DARWINIAN DYNAMIC CAPABILITY: PERFORMANCE EFFECTS OF BALANCED INTRAFIRM SELECTION PROCESSES

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ABSTRACT

This research identifies the conditions that give rise to selection and adaptation. The concept of *balanced continuity* introduced argues that a balance among the levels of internal VSR results in adaptive organizational outcomes. Results suggest that internal natural selection explains two forms of population change: Darwinian and Lamarckian.

Key Words: Dynamic capability; Evolution, Natural Selection, Adaptation, Performance

The dynamic capabilities of firms (Teece, Pisano, and Shuen, 1994) form a central pillar of the resource-based view of competitive strategy (Teece, 1984; Wernerfelt, 1984; Barney, 1986, 1989, 1991; Rumelt, 1987; Prahalad and Hamel, 1990; Reevis-Conner, 1991; Bogner, Mahoney, Thomas, 1993; Mosakowski and McKelvey, 1996). The dynamic capabilities of firms are those processes that contribute toward "...appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional competences..." in changing environments (Teece, Pisano, and Shuen, 1994: 12). Dynamic capabilities, therefore, play an important part in, 1) determining the coevolutionary success of firms competing against each other in an industry population, and 2) the evolution of these populations.

A fundamental debate remains, however, 1) as to the organizational processes underlying dynamic capabilities and 2) whether industry populations evolve because member firms have dynamic capabilities or whether populations change as a result of the death and replacement of member firms suffering from inertia. Two competing theories of evolution figure in this debate. *Lamarckian* (adaptation) perspectives focus on the intrafirm level of analysis and emphasize that the evolution of industry populations reflects changes in the strategy, structure and capabilities of member firms in response to environmental pressures and opportunities (Cyert and March, 1963; Lawrence and Lorsch, 1967; Thompson, 1967; Child, 1972; Pfeffer and Salancik, 1978; Nelson and Winter, 1982; Teece, Pisano, and Shuen, 1994). *Darwinian* (selection) views emphasize the structural inertia (Hannan and Freeman, 1977, 1984) present in firms that mitigates against dynamic capabilities, arguing instead that industry evolution occurs via the death and replacement of member firms based on external selection forces (Brittain and Freeman, 1980; Carroll, 1984).

This paper focuses on both elements of the debate. We hypothesize that Darwinian principles of natural selection may operate *inside* firms to create dynamic capabilities. These in turn act to thwart the effects of internal inertia, thereby improving firm performance and reducing the effect, via death and replacement, of *external* natural selection forces on industry evolution. Directing attention to the intrafirm adaptive processes associated with firm performance illuminates the mechanisms underlying organizational evolution and suggests a rapprochement between selection and adaptation perspectives.

Weick (1979) defines internal natural selection, but little work has been done to examine the relationship between this process and firm performance. Firms have been observed to adjust the balance between adaptive processes of internal variation, selection, and retention (VSR) to address external selection pressures (Burgelman, 1991; Miner, 1994). The concept of *balanced continuity*, introduced here, suggests that a particular balance among continuous internal natural selection processes is necessary to sustain performance in a competitive environment.

This paper examines the relationship between internal VSR processes and firm performance and provides a partial test of the concept of balanced continuity. In subsequent sections, we discuss organizational evolution, internal natural selection processes, describe the research design employed, and present the results. We conclude with a discussion of the implications of this research for the study of organizational evolution.

EVOLUTION—TWO PROCESSES OF POPULATION CHANGE

Organizational evolution is an explanation in which performance differences among industry populations and their member firms are attributed to a continuous process of slight or dramatic change over a long period of time (Aldrich, 1979; McKelvey, 1982; Nelson and Winter, 1982). An industry population is defined as a group of coevolutionarily interacting organizations embodying similar combinations of key competencies (McKelvey, 1982; Baum and Singh, 1994a: 10). Evolutionary change involves a change in the blueprints (Hannan and Freeman, 1977), competencies (McKelvey, 1982), or routines (Nelson and Winter, 1982) held by members of a firm, that ultimately are diffused throughout a population. Routines and competencies reflect a firm's experience based knowledge, skills and learning capabilities (McKelvey, 1982; Nelson and Winter, 1982). In the resource-based view, firms have at their disposal configurations of routines and competencies temporarily embodied in tacit, or not so tacit, knowledge held by their employees at any one time (Teece, Pisano and Shuen, 1994; Mosakowski and McKelvey, 1996).

For the most part, evolutionary perspectives take a *firm* level of analysis, focusing on the adaptation, or death and replacement, of firms with respect to an exogenous competitive context (Hannan and Freeman, 1977; Aldrich, 1979; McKelvey, 1982; Nelson and Winter, 1982). Recently researchers have begun applying Darwinian principles to intrafirm *parts* (Burgelman, 1991, 1994; Baum and Singh, 1994b; Brittain, 1994; Rosenkopf and Tushman, 1994; and Van de Ven and Garud, 1994; McKelvey, 1996). We begin by defining the Darwinian and Lamarckian views of evolution as they typically apply at the firm level of analysis. We then move to an intrafirm level of focus.

DARWINIAN EVOLUTION—NATURAL SELECTION

Most research in organizational evolution deals with the Darwinian view of population dynamics, where organizations are severely constrained by inertial forces, and change occurs within a population via environmental selection forces rather than internal adaptation (Aldrich and Pfeffer, 1976; Hannan and Freeman, 1977, 1984; Carroll and Hannan, 1989). Ecological theory argues that inertia limits a firm's ability to institute adaptive changes (Hannan and Freeman, 1984). Variations at the population level,[1] of member firms, only arise by chance as entrepreneurs start up new firms. Failing firms are locked into obsolete capabilities while replacement firms survive because they have advantageous capabilities, given the present environmental conditions. External selection forces, in the form of competitors and environmental constraints, provide a context in which some firms thrive and are selected favorably while others fail and are replaced (Hannan and Freeman, 1989; Singh, 1990; Singh and Lumsden, 1990).

Darwinian evolution only occurs when all four principles of natural selection are simultaneously in effect (Dobzhansky, *et al.,* 1977; Lewontin, 1978; McKelvey, 1982):

1. *Principle of Variation*: Differences in competencies and fitness occur across organizations.
2. *Principle of Selection*: Environmental forces selectively discriminate against some organizational variations and favor others within a population.
3. *Principle of Retention and Diffusion*: Favored variations are retained and diffused throughout the population.
4. *The Struggle for Existence*: The competitive context is such that organizations holding a larger proportion of favored competencies will deprive organizations holding fewer favored competencies of required resources, leading to the eventual failure of the latter.

