SEQUENCES OF COMPETITIVE MOVES AND EFFECTS ON FIRM PERFORMANCE

SRUTHI M. THATCHENKERY
Department of Management Science & Engineering
Stanford University
Stanford CA 94305

RIITTA KATILA
Stanford University

ERIC L. CHEN
Onyx Pharmaceuticals and
University of California-Berkeley

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INTRODUCTION

While the majority of research on competitive dynamics examines competitive moves in aggregated repertoires, recent work has started to deal with patterns in moves over time. Such work on competitive sequences shifts focus from "average" move attributes to how moves fit together to form longitudinal patterns. In this paper, we focus on such time-paced competitive sequences, i.e. ordered lists of potentially repeating competitive moves, in which moves are measured at regular intervals (Abbott & Hrycak, 1990). We adopt the sequence lens in order to examine different temporal patterns, such as regular versus irregular rhythm, as well as the degree of conformity to competitors' sequences.

We ask: *How does the temporal structure of competitive sequences impact firm performance?* By recording each move type at regular intervals, we capture new nuances about the temporal pattern of a firm's competitive behavior. Such patterns can be central to competitive advantage, but are not yet well-understood.

THEORY AND HYPOTHESES

Recent research suggests that a learning perspective in which a firm's actions are conceptualized as problem-solving search might be a useful theoretical lens to understand competitive moves (e.g., Katila & Chen, 2008; Katila et al., 2012). This lens can be particularly useful to understand longitudinal patterns of moves, i.e. competitive sequences. The literature on search has identified rhythms of longitudinal search behavior and has theorized about subsequent effects these search rhythms might have on firm performance.

Our first hypothesis asks what effects conformity between a firm's competitive sequences and those of its rivals will have on the focal firm's performance. Undertaking similar numbers of moves in the same time periods increases conformity. We predict that *non-conformity* with rivals' competitive sequences increases performance, for two reasons. First, we propose that firms that engage in non-conforming sequences embark upon a differentiated path of learning and routine-building, and in the process gain unique knowledge about the environment. These unique paths create competitive advantage relative to rivals, increasing firm performance. Second, competitive dynamics research suggests that deviant competitive behavior is difficult for competitors to anticipate or imitate, and therefore decreases the likelihood of counter-attacks that typically destroy the focal firm's advantage. Overall, firms that move out-of-step with rivals gain unique knowledge and resources that create differentiation, sidestep retaliation, and enhance competitive advantage. We hypothesize:

H1: Non-conforming sequences will outperform conforming sequences.

Our second and third hypotheses compare the performance consequences of prototypical sequences. Scholars in the search tradition describe two main rhythmical patterns of moves: regular vs. irregular (Tushman & Romanelli, 1985; Levitt & March, 1988). Firms that follow regular sequences move with a regular rhythm through time. There are two types of regular sequences. In *continuous* sequences, moves are carried out in successive interval-measured steps. In *periodic* sequences, firms alternate between bursts of change and periods of stability (e.g., Tushman & Romanelli, 1985). In contrast, in *irregular* sequences, firms search infrequently and in an ad hoc manner, corresponding to a sudden burst of search surrounded by long periods of inactivity. These patterns – regular (continuous, periodic), and irregular – thus serve as the foundation for our analysis of prototypical sequences and their effects on performance.

In hypothesis 2 we propose that the regular (continuous and periodic) sequences outperform irregular sequences. Prior work suggests that firms learn from the process of carrying out competitive moves by developing routines and knowledge about how to execute particular actions (Young, Smith, & Grimm, 1996). Firms that regularly engage in a particular move, such as market entry, are therefore more likely to have accumulated helpful routines and knowledge. Regularly carrying out a specific move also ensures that relevant knowledge is readily available and applicable, rather than atrophied due to lack of use. Regularity also fosters internal consistency, which further facilitates learning and increases performance. Work on time-paced rhythms in particular shows that regular time-pacing entrains the firm with internal and external cycles and improves performance (Gersick, 1990). By creating consistent rhythms, then, regular sequences allow firms to develop routines, learn from past moves, and better apply prior knowledge. We hypothesize:

H2: Regular (continuous and periodic) sequences will outperform irregular sequences.

In hypothesis 3 we propose a hierarchy of types of regular sequences. In particular, we expect that continuous sequences will outperform periodic sequences. First, continuous sequences create shorter intervals between moves, which allow firms to relate any knowledge and experience gained to similar actions in its recent past. The more recent the prior experience, the greater the likelihood that such inferences are available and applicable. Shorter intervals also allow firms to avoid periods of inactivity, during which routines can atrophy, knowledge can be forgotten, and absorptive capacity can be reduced. Second, increasing the frequency with which a firm engages with its environment makes it more likely that the firm will be aware of significant environmental shifts. Finally, continuous movement creates market disruption that unsettles opponents, allowing firms to exploit more opportunities and close off the potential for rival action. Overall, continuous sequences allow firms to better build on existing knowledge and offer more opportunities to learn, refine routines, and gain competitive advantage. We propose:

H3: Continuous sequences will outperform periodic sequences.

METHOD

Research Setting

We analyze the competitive sequences of 160 firms using data from an experiential simulation called *Markstrat3*. In this simulation participant teams compete in an established (“Sonite”) and new (“Vodite”) market. Teams make a variety of competitive moves over six rounds of play. We focus on *R&D product* and *market entry* moves as significant moves for competitive advantage (Katila et al., 2012).

Experiential simulations such as Markstrat have several advantages. First, simulation controls for many confounding factors, which sharpens and isolates the phenomena of interest, i.e. competitive sequences. Second, the data are uniquely comprehensive, recording all moves by all firms at regular intervals. Third, the outcomes of Markstrat are realistic and appropriately complex. The simulation is based on several decades of theoretical and empirical research and has been shown to provide an accurate description of competition among firms. In fact, practicing managers who have participated