleinschmidt, 1986) to support stable processes that generate variance in the portfolio of new products.

**Structural Partitioning.** Organizations can partition their resources for exploitation routines (that reduce variation, e.g. in manufacturing) and exploration routines (that generate variation, e.g. of new product designs). In this way, organizational structure and job design are levers for influencing the degree to which organizational routines facilitate reliability vs. organizational change. In prior research, three different mechanisms have been identified. Tushman & O’Reilly’s (1996) idea of structural ambidexterity involves having separate organization units dedicated to and specialized in exploration and in exploitation. In contrast to ‘contextual ambidexterity’ (Birkinshaw & Gibson, 2004), structural ambidexterity refers to individuals who are specialized in either exploration or exploitation. Adler et al. (1999) found that NUMMI also relied on this mechanism which enabled differentiated subunits to work in parallel on routine and nonroutine tasks.

The structural partitioning mechanism can improve performance by capitalizing on complementarities among tasks. For instance, consider job enrichment. Job roles are bundles of tasks which can be accomplished by routines (Miner, 1991). Complementary exploration and exploitation tasks can be combined in the same job role. In their study of the NUMMI automotive manufacturing joint venture, Adler et al. (1999) identified an example of such job role design. Job roles of production floor staff contained not just production tasks but also the task of reflecting about and passing on improvement possibilities. As Adler et al. (1999) argue, such job enrichment was one cause of NUMMI’s exceptional combination of flexibility and efficiency.

Another way of harnessing complementarity is job role switching. Rather than combining different types of tasks within one job role, switching between complementary exploration and exploitation roles is a different way to pursue both exploration and exploitation. Such switching can be organized systematically at the organization level to make the process reliable. Adler et al. (1999) find such a mechanism in NUMMI, where workers switched between production and improvement tasks (e.g., Quality Circle meetings, or pilot production runs where workers helped identify problems and improvement opportunities). Adler et al. (1999: 51) specifically point out that ‘a broad range of policies encouraged workers to switch easily between production and improvement tasks’, underlining that such switching was anchored at the organization level. In their study of how routine-based organizations for emergency response can react flexibly, Bigley & Roberts (2001) also identify role switching as one of the mechanisms that enabled such flexibility as well as reliability. In their
study of a fire department, they find that role switching, i.e., the reassignment of personnel to different positions within the organization, played an important role in this respect. As roles convey well-defined expectations and define reporting relationships, transferring individuals among (complementary or related) roles represents a fairly efficient way of reorienting them to evolving conditions (Bigley & Roberts, 2001: 1287). Role switching is thus considered an important element of the capability of bureaucratic organizations to react flexibly and reliably to complex, volatile task environments. Birkinshaw & Gibson’s (2004) ‘contextual ambidexterity’ also refers to switching between exploration and exploitation over time. As the term implies, the organizational context (e.g., performance evaluation systems) plays the central role in ensuring the switch.

Variations within routines. Feldman (2000) and Feldman & Pentland (2003) point out that a routine itself can also be an important source of variation. Highlighting the agents that carry out routines, they argue that routines are ‘effortful accomplishments’, rather than the result of automatic repetition. They point out that agents might adapt the routine in reaction to performance feedback. For instance, agents might repair a routine to produce the intended outcome, expand it to make use of new possibilities, or strive and attempt to attain something that is difficult to attain (Feldman, 2000: 620). In her study of four routines of a university housing organization, Feldman (2000) found that agents who carried out the routines for moving students into and out of university dormitories at the turn of the academic year changed the routines in order to improve them (e.g., to teach students to take responsibility for their rooms rather than just collect payment for damages to dormitory rooms), or to cater to specificities of the situation (such as coordinating the move-in with a mass event). Pentland et al. (2011) analyze a longitudinal data set of an invoice-processing routine in four organizations. They find support for the hypothesis that ‘[i]n the absence of outside intervention, organizational routines generate patterns of action that are stable over time’. The invoice-processing routine in these four organizations thus drifted over the course of the period considered, indicating that routines can change when external conditions stay the same.