The fourth principle emphasizes the role of competitive pressures in organizational evolution. Favored competencies and resources are those which are idiosyncratic,[2] and generate rents (Wernerfelt, 1984; Barney, 1986; Teece, Pisano, and Shuen, 1994; Mosakowski and McKelvey, 1996). In addition, idiosyncratic resources and competencies generate rents only as long as they remain relevant to the environment (Barney, 1991). Favored competencies may also work to assure survival, but without rents (Mosakowski and McKelvey, 1996).

LAMARCKIAN EVOLUTION—ORGANIZATIONAL ADAPTATION

Lamarck (1809) defined the earliest complete theory of evolution. His view has since been discredited in biology (Mayr, 1982), but it offers a useful alternative to Darwinian theory for understanding organizational evolution. Applying Lamarckian theory to firms, internal organizational adaptive changes arise purposefully in response to shifting environmental pressures observed by members of the firm, and not by chance. Darwinian theory argues that variations only arise by chance and are "blind" as to their adaptive efficacy, and it is selection forces which reflect environmental constraints. Penrose (1952) argues that adaptation is often too perfect to be accounted for simply by chance and some changes arise via managerial responses to environmental pressures. Goldschmidt (1976) suggests it also is likely that a certain portion of internal organizational changes may be purposefully responsive to environmental needs. Lamarckian (adaptation) perspectives suggest that people in organizations take a purposeful role in searching for alternatives, and firms are able to successfully adapt to shifting environmental conditions so as to ensure performance and continued survival (Lawrence and Lorsch, 1967; Thompson, 1967; Pfeffer and Salancik, 1978; Andrews, 1980).[3] A variety of theories exist in the literature that emphasize different internal factors that influence organizational change and adaptation:

- Structural Contingency Theory (Burns and Stalker, 1961; Thompson, 1967; Lawrence and Lorsch, 1967)
- Goals, Expectations, Choice and Control (Cyert and March, 1963)
- Strategic Management Theory (Child, 1972; Chandler, 1962; Miles and Snow, 1978; Andrews, 1980)
- Organizations as Institutions (Zucker, 1977, 1983, 1987)
- Resource Dependence Theory (Pfeffer and Salancik, 1978)
- Organizational Learning (Levitt and March, 1988; March, 1991)

• Organizational Change (Bennis, *et al.,* 1976; Kanter, 1983; Goodman, *et al.,* 1982)
• Organizational Development (French, Bell, and Zawacki, 1994)
• Resource-Based View (Teece, Pisano, and Shuen, 1994; Henderson and Cockburn, 1994)

SELECTION VS. ADAPTATION

The earliest rapprochement between Darwinian and Lamarckian approaches was developed by Weick (1979). In Weick's view, purposeful adaptive outcomes are achieved via the processes of internal natural selection—VSR. Managers, having studied the constraints of the external environment, and understanding the adaptive needs of their firms, "enact" programs of action which are Weick's equivalent to Darwin's variations— "Enactment is to organizing as variation is to natural selection" (1979: 130). March (1991) says that firms adapt to their surroundings by exploring new variations and environments, selecting alternative courses of action, implementing adjustments to environmental changes, and exploiting the existing environment and organizational competencies in novel ways.

Other authors suggest that selection and adaptation are interrelated processes of change (Singh, House, and Tucker, 1986; Levinthal, 1991; Burgelman, 1991). *First*, in examining organizational change and mortality, Singh, House and Tucker consider whether adaptation arguments are more consistent with the empirical relationships between organizational change and mortality than ecological arguments. Their findings indicate that all changes are not adaptive with respect to survival and that organizational change does not always increase organizational death rates. *Second*, Levinthal argues that adaptation and selection are interrelated through processes of learning and inertia. *Third*, Burgelman suggests that adaptive processes of internal selection may combine with death and replacement processes to explain change in populations. Our research directs attention to the need for a simultaneous modeling of selection and adaptation processes for complete theory of evolutionary change.

INTRA-ORGANIZATIONAL EVOLUTION

The study of evolution may span multiple levels of analysis (intrafirm, firm, industry population, and multiple population community) nested within a hierarchy[4] (McKelvey, 1982; Astley, 1985; Fombrun, 1988; Kauffman, 1993; Pianka, 1994; Barnett, 1994; Baum and Singh, 1994b; Brittain, 1994; Rosenkopf and Tushman, 1994; and Van de Ven and Garud, 1994; McKelvey, 1996). This literature indicates the several ways in which each level of the hierarchy interacts with other levels, influencing change processes and forming the patterns of organizational evolution. Given that in natural selection theory, selection is a contextual (or external) property affecting variation and retention, confusion may result once we think of evolution as a multilevel process. Plotkin (1993) uses the notion, 'Darwin machine'[5] , to represent the effect of the four Darwinian principles at a particular level of analysis (though selection may operate from a different level). Thus, an organism or firm may have Darwin machines operating at several internal levels as well as a niche or environmental level.

In a minimal hierarchical view, variation and selection processes exist where variations are weeded out at *two* levels, that is, two Darwin machines: 1) At the intrafirm level—firms develop a portfolio of variations from which *managers* select, and 2) At the firm level—*external agents* select some firms over others based on the variations *retained* by the firms. Two levels of retention also exist: 1) At the intrafirm level —variations selected by managers and retained by the firm are diffused throughout the firm, and 2) At the firm level—variations, retained by a firm that is favored by external selection agents, are diffused throughout the population. The following subsections present hypotheses, define internal VSR, and identify organizational mechanisms which facilitate each part of the internal natural selection process. All the hypotheses are expected to hold more strongly in environments where the intensity of the competitive struggle for existence is high.

H_1: Firm performance varies non-monotonically (inverted U) with variation.

Variation. The heart of internal natural selection involves variation as trial-and-error learning events (Campbell, 1969; McKelvey, 1994). Intrafirm variations occur via, 1) intentional or unintentional trials, 2) focused or unfocused trials, and 3) direct/indirect incentive systems (Miner, 1994). Whether intentional or unintentional, intrafirm variations are mostly blind (Campbell, 1969; Aldrich, 1979; Weick, 1979; Mosakowski, forthcoming) as managers do not necessarily know, under conditions of uncertainty and competition, which variations will become successful adaptive outcomes and consequently enhance firm performance. Variations may occur purposefully in response to environmental changes, they might be planned but not necessarily aimed at a particular environmental condition, or they might just happen (Campbell, 1969; McKelvey, 1994). Variations also might arise from combinations of old and new routines that are not currently recognized as distinct competencies for the firm (Nelson and Winter, 1982; Teece, 1982).