Bounded Rationality and Organizational Adaptation

The previous subsection provides a comprehensive list of the mechanisms by which routines facilitate organizational change. These mechanisms, however, need to account for the fact that agents have limited cognitive resources (Levinthal & Rerup, 2006; Simon, 1947). To make desirable changes on the basis of routines, for example, organizations should figure out how to routinize what kinds of innovation processes and to what extent; how to structure and balance the exploration and exploitation units; when to switch between exploration and exploitation tasks; and which exploration and exploitation tasks to bundle in a job role. Further, pursuing both exploration and exploitation at the same time through structural partitioning may cause some efficiency losses in either exploration or exploitation tasks. In sum, regardless of how systematic they are, efforts to figure out desirable
changes in the long run and to assign organizational resources to implement them are subject to important limitations as long as human agents are involved (Gavetti, 2012; Levinthal, 2011; Winter, 2012).

In this study, we consider the ways in which organizational routines impact organizational adaptation. We suggest an alternative mechanism by which the inertial nature of routines contributes to organizational adaptation. We show under which conditions this mechanism helps, rather than hinders, organizational adaptation. The mechanism highlights a complementarity between routines and bounded rationality. Prior research has already identified some other complementarities – e.g., routines free cognitive resources which could be used for more valuable purposes (e.g., Bigley & Roberts, 2001; Levinthal & Rerup, 2006; Weick & Roberts, 1993). Yet the suggested mechanism has not received much attention in the literature, even though both of its elements, bounds to cognitive resources and the inertial tendency of routines, are strong empirical regularities. In the next section, we develop a formal model of organizational adaptation to demonstrate and investigate the suggested mechanism, by paying attention to the duality of routines – that is, routines are capable of not only reducing variance of performance but also generating variations in performance (Feldman & Pentland, 2003; Feldman, 2000).

**MODEL**

Our model is designed to formalize the dual properties of routines and examine their effects on organizational adaptation. We extend the NK model which has been widely used to study the process of organizational adaptation and environmental selection in a formal way (e.g., Ethiraj & Levinthal, 2004a; Levinthal & Posen, 2007; Levinthal, 1997; Rivkin, 2000; Siggelkow & Levinthal, 2003). Along with the discussions in the previous section, the model builds on three important empirical regularities: (1) organizational adaptation is local, path-dependent and myopic (Levinthal & March, 1993; Levinthal, 1997; Levitt & March, 1988), (2) organizational routines vary but resist change (Becker, 2004; Feldman & Pentland, 2003; Hannan & Freeman, 1984), and thus (3) changes planned by decision makers may not take place promptly, which loosens the coupling between high-level choices and low-level changes (Siggelkow & Rivkin, 2009).

**The Organization and Its Performance**

An organization is represented as a structured set or configuration of $N$ routines, $x_i$ (Hannan & Freeman, 1984; Levinthal, 1997; Nelson & Winter, 1982), each of which has a state of either 0 or 1.¹

¹ This is a simplest possible setting to model routines which vary between different states. As an extension, one might think of more-than-two states of a routine. The model, however, is general enough in the sense that a bunch of $x$ variables could be interpreted as subroutines that constitute a routine of more-than-two states. For instance, an organization of ten routines with two distinct states could be viewed as an organization of five routines with four distinct states. The contribution of a routine is the sum of the contribution of its subroutines,
Thus, for a given organization size, \( N \), the number of distinct forms corresponding to the configurations of routines amounts to \( 2^N \).

Our performance landscape is based on the classic \( NK \) landscape (Kauffman, 1993) in the way that we model complexity and performance. When \( K=0 \), each of the \( N \) routines functions independently of each other and there are no constraints that decision makers face in pursuing the best configuration of routines. Organizational performance is simply an additive function of the contribution of the individual routines. When \( K>0 \), the problem of organizational adaptation becomes more complex. Complexity increases with \( K \) because the contribution of each routine depends on \( K \) other routines. Thus, each routine may be independent, dependent on other routines, or influence other routines; it is possible that a routine may both affect and be affected by other routines.

Each routine makes a distinct contribution to overall organization performance, albeit one that depends on \( K \) other routines which are randomly assigned to the focal routine. A routine’s contribution value is preset for each configuration of its interdependent routines and itself. This value is drawn from a uniform distribution \( U[0,1] \). Organization performance is an average of the contribution values of the \( N \) organizational routines.

**Organizational Adaptation**

To enhance performance, the organization engages in search for a better configuration of its routines. We focus our modeling efforts on two important aspects of organizational adaptation: bounded rationality and resistance to change.

*bounded rationality*. Decision makers are boundedly rational and the organization’s planning of changes is characterized by an ongoing process of identifying and implementing local, incremental changes (Cyert & March, 1963; Levitt & March, 1988; Simon, 1947). In our model, change in a routine may be planned in each time period: The focal routine is randomly chosen and a change of its current state is planned if the expectation is that such a change will improve organizational performance (Ethiraj & Levinthal, 2004a; Levinthal, 1997; Rivkin & Siggelkow, 2003; Rivkin, 2000).

*Resistance to change*. What an organization has learned is stored and exploited in the form of routines, and organizational routines enable the organization to keep doing well what it has done successfully before (Levitt & March, 1988; Nelson & Winter, 1982). Such a function of routines, however, not only enhances reliability of performance but also engenders inertia in the process of organizational adaptation (Becker, 2004; Feldman & Pentland, 2003; Hannan & Freeman, 1984; Levinthal, 1991). We explicitly model both consequences of routines.

First, we model the consequence of routines as a source of inertia in a simplest possible way:

and the interdependence structure remains unchanged indicating which state of which routines influence (increases or decreases) the contribution value of which routines. Organizational adaptation still aims to search for a better configuration of interdependent routines with the level of complexity held constant in terms of both the number of choices (states of routines) and interdependence among them.
When change in a routine is planned, the change takes place in one time period with a probability of $1 - R$ ($0 \leq R \leq 1$). The parameter $R$ therefore denotes the degree of the routine’s ‘resistance’ to change. When $R=0$, a change planned is promptly implemented and we can see its effect in the next period – this is the case of the canonical local search model (e.g., Levinthal, 1997). As $R$ increases, however, it takes on average longer time for a planned change to actually be implemented and thus, for its actual effect to become observable.

Second, the consequence of routines as a source of reliability is modeled as follows. In each time period, routines face perturbation or variation from within with a rate of $P$ ($0 \leq P \leq 1$). These routine-level changes could be a result of efforts by agents involved, or of errors (Feldman & Pentland, 2003; Feldman, 2000). The probability of actual change, however, is reduced by the degree of resistance to change, $R$. Further, its consequence may or may not be beneficial at the organization level, mainly due to organizational complexity and bounded rationality of (routine-level) decision makers. Technically, in each period, a routine is assigned a random draw from the uniform distribution, and if its value is smaller than $P(1-R)$, the routine is set to be either 0 or 1 with equal probability.

In sum, resistance to change generated by routines enhances robustness to internal perturbations or potentially disruptive changes from within (reliability effect) but slows down execution of change plans (inertia effect). This simple but generalizable setup allows us to examine the dynamic process and consequence of organizational change driven both by variations within individual routines and by decision makers at the organization level.

**SIMULATION**

Using the model, in this section we examine how routines affect organizational adaptation, as well as the process and consequences of environmental selection on a population of adapting organizations.

**Experiment 1: Routines and Organizational Adaptation**

This experiment is designed to examine how routine-level inertia, combined with boundedly rational planning, affects the process and performance of organizational adaptation. In a simulation run, 100 organizations with random initial configurations engage in local search for a better configuration of routines. The results are measured after 1,000 time periods, enough for their average performance to reach a steady state. They are averaged over 100 runs on different landscapes (with different seeds for random number generation). Thus, the results for each set of parameter values are calculated based on 10,000 observations.

Figure 1 shows the steady-state performance of organizational adaptation for different degrees of resistance to change ($R$) and internal perturbation ($P$) at the routine level. The result suggests two important patterns. First, some degree of internal perturbation could be beneficial, but its overall
effect is detrimental. The intuition behind the mechanism is as follows. In complex environments, changes that are detrimental in the short-run may help get out of status quo traps caused by bounded rationality in search and therefore enhance long-run performance. This result and the underlying mechanism are consistent with that of previous studies on the beneficial role of errors or unintended variations in adaptation – e.g., ignorance of cross-divisional interdependences (Siggelkow & Rivkin, 2005), incomplete architectural knowledge (Ethiraj & Levinthal, 2004b), or evaluation errors (Knudsen & Levinthal, 2007). Above a certain level, however, internal perturbations largely hurt organizational performance because they counteract coordinated adaptation efforts at the organization level.

Secondly, and more importantly, resistance to change at the routine level not only reduces the damage caused by internal perturbations but also further improves the performance of organizational adaptation. Routines store what has been learned in the search process and enable the organization to replicate what has been done successfully. In this regard, resistance to change provides robustness against internal perturbation, which hinders such continuity (reliability effect). However, this is not the only consequence of routines. Resistance to change at the routine level delays implementation of planned changes (inertia effect), which introduces unplanned variations into the organization of interdependent routines – i.e., variations in the completion, timing and sequence of the implementation of planned changes. To the extent to which organizations are bounded in figuring out and planning desirable changes, there is room for such unplanned variations to become a source of rewarding exploration in organizational search (exploration effect). Subsequent planning builds on the mixed consequence of previously planned changes and unplanned variations. The result of superior performance implies that useful variations have been systematically retained in the process of organizational change. Consequently, routines not only foster organizational reliability but also facilitate organizational change.