Some firms acknowledge the value of unfocused experimentation or “galumphing” (Weick, 1979: 248) and encourage boundary spanning activities, the exploration of new environments, diversity of ideas and competence acquisition (March, 1991; Kanter, Stein, and Jick, 1992; Ulrich, *et al*., 1993). Firms often create havens for “safe learning” such as “skunkworks”, which facilitate informal work on new ideas (Galbraith, 1982; Peters and Waterman, 1982). Firms also promote variation via focused experimentation activities which include: 1) Formalized research and development (Miner, 1994); 2) Identifying “champions of change” who shape a vision within firms and lead focused experimentation efforts (Nadler and Tushman, 1991; Kanter, *et al.,* 1992); and 3) Creating parallel projects where several teams work on the same problem, generating competition around creating potential new product or technology variations (Miner, 1994).

Reward systems which provide direct and indirect incentives to individuals also facilitate variation (Lawler, 1991; Kanter, *et al.,* 1992; Miner, 1994). Efforts to produce variations are motivated by incentives that reinforce useful innovation as part of standard responsibilities, compensate individuals for patents or innovative work, or allocate limited resources based on a competition between employees.

Organizations differ based on how they structure the variation process, that is, by how much they promote focused and unfocused experimentation and incentive systems. Increasing the level of variation promotes the learning process which diffuses throughout the organization and leads to more adaptive forms of behavior (Aldrich, 1979; Weick, 1979). Developing a portfolio of variation alternatives from which to draw positions a firm more effectively to respond in the event of environmental change, as compared to firms that lack alternative courses of action and experience with experimentation (Nadler and Tushman, 1988; Kanter, *et al.,* 1992). In addition, Tushman and Anderson (1986) show that firms that engage in change grow more rapidly then other firms. Firms that fail to adopt changes in behavior and continue to invest in an obsolete practices may lose touch with the competitive environment and risk failure. On the other hand, while novel change or "non-institutionalized innovation" increases the potential for achieving competitive advantage, it also increases the risk of firm failure (Zucker, 1987). Consequently, firms need to achieve a balance between introducing change and reinforcing experience.

Too much variation may have adverse implications for firms. First, excessive variation in organizational form threatens the preservation of complexly adaptive forms (Campbell, 1969) and is disruptive to the firm as a whole (Hannan and Freeman, 1984). In Amburgey, Kelly, and Barnett's (1993) study of Finnish Newspaper industry, changes in product content and frequency of publication result in an immediate increase in the hazard rate of firm failure. Second, the cost of excessive variation may be detrimental to firm performance in the long run and place the firm at risk of losing market share. Third, frequent change may result in random drift rather than performance enhancement when a firm's operations are altered prior to the firm fully understanding the competitive environment (Lounamaa and March, 1987). In contrast, while reducing the frequency of change might enhance the understanding of the coevolutionary system, a tradeoff exists between the benefits of an increase in understanding of one environmental state vs. a decrease in information about others (Levitt and Yao, 1988). This calls attention to a fundamental question in organization science and strategy: What level of change is appropriate to sustain a firm's competitive position in a dynamic environment?

While high levels of variation are necessary in order to provide a sufficient amount of requisite variety in the event of environmental change (McKelvey and Aldrich, 1983), too much variation may send the organization into a downward spiral (Hambrick and D'Aveni, 1988; Hannan and Freeman, 1984) or lead to suboptimal equilibria (March, 1991). Further, the cost of excessive variation may be detrimental to the firm. Thus, too high levels of variation contribute to low performance. When the level of variation is too low, excessive controls and reinforcement of previously retained variations override experimentation, constrain the selection of new variations and contribute to inertia. Too little variation also limits the number of alternatives managers have to select from.

H_2: Firm performance varies non-monotonically (inverted U) with selection.

Internal Selection. Internal selection is the managerial choice of variations (Weick, 1979). Organizations facilitate internal selection primarily through administrative and cultural control mechanisms (McKelvey and Aldrich, 1983; Burgelman, 1991; Miner, 1994). Administrative control mechanisms include strategic planning, goal setting, and rules governing research allocation (Weick, 1979; Burgelman, 1991) as well as project evaluation criteria, schedules or basic pre-screening criteria for projects, competition for resources or standards within the organization, and informal competition within an organization (Miner, 1994).

Organizations also promote selection by defining goals but not explicitly identifying the mode of action to achieve the goals. In this scenario, lower level employees may use goals to guide their selection of variations, that is, as a selection criteria for determining a course of action (Miner, 1994). In addition, goals set premises which are accepted by organizational members as a basis for future decisions (Simon, 1976).

Cultural control mechanisms include behavioral norms. Organizations are held together in part by a normative glue (Blau and Scott, 1962). Allegiance to behavioral norms or status quo may underlie selection processes—norms against offering suggestions, against experimenting or against taking initiative may select out beneficial variations (Weick, 1979).

In the absence of selection mechanisms, variations are not selected or retained, and previous firm behavior plays a larger role than new variations in defining firm performance. Consequently, the core firm characteristics, its organizational competencies, may progressively become less fit with the environment over time as the reinforcement of past behavior contributes to inertia and precludes attention to environmental change (Stinchcombe, 1965; Hannan and

Freeman 1984; Meyer and Zucker, 1989). Further, other organizational characteristics may influence behavior in the absence of administrative and cultural control processes (Meyer, 1994). For example, political coalitions may govern the selection of alternatives. Consequently, changes may be selected regardless of whether they benefit the firm as a whole. In addition, adopting change is often resisted by firm members when they may be at risk of losing private gains. Firm members' divergent interests as well as actors dependent on the firm and its owners, often drive the preservation of existing patterns of firm behavior in the face of change (Meyer and Zucker, 1989: 84).

Inordinately high levels of selection, or too high a pressure within the firm for control, also adversely impact firm performance (Weick, 1979: 186; McKelvey and Aldrich, 1983). First, excessive procedures, such as rigorous project evaluation criteria, as well as deep set behavioral norms, may limit the number of variations managers evaluate. Second, managers may hesitate to evaluate and select particular variations when maintaining a previous course of action requires less effort than adopting of a new variation. Over time, variation activity might dry up when firms mandate tight control practices (Campbell, 1969).

H_3: Firm performance varies non-monotonically (inverted U) with retention.

Retention. Retention involves the diffusion and reinforcement of selected variations. It represents the firm's memory, its experience based knowledge; stored information from the firm's history that can influence present and future decisions (Walsh and Ungson, 1991). Firms facilitate retention through: 1) Implementation processes focused on maintaining consistency between actions instigated via internal selection and the actual implementation behavior of individuals; 2) Leadership which serves as the driving force behind change and establishes a commitment to change efforts (Kanter, *et al.,* 1992; Nadler and Tushman, 1991); and 3) Organizational design which facilitates communication and augments the transfer of information across units to share results of previously retained variations and facilitate the diffusion process (Nadler and Tushman, 1988). In addition, a continuous review of change efforts through management information systems, budgets and schedules assists in propagating consistent behavior across subunits (Kanter, *et al.,* 1992).

Too high levels of retention reflect the reinforcement of past behavior. With repetition, each retained variation becomes more routine to a firm and the chances that it will be used again in the future increase (Stinchcombe, 1965; Nelson and Winter, 1982; Levitt and March, 1988). The current wisdom of the firm stems from past events, but is only useful if the environment remains stable (Campbell, 1969; Chakravarthy, 1982). Opportunities and risks are often blurred by familiarity (Andrews, 1980) and when environments change, prior firm practices and procedures may no longer be functional (Nadler and Tushman, 1988). Consequently, firms that fail to look beyond present behavior are vulnerable to surprise (Andrews, 1980). Retention activities that are too rigorous act as mechanisms of inertia which constrain internal variation and selection, and become obstacles to adaptive outcomes and sustained firm performance.

The absence of internal retention also promotes low firm performance. Low firm retention levels may indicate: 1) the firm is not drawing from its experience based knowledge, 2) a lack of feedback on performance outcomes of previously implemented variations, and/or 3) a lack of diffusion of selected variations. *First*, Levinthal (1991) argues that building on existing knowledge enhances firm survival chances. Not utilizing current knowhow also results in a resetting of the firm's liability of newness clock thus, exposing firms to the risks associated with young firms (Stinchcombe, 1965: 148; Freeman, Carroll and Hannan, 1983; Carroll and Delacroix, 1982; Amburgey, Kelly, and Barnett, 1993).

Second, retention serves as a data base from which to compare future courses of action. Without feedback on the performance outcomes of previously retained variations, trial and error learning breaks down as managers fail to learn which variations result in effective or ineffective outcomes and possibly even why they do so (Levinthal and March, 1993). Associations to past actions and the performance of those actions are necessary for learning to occur (Fiol and Lyles, 1985).

Third, a lack of diffusion of retained variations throughout the firm may reflect an inability to integrate knowledge across the firm and/or a lack of leadership support for change efforts. The absence of diffusion might indicate that the firm is not transforming experience into routines and recording routines in the firm's memory (Levitt and March, 1988). As a result, knowledge of past experience may not be available for integration across the firm. When selected variations are not diffused, parts of a firm continue to base behavior on previous actions which may not satisfy current environmental conditions.

In addition, effective diffusion of selected variations requires leadership support for change efforts (Kanter, *et al.,* 1992; Bennis, 1993) and consistency between preferred actions resulting from internal selection and the actual behavior of individuals. A lack of leadership support presents a negative influence for employees attempting to implement a variation and limits the ability of a firm to accomplish change effectively. If variations are implemented that are inconsistent with a selected course of action, they may result in outcomes incommensurate with the originally selected change. This jeopardizes the organization's ability to satisfy environmental pressures and sustain firm performance.

H_4: In a competitive environment, sustaining firm performance requires balanced levels of internal VSR.

Balanced Continuity. Internal natural selection is a continuous chain of events (Campbell, 1969; Weick, 1979). This process allows firms to develop and adopt changes which meet environmental pressures (Burgelman, 1994). Each element of the VSR process is necessary for the adoption of variations. Dysfunctionally high or low levels of VSR constrain a firm's ability to adopt changes and limit the firm's responsiveness to internal and external pressures.

While Campbell (1969) and Weick (1979) emphasize that internal natural selection is a continuous process, they do not address what level of variation, selection or retention is necessary for adaptive outcomes to occur. McKelvey and Aldrich (1983: 125) say, "Managers should attempt a balanced emphasis on all four principles as the best way of increasing the chances of the survival of their organization." Tushman and Romanelli (1985) argue that successful organizations are those which develop a balance between change and stability, while March (1991) calls for balancing exploration and exploitation. The concept of balanced continuity builds on these arguments.

Firms differ on how they structure the internal natural selection process. Two sets of pressures exist, 1) internal pressures for VSR and 2) environmental pressures. An example of internal pressures involves top management pressuring members of the organization to pursue a high level of variation and a low level of retention. Depending on how firms structure the process, different distributions of the level of VSR processes will occur across firms, which in turn gives rise to varying patterns of behavior or different VSR profiles. Internal VSR processes jointly form an intertwined process that becomes the basis for idiosyncratic dynamic capabilities. How effectively the links among the VSR processes are managed influences the firm's ability to adopt changes, learn from past experience and control the types of changes adopted. Firms compete using different patterns of change or different VSR profiles. Balanced continuity suggests that, in a competitive environment, all three internal VSR pressures must exist in a balanced relationship, for firms to achieve adaptive outcomes and thus sustain performance.

By finding the appropriate balance between VSR capabilities relative to the environmental context, firms gain competitive advantage. A match between VSR balance and the sources of competitive advantage (idiosyncratic competencies and resources), in a changing environment, allows a firm to achieve a dynamic capability and thereby sustain its performance. In the absence of balanced continuity, firms lack the ability to adopt changes necessary to sustain performance under changing competitive conditions and become subject to external selection forces. Thus, internal natural selection characterized by balanced continuity leads to adaptive outcomes, sustained firm performance, and favorable external selection.

H_5: In a competitive environment, when balanced continuity is achieved, internal natural selection leads to adaptation.

H_6: In a competitive environment, when balanced continuity is not achieved, inertia tends to increase and external selection forces play a more dominant role in organizational evolution.

These two hypotheses tie the balanced continuity hypothesis back to the broader scope of evolutionary theory as a means of explaining changes in industry populations. They link internal natural selection to Darwinian and Lamarckian theory and identify the conditions giving rise to one form of evolution over the other. While data limitations preclude a direct test of H_5 and H_6, this paper tests hypotheses H_1 to H_4, which underlie H_5 and H_6.

RESEARCH DESIGN

DATA

Data from a 1993 questionnaire on organizational learning, culture change, and competitiveness (Ulrich, Von Glinow, Jick, Yeung and Nason, 1993) are used. Approximately 2000 surveys were submitted to 382 business units and 1359 responses were received from 380 firms worldwide (return rate = 68%). The data were collected following key informant methodology where the selection of respondents is based on their ability to provide an informed response about their business (Campbell, 1955; Siedler, 1974; Phillips and Bagozzi, 1986). Respondents consist of senior managers with an average tenure of 15.8 years, average age of 45.7 years and constitute an array of functions including finance, general management, human resources, manufacturing, marketing/sales and research and development. The firms represent ten major industry groups (including electronics and computers, chemicals and pharmaceuticals, wholesaling and retailing, finance, services, aircraft, and automobiles) and one miscellaneous manufacturing group. The sample is skewed toward large, older firms (Ulrich, *et al.,* 1993).