This result supports and adds to the conventional idea that the degree of inertia tends to increase in a population of complex organizations (Hannan & Freeman, 1984). Our result implies that organizations characterized by more reliable routines have an advantage in selection processes not only because of the reliability of their performance (i.e., reduced variance of performance) but also because of the potential of rewarding exploration (i.e., enhanced average of performance). It is therefore expected that the degree of reliability or inertia, measured by average $R$ in a population of organizations, will increase over time in the process of organizational adaptation and environmental selection. In the next subsection, we further investigate this process and develop useful insights.

**Experiment 2: Environmental Selection and Emergence of Inertia**

To examine the competitive (dis)advantage of more or less reliable organizations in selection
processes, we design a new simulation experiment with a population of organizations that engage in local search under a risk of failure or environmental selection. The organizations are heterogeneous in the degree of inertia \( R \), and the probability of failure is determined by their relative performance. Therefore, how long an organization survives will depend on how well it manages to adapt while maintaining good enough performance over time so as to survive selection and continue search.

The adaptation of an organizational population or industry evolution is often characterized by a few stylized patterns: entries of heterogeneous organizations, their gradual adaptation and sequential exits of laggards (Klepper & Graddy, 1990). Since the aim of our analysis is to understand the influence of routines on organizational adaptation and survival, we focus on the process of industry shakeout or organizational failures. In doing so, other processes such as entrepreneurial development and market entry of new organizations are not explicitly formalized. The specific setting of the new simulation experiment is as follows. A simulation run starts with a population of 100 organizations with random configurations of routines – i.e. the states of the \( N \) routines to be either 0 or 1 with equal probabilities. The organizations engage in local search as specified in the model above and face a continuous risk of failure.

The selection process draws on the ideas of genetic load and myopic selection. The former means that the selection pressure on a population of organizations increases with the gap between the average fitness and the best fitness in the population, and the probability of a particular organization’s failure is determined by its relative fitness as compared to that of the most fit organization (Levinthal, 1997; Wilson & Bossert, 1971). This idea is formalized as follows. At the end of each time period (after organizational adaptation), an organization is randomly chosen and selected out with a probability equal to the ratio of its performance to that of the best performer at that time. The size of the population, therefore, may or may not decrease during a time period, and the probability that it loses an organization increases as the market leader dominates the average ones to a larger extent. This selection process is myopic in the sense that an organization’s potential of success in the future is not taken into account (Levinthal & Posen, 2007). Therefore, an organization is subject to the tradeoff between the potential of beneficial change and the reliability (or continuity) of performance. That is, it should survive in the short run to get chances for the long-run.

Figure 2 shows the performance of survived organizations and the level of inertia in the organizational population. It confirms the expectation that the level of organizational performance and inertia would increase in the process of environmental selection. This population-level phenomenon is largely consistent with extant theories (e.g., Hannan & Freeman, 1984). Our theory on routines, however, provides a nuanced explanation of the phenomenon by highlighting the exploration-generating role of routine-level inertia in the process of organizational change which is constrained by decision makers’ bounded rationality. Routines not only help maintain reliability to earn time for survival and further adaptation (advantage in selection) but also help overcome the status-quo bias by
engendering rewarding variations in the implementation process of planned changes (advantage in adaptation). Those advantages in both adaptation and selection are mutually reinforcing and thus may help overcome the disadvantage of organizational inertia in adaptation. The mechanism of routine-engendered exploration is different from other routine-related mechanisms well documented in previous studies, and its complementarity with other mechanisms such as myopia of learning and selection has been underexplored in the literature on routines and organizational change.

The inertial nature of routines is not only relevant for organizational reliability but also for the long-run performance of organizational change. Therefore, organizations characterized more strongly by routines, as opposed to those characterized less by routines (e.g., more ad-hoc or younger organization), have an advantage in the evolutionary process driven by myopic selection forces. This helps better understand the emergence and persistence of routines, and thus inertia, in organizational populations. From this nuanced perspective, the evolutionary reason of inertia therefore includes its adaptive role in the process of organizational change. Resistance to change engenders unplanned variations in the timing and sequence of the implementation of planned changes, which helps overcome the status-quo bias in adaptation and attain a better configuration of interdependent routines.

**DISCUSSION**

**Routines and Organizational Reliability**

In this study, we suggest a novel mechanism by which the stability of routines, as a primary source of reliability and inertia, helps organizational adaptation in complex task environments by engendering the potential of exploration held by the interaction of the stability-inducing feature of organizational routines with the bounded rationality of decision makers. Our theory adds to the long-lasting discussions on how routines help or hinder organizational adaptation, which lie at the intersection of the literatures on routines, organizational change, and economic evolution.

This question is important for two primary reasons. First, the nature and role of routines lie at the heart of the theory of economic evolution. In the evolutionary process, selection forces shape the population of survived organizations to better fit the environment. In this logic, the fact that organizations cannot adapt perfectly to the environment gives rise to the importance of selection as a powerful force of change. Organizations, however, do adapt by change efforts of organizational members. A more nuanced perspective therefore suggests that adaptation and selection are not mutually exclusive alternatives, but rather fundamentally interdependent processes that drive the evolutionary process (Levinthal, 1991). To the extent to which routines are involved in both organizational adaptation and environmental selection, the question of how routines influence organizational adaptation becomes important in understanding of the evolutionary process of economic changes jointly driven by selection and adaptation.
Second, this helps enhance our understanding of why reliability, despite the issue of inertia, could be a strongly favored trait of organizations in the evolutionary process. The fundamental challenge that a changing organization faces is to find and introduce desirable changes, given the risk of change (Hannan & Freeman, 1984; Hannan, Pólos, & Carroll, 2003). Theory, however, suggests that organizations by nature are bounded in their capabilities of foreseeing desirable changes and implementing intended ones (Gavetti, 2012; Levinthal, 2011; Nelson & Winter, 1982; Simon, 1955). Further, by the same reasons, organizational learning and adaptation are self-limiting, often causing false learning and status-quo bias (e.g., Denrell & March, 2001; Levinthal & March, 1993; Levinthal, 1997). A key to sustainable success is therefore how to maintain the potential of rewarding exploration while operating on the reliable basis of previous solutions to survive the risky process of change. The possibility that routines, as a primary source of reliability, also help organizational change is therefore an important key to understanding the performance of high-reliability organizations that look inertial but keep surviving and often outperforming (Adler & Borys, 1996; Bigley & Roberts, 2001; Levinthal & Posen, 2007; Weick & Roberts, 1993).

Routines and the Theory of Economic Evolution

The suggested theory contributes to the internal consistency of the evolutionary theory which draws on the stability of routines as an analogue of genes (Nelson & Winter, 1982). If the concept of routines is essential in developing the theory of economic evolution, the emergence and persistence of (the stability or inertia of) routines should also be explained in an evolution-friendly way. That is, routines should provide organizations with an evolutionary advantage in the process of their adaptation or environmental selection. By highlighting the bounded rationality of decision makers and the adaptive role of routines, our theory explains this in terms of both adaptation and selection. That is, the stability or inertia of routines not only enhances the reliability of organizational performance but also (unintendedly) helps organizational adaptation in task environments characterized by complexity. From this perspective, organizations have incentives and tendencies to develop in the direction in which their activities are routinized. This direction of organizational change in turn helps selection forces and thus the mechanism of evolution to work well, benefiting the population as a whole. Therefore, the mechanism of evolution could be, by using the evolutionary term, ‘selected’ as the primary force which drives changes in surviving populations.

Future Research

Our theory raises promising opportunities for future research. First, the conditions where reliability has more or less advantages can be further examined. Considerable factors will include, for example, the nature of industry structure and competition, the degree of environmental turbulence, and the effects of entry or entrepreneurship. For each of them, we need to make assumptions for formalization which should be grounded on supporting theories. We hope our model and related
theories serve as a useful basis. Further, our results will provide useful insights to understand their processes and consequences. For instance, Figure 2 shows that average $R$ temporarily declines in early periods, which implies that frequent environmental changes would undermine the proposed mechanism and thus the advantage of reliable organizations (Levinthal & Posen, 2007). Nevertheless, other mechanisms such as organizational slacks, integration of decision-making structure, and recycling of abandoned solutions or technologies may take place and help overcome unexpected shocks. This will bring reliable organizations back on track and allow them to benefit from the advantage of reliability.

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Figure 1. Effects of Routines on Organizational Adaptation
Figure 2. Environmental Selection and the Emergence of Inertia