Only questionnaires from 193 North American firms are used. Following multiple informant methods, data are aggregated by firm for firms having three or more respondents (Siedler, 1974). Cases with high disagreement among respondents in key variables, such as the size or age of the business unit, are treated as missing values.[6] The average size and age of the sample of 193 firms does not differ statistically from the total sample. The responses of the informants in the same firm are averaged and represent an aggregate score for each questionnaire item.

DEPENDENT VARIABLE

Drawing on Ulrich, *et al.,* (1993), firm performance is based on a composite measure that is consistent with multi-dimensional performance measures recommended by Venkatraman and Ramanujam (1986), in their review of performance measures for strategy and organizational research. Respondents: 1) Rate their firm's financial performance compared to major competitors on a 6 point Likert scale ranging from "much worse" to "much better"; 2) Report their firm's performance relative to other competitors in five functions: customer relations, distribution channels, globalization, marketing and sales, and research and development; 3) Rate their firm's cycle time for innovation and reputation as an innovator compared to major competitors. The firm performance measure is estimated for each firm by summing the 8 questionnaire items. Cronbach's alpha is 0.76.

INDEPENDENT VARIABLES

The independent variables, VSR, are empirically developed using orthogonal factor analysis (varimax rotation). The factor analysis consists of 3, 4 and 5 factor rotations; a three factor solution is extracted.

Variations are alterations in state, form, appearance, or function of the organization and occur via focused and unfocused experimentation, and direct and indirect incentive systems. Factor 2 represents Variation (VAR) and reflects the extent to which a firm: 1) Encourages the acquisition of competencies; 2) Continually seeks new ideas; 3) Continually seeks new ways to do work; 4) Embraces experimentation; 5) Strives to be the first to market with a new process or product; and 6) Embraces change. Cronbach's alpha for the summed items is 0.84.

Selection (SEL), the managerial choice of variations, is carried out primarily through administrative and cultural control mechanisms. The following items load high on Factor 1 and reflect the extent to which each firm: 1) Performs problem analysis prior to implementation of ideas, 2) Employs procedures that make a difference in the organization, 3) Employs behavior that redresses past mistakes, 4) considers the implications of change and 5) Ensures actions are consistent with goals. Cronbach's alpha for the summed items is 0.84.

Retention, the diffusion and reinforcement of selected variations is identified as Factor 3. Items that load high on Retention (RET) reflect the extent to which the organization and its leadership: 1) Transfer learning from one site to another, 2) Integrate any one business change to the overall business process, 3) Track progress on business changes, 4) Share results widely, and 5) Provide specific and frequent feedback that improves performance. Cronbach's alpha for the summed items is 0.85.

CONTROL VARIABLES

Previous research shows that firm size (SIZE) influences a firm's ability to perform in its environment (Barnett and Amburgey, 1990). Firm size is measured by the number of employees in the firm. We use the natural log of firm size to reduce the skewness of the distribution which normalizes it by compressing the upper tail of the distribution and expanding the lower tail. This approach acknowledges that a one-unit change in the size of a small organization will have a greater impact than a one-unit change in a large organization. Empirical evidence establishes links between age and inertia (Hannan and Freeman, 1989; Singh, Tucker, and Meinhard, 1988; Baum, 1990; Kelly and Amburgey, 1991; Amburgey and Miner, 1992). We include a control variable for firm age (AGE), defined as the number of years since founding. The natural log of firm age is also used to reduce the skewness of the distribution.

Environmental uncertainty (EU), the extent to which changes in the environment are unknown, affects elements of organizational functioning (Lawrence and Lorsch, 1967; Duncan, 1972; Khandwalla, 1977; Randle, 1990; Levinthal, 1994; Romanelli and Tushman, 1994). Including environmental uncertainty partially controls for environmental effects. Respondents rated the extent to which changes are predictable in their industry over the next three years on a 6 point Likert scale with a high score indicating very high level of environmental uncertainty.

Dynamism (DYN), defined as the extent to which changes occur in a firm's business environment, influences the firm's ability to function in its environment (Aldrich, 1979). Including a measure of dynamism partially controls for the environmental conditions facing firms. Respondents are asked to rate the extent to which 14 functions or activities are changing in their business (e.g., customer buying criteria and customer relations, distribution channels, organization structures, research and development, production capability and sales and marketing) on a 6 point Likert scale, with a high score indicating a very high dynamism. The dynamism index is a summation of the 14 scores for each firm.

DESCRIPTIVE STATISTICS

Table 1 presents the means, standard deviations, and correlations for the variables used. A large standard deviation in firm size and dynamism indicates large differences in the sample of 193 firms. Firm performance is positively correlated with VSR as expected and negatively correlated with firm size and age. Firm size and age are also negatively correlated with variation and selection but positively correlated with retention. Moderate positive correlations exist among the three main constructs, VSR. The positive correlation between variation and retention opposes the expectation that the diffusion and reinforcement of change conflicts with experimentation. Environmental uncertainty and dynamism negatively correlate with selection and retention but positively correlate with variation. This follows expectations that firms may pursue more variations under conditions of uncertainty and environmental change. Some interactions may exist among the independent variables given their moderate correlations. Variable inflation factor tests indicate a lack of multicollinearity (VIF < 1.4 in all cases).

[Insert Table 1 about here]

MODEL SPECIFICATION

This analysis uses ordinary least squares regression to test the relationship between internal natural selection and firm performance. The model estimates as follows:

$$Y = ß_0 + ß_1(SIZE) + ß_2(AGE) + ß_3(EU) + ß_4(DYN) + ß_5(VAR) + ß_6(SEL) + ß_7(RET) + ß_8(VAR)^2 + ß_9(SEL)^2 + ß_{10}(RET)^2$$

where Y is the composite measure of firm performance. We first test the baseline model for the effects of firm size, age, environmental uncertainty and dynamism on performance and then add the first order terms for variation (model 2), selection (model 3), and retention (model 4) followed by the second order effects for each construct (models 5 to 7 respectively). These analyses make it possible to determine whether the internal natural selection process explains firm performance after controlling for heterogeneity in the sample due to firm characteristics and environmental differences. The combination of first and second order effects of variation, selection and retention tests the hypothesis that firm performance varies non-monotonically (inverted U) with each construct.

RESULTS

Table 2 presents the results of the hierarchical regression analyses. Coefficients are estimated for seven hierarchical models. Model 2 shows a positive and significant relationship between firm performance and variation. This model fits the data significantly better than the baseline model (1) which contains only the control variables: change in adjusted R^2 (ΔAdj R^2) = 0.26, $p < .01$. The next two models add first order selection and retention effects respectively. The coefficient for selection is positive and significant but retention is not significant. These results fail to support H_4 which predicts that VSR are all necessary for sustaining firm performance. Note that model 3, adding in selection, significantly improves fit to the data over model 2 containing only the control variables and variation: Adj R^2 = 0.35, ΔAdj R^2 = 0.07, $p < .01$. The addition of variation and selection significantly enhances the explanatory power of the model, and offers partial support of H_4.

[Insert Table 2 about here]

The second order effects of VSR are added in models 5 through 7 respectively. The results fail to support H_1 and H_3. Firm performance does not vary in an inverted U-shape with variation or retention. Results indicate that performance rises with an increase in the level of variation. With the inclusion of the second order term for variation, the first order effect is no longer significant, but the coefficient for the second order term is positive and significant. In models 4 through 6, the coefficients for the first order retention term are small and non-significant. With the addition of the second order retention term in model 7, the coefficient for the first order retention term increases dramatically and changes sign but remains non-significant. The coefficient for the second order retention term is positive but also not significant. The ΔAdj R^2

from models 3 to 4 and models 6 to 7 indicate that the addition of the first and second order retention terms does not significantly enhance the explanatory power of the model.

Results of model 7 support H_2. Firm performance varies non-monotonically (inverted U) with selection; moreover, the inverted U reaches its peak within the observed range for these variables.[7] While the equation for the full model (7) has an adjusted R-square of .38 ($p < .01$), the ΔAdj R^2 from model 6 is not significant.

RESULTS: PICTURES FROM A DIFFERENT ANGLE

In addition to the above analyses, two other hierarchical regression analyses are also performed in order to test the hypotheses from a different VSR analysis perspective—rather like moving a camera in the middle of a forest to alter the effect of obstructing trees. Table 3 presents the results of the second approach which uses factor scores for the VSR constructs rather than an average of the survey items that mapped to each variable. Each element of the internal natural selection process significantly contributes to firm performance providing strong support for H_4 and the concept of balanced continuity. In addition, model 4 shows a significant improvement in fit to the data over model 3 containing only the control variables and variation and selection: Adj $R^2 = 0.36$, $p < .01$, ΔAdj $R^2 = 0.04$, $p < .01$. Consistent with the first set of analyses, model 7 supports H_2. Model 6 also supports H_2. Firm performance varies non-monotonically (inverted U) with selection.

[Insert Table 3 about here]

A third perspective was taken by revising the order in which the the first and second order terms for the independent variables are added in the model. Table 4 presents results of the third view. Consistent with the first two sets of analyses: 1) Performance varies non-monotonically with selection; 2) The coefficient for variation is positive and significant until the second order variation term is included; and 3) The second order variation effect is significant and positive. Consistent with the first set of analyses, retention does not prove significant. In addition, the concept of balanced continuity is only partially supported—retention is missing.

[Insert Table 4 about here]

The alternative views provide additional support for the hypotheses. For the most part, the different angles command the same snapshot with subtle differences. Evidence regarding the relationship of internal VSR with firm performance is summarized as follows: 1) Performance varies in an inverted U-shape with selection; 2) The concept of balanced continuity is partially supported; 3) Performance increases with the level of variation; and 4) The control variables do not achieve significance in any of these analyses.

DISCUSSION AND CONCLUSIONS

We hypothesize that performance varies non-monotonically (inverted U) with VSR and that each element of the internal natural selection process must exist for adaptive outcomes and sustained performance in the context of changing competitive environments. Results show partial support for the hypotheses. The balanced continuity/firm performance hypothesis is strongly supported from one analytical angle, but only partially supported from other angles—the retention effect is missing. Firm performance varies in an inverted U-shape pattern with selection. High or low levels of control adversely impact performance. The non-monotonic relationship between performance and variation is neither corroborated nor refuted. Results suggest that firm performance increases with variation. In addition, variation and selection significantly influence firm performance. A lack of support exists for the hypothesis that too much or too little retention leads to low firm performance.

While this research paves new ground, some words of caution are in order. *First*, the measures for the independent and dependent variables serve as proxy measures of varying quality. In general, measures of the independent variables align with the theoretical definitions but are not as valid as one might prefer. This reflects a limitation of the use of a secondary data base. A more complete alignment between the theoretical and operational definitions might be achieved by incorporating more objective measures of VSR and firm performance. For example, more objective measures might capture the type and quality of particular variations.

Second, a possible common method variance (CMV) problem exists (all data stem from the same questionnaire), though the findings seem to mitigate against this. The lack of a retention effect findings goes against CMV expectations—why wouldn't executives, via conventional wisdom, say, link up change orientation in changing environments with higher performance? The non-monotonic selection finding seems unlikely to be CMV caused since the dysfunctional effects of too much variation and selection (analysis and procedure) are probably outside conventional wisdom. The performance/variation result could indicate CMV, but if this were true consistency would suggest that respondents would also link up variation with environmental uncertainty and dynamism, which they do not. We conclude that if there is a CMV effect, it is not consistent or obvious—it should not turn off or on depending on which variable is picked. One might recommend substituting "hard" measures such as ROI or stock returns in place of the "managerial perceptions" used in this study, but there are as many complaints typically lodged against hard measures as against perceptual measures. Studies using both would be welcome.

Third, while this research controls for environmental uncertainty, dynamism, firm size and age, it lacks assessment of other environmental and firm characteristics. Firms in the sample compete in different industries and face different sets of environmental pressures, which might affect their VSR balance. In addition, hidden factors such as technological interdependencies, imprinting, or individuals adapting to the firm might influence intrafirm processes (Miner, 1994; Meyer, 1994). We use a 14 item measure of dynamisin for purposes of enhanced validity and reliability. Other researchers may want to single out specific effects, such as slow or rapid life cycles (which in fact is one of our 14 measures). *Fourth*, this analysis uses cross-sectional data. A longitudinal study which tracks internal natural selection processes and their influence on firm survival over time will further inform the study of evolution across levels of analysis.[8]

We discuss the findings below in the context of the foregoing limitations. Our findings show that natural selection at the *intrafirm* level of analysis partially explains performance at the *firm* level. The question for future research remains: What balance among VSR, as an essential dynamic capability, is necessary to sustain performance in a competitive environment? Our results provide some direction for future research. *First*, while performance does not vary non-monotonically with variation, the level of performance increases with variation. This supports the argument that the greater a level of variation or trials firms undertake, the greater chance they have at achieving adaptive outcomes in changing, competitive environments (Weick, 1979; Aldrich, 1979). It is possible that our sample of firms had not reached dysfunctional levels of variation (many firms have troubles reaching adequate levels of innovation, let alone too much), hence no signs of the nonmonotonic effect. *Second*, too much or too little selection adversely affects performance. These results suggest that a large number of trials in conjunction with a moderate level of selection lead to higher levels of firm performance. The regression analyses using factor scores (Table 3) suggest that organizations scoring higher on retention (i.e., reinforcing previous experience), also increase performance.

While multicollinearity tests indicate independence among the variables, potential interaction may exist between variation and selection based on the nature of the constructs. *First*, managerial selection of particular variations may influence the type of future variations pursued by employees. Selection processes may serve as a signalling device between management and those involved in experimentation efforts. *Second*, extensive control mechanisms may overwhelm experimentation and retention activities. These results might reflect characteristics of the firms in the sample that are large older firms (average age 69 years). Research shows that large, old firms are more prone to bureaucratic rigidity effects (Haveman, 1993).

We establishes links between Lamarckian adaptation and Darwinian selection perspectives by identifying adaptive processes that determine, in part, why some firms are more likely to achieve higher levels of performance than others. *First*, research in organization science emphasizes that changes occur in organizational populations through two conflicting perspectives, Darwinian (Hannan and Freeman, 1977; 1989) and Lamarckian evolution (Cyert and March, 1963; Lawrence and Lorsch, 1967; Pfeffer and Salancik, 1978, Nelson and Winter, 1982). This paper directly addresses the central debate by identifying the conditions that give rise to one form of evolution over the other. Weick's (1979) internal natural selection process explains both forms of population change. In addition, selection and adaptation are not mutually exclusive but linked via internal natural selection processes.

Second, managerial action influences, 1) internal evolutionary processes, 2) the evolutionary system in which they are embedded and 3) the coevolution of organizations and their contexts (Baum and Singh, 1994a: Part 5; McKelvey, 1996). This conflicts with strict organizational ecology and environmental determinism views which emphasize that the nature and distribution of resources in the environment play a larger role in organizational evolution than the internal operation of the organization (Hannan and Freeman, 1977; 1989).

Third, the mechanisms which facilitate internal natural selection reaffirm links between different bodies of research. For example, in stable environments, theories on organizing, controlling, planning, and reinforcing behavior may be appropriate for intraorganizational processes while, in changing environments, theories of organizational learning, organizational change, or entrepreneurship may play a more important role. *Fourth*, developing a portfolio of variations as well as selection and retention capabilities might better position a firm to respond to shifting environmental conditions than firms lacking these capabilities. *Fifth*, adjusting the balance of pressures among internal natural selection processes is central to achieving adaptive outcomes, dynamic capability, and higher levels of performance.

Our findings suggest several avenues for future research: 1) Additional empirical testing of the relationship between intrafirm evolutionary principles and firm performance and survival; 2) Evaluating the interactions between evolutionary processes when Darwin machines are present at multiple levels; 3) Investigating the processes underlying VSR; 4) Examining different environmental conditions and their relationship to balanced continuity profiles; and 5) Comparing a balanced VSR contribution relative to other internal processes that might foster dynamic capability. Such research would refine the basic hypotheses by illuminating the conditions that qualify the hypotheses as they apply in various contexts and further enhance our understanding of intrafirm evolution in relation to the evolutionary system within which it is nested.

In conclusion, the theory and research presented in this paper show that adaptation and selection are interrelated processes of change and evolution at the *intrafirm* level partially drives performance outcomes at the *firm* level of analysis. The main contribution of this research is the use of an internal Darwin machine to explain both Darwinian (selection) and Lamarckian (adaptation) processes. *First*, adopting a *firm* level selection or adaptation view misses insights which may be gained by considering these theories of evolution as interrelated intrafirm processes of change. *Second*, limiting research to one level of analysis (one Darwin machine) severely constrains our understanding of the forces underlying dynamic capabilities within and among industrial populations. *Third*, our findings offer some preliminary insight into the nature of the evolutionary principles or change processes underlying the dynamic capabilities concept increasingly central to the resource-based view of how firms achieve sustained competitive advantage. By identifying the conditions that give rise to selection and adaptation processes and drawing attention to links across the evolutionary *firm/parts* hierarchy, this paper highlights potentially rewarding lines of inquiry in the study of organizational evolution, dynamic capability, and competitive strategy.

ENDNOTES

Tammy, the correct endnotes are after the last Table. You need to get them up here to replace these. I am not sure how you get "end notes" to be not at the end. I do it by having references and tables in a different file, but may there is another way, like just moving them---which I will try!!---I just tried and I can't move them, so perhaps the only way is to have separate files---I think end notes have to be at the end of the file, period.

1 Variations are defined as alterations in the state, form, or function of some firm attribute (Weick, 1979; McKelvey and ALdrich, 1983).

2 Idiosyncratic resources are those that are unique, inimitable, and nonsubstitutable (Barney 1991).

3 Conceptually, performance is the achievement of stakeholder satisfaction relative to competitors in the environment and is an outcome of adaptation. Firms sustain performance by earning above average profits, relative to competitors, over the long run (Porter, 1985).

4 The community level "focuses on the rise and fall of populations as basic units of evolutionary change" (Astley, 1985).

5 High disagreement within units implies potential misinformation among informants, references to different units of analysis or misleading selection of informants, which violates the sampling of key informants.

6 The cumulative effect of the linear and quadratic terms for any variable X reaches a peak (if inverted U-shaped) or a trough (if U-shaped) when $X = -ß_1/(2 * ß_2)$, where $ß_1$ is the parameter estimate for the linear term and $ß_2$ is the parameter estimate for the quadratic term (Hannan and Carroll, 1992: 62).

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TABLE 1

Means, Standard Deviation and Correlations for Dependent, Independent and Control Variables

Variable	Mean	S.D.	1	2	3	4	5	6	7	8
1. Peformance	23.12	0.53	1.0							
2. Ln Size	9.27	1.81	-0.17**	1.0						
3. Ln Age	4.25	0.81	-0.03	0.25**	1.0					
4. Uncertainty	1.94	0.53	0.12*	-0.01	-0.15*	1.0				
5. Dynamism	46.41	4.27	0.03	0.28**	0.11	0.10	1.0			
6. Variation	3.22	0.50	0.50**	-0.01	-0.08	0.19**	0.27**	1.0		
7. Selection	3.31	0.52	0.45**	-0.26**	-0.22**	-0.05	-0.08	0.33**	1.0	
8. Retention	3.08	0.45	0.38**	0.05	0.03	0.01	0.12*	0.53**	0.51**	1.0

* p < .05, ** p < .01

TABLE 2

The Impact of Variation, Selection and Retention on Firm Performance

	Model						
Variables	1	2	3	4	5	6	7
Controls							
Ln Size	-0.32*	-0.26*	-0.16	-0.17	-.18	-0.23*	-0.22*
	(.12)	(.10)	(.10)	(.10)	(.11)	(.11)	(.11)
Ln Age	0.07	0.23	0.41	0.40	0.40	0.41	0.46*
	(.27)	(.24)	(.23)	(.23)	(.23)	(.23)	(.23)
Environmental Uncertainty	0.69	0.22	0.48	0.48	0.38	0.44	0.46
	(.42)	(.36)	(.35)	(.35)	(.35)	(.35)	(.35)
Dynamism	0.05	-0.06	-0.04	-0.04	-0.03	-0.02	-0.02
	(.05)	(.05)	(.04)	(.04)	(.04)	(.04)	(.04)
Variation		3.27***	2.52***	2.48***	-5.06	-6.51	-4.94
		(.39)	(.41)	(.45)	(3.39)	(3.45)	(3.66)
Selection			1.79***	1.73***	1.66***	7.61*	8.26*
			(.39)	(.44)	(.43)	(3.15)	(3.19)
Retention				0.09	0.23	0.20	-4.93
				(.54)	(.53)	(.53)	(4.13)
Variation^2					1.16*	1.37***	1.12*
					(.52)	(.53)	(.56)
Selection^2						-0.90	-0.99*
						(.48)	(.48)
Retention^2							0.85
							(.67)
R^2	0.05	0.30	0.38	0.38	0.39	0.41	.41
AdjR^2	0.03	0.29	0.35	0.35	0.37	0.38	0.38
ΔAdj R^2		0.26**	0.07**		0.02*	0.01	
F Value	2.47*	16.74***	18.91***	16.13***	15.05***	13.97***	12.77***

N = 193
* p<.05; ** p < .01; *** p < .001
Standard errors are in parentheses.

TABLE 3

The Impact of Variation, Selection and Retention on Firm Performance
(using factor scores for independent variables)

Variables	Model 1	2	3	4	5	6	7
Controls							
Ln Size	-0.32* (.12)	-0.27* (.11)	-0.12 (.11)	-0.16 (.10)	-.18 (.10)	-0.23 (.11)	-0.22 (.11)
Ln Age	0.07 (.27)	0.22 (.25)	0.53* (.24)	0.42 (.23)	0.43 (.23)	0.43 (.23)	0.48* (.23)
Environmental Uncertainty	0.69 (.42)	0.13 (.39)	0.41 (.36)	0.45 (.36)	0.38 (.36)	0.42 (.35)	0.45 (.35)
Dynamism	0.05 (.05)	-0.02 (.05)	-0.004 (.04)	-0.01 (.04)	-0.01 (.04)	-0.00 (.04)	-0.00 (.04)
Variation		1.30*** (.21)	1.28*** (.19)	1.26*** (.19)	-2.53*** (.83)	-2.5*** (.82)	-2.47*** (.82)
Selection			1.39*** (.19)	1.07*** (.19)	1.05*** (.19)	2.63*** (.82)	2.58*** (.82)
Retention				0.61*** (.18)	0.63*** (.18)	0.57*** (.18)	-1.57* (.81)
$Variation^2$					0.21 (.13)	0.21 (.13)	0.21 (.13)
$Selection^2$						-0.26* (.13)	-0.25* (.13)
$Retention^2$							0.15 (.12)
R^2	0.05	0.20	0.32	0.36	0.37	0.38	0.39
Adj. R^2	0.03	0.18	0.30	0.34	0.34	0.35	0.36
ΔAdj R^2		0.15**	0.12**	0.04**		0.01*	0.01
F Value	2.47*	9.81***	15.07***	15.17***	13.68***	12.79***	11.71***

N = 193
*p<.05; **p < .01; *** p < .001
Standard errors are in parentheses.

TABLE 4

The Impact of Variation, Selection and Retention on Firm Performance
(Revised Order)

Variables	Model 1	2	3	4	5	6	7
Controls							
Ln Size	-0.32*	-0.26*	-0.27*	-0.17	-.22*	-0.24*	-0.22*
	(.11)	(.10)	(.10)	(.10)	(.11)	(.11)	(.11)
Ln Age	0.07	0.23	0.25	0.42	0.42	0.41	0.46*
	(.27)	(.24)	(.23)	(.22)	(.22)	(.22)	(.23)
Environmental Uncertainty	0.69	0.22	0.12	0.39	0.44	0.44	0.46
	(.42)	(.36)	(.36)	(.35)	(.35)	(.35)	(.35)
Dynamism	0.05	-0.06	-0.05	-0.03	-0.02	-0.02	-0.02
	(.05)	(.05)	(.04)	(.04)	(.04)	(.04)	(.04)
Variation		3.27***	-4.28	-4.82	-6.31	-6.52	-4.94
		(.39)	(3.58)	(3.33)	(3.40)	(3.45)	(3.66)
Variation^2			1.17*	1.14*	1.35*	1.37***	1.12*
			(.54)	(.51)	(.52)	(.54)	(.56)
Selection				1.76***	7.72*	7.61*	8.26*
				(.38)	(3.13)	(3.15)	(3.19)
Selection^2					-0.91*	-0.90*	-0.99*
					(.47)	(.47)	(.48)
Retention						0.20	-4.93
						(.53)	(4.13)
Retention^2							0.85
							(.67)
R^2	0.05	0.30	0.32	0.39	0.40	0.40	0.41
AdjR2	0.03	0.29	0.30	0.37	0.38	0.38	0.38
ΔAdj R^2		0.26**	0.01*	0.07**	0.01*		
F Value	2.47*	16.74***	15.01***	17.25***	15.77***	13.97***	12.77***

N = 193
* p<.05; ** p < .01; *** p < .001
Standard errors are in parentheses.

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[1] Variations are defined as alterations in the state, form, or function of some firm attribute.
[2] Idiosyncratic resources are those that are unique, inimitable, and nonsubstitutable (Barney 1991).
[3] Conceptually, performance is the achievement of stakeholder satisfaction relative to competitors in the environment and is an outcome of adaptation. Firms sustain performance by earning above average profits, relative to competitors, over the long run (Porter, 1985).
[4] The community level "focuses on the rise and fall of populations as basic units of evolutionary change" (Astley, 1985).
[5] Plotkin (1993: xvii) attributes this phrase to the American neurobiologist, William Calvin.
[6] High disagreement within units implies potential misinformation among informants, references to different units of analysis or misleading selection of informants, which violates the sampling of key informants.
[7] The cumulative effect of the linear and quadratic terms for any variable X reaches a peak (if inverted U-shaped) or a trough (if U-shaped) when $X = -ß_1/(2 * ß_2)$, where $ß_1$ is the parameter estimate for the linear term and $ß_2$ is the parameter estimate for the quadratic term (Hannan and Carroll, 1992:62).
[8] A multiyear longitudinal study is in fact in process by the senior author, along with Elaine Mosakowski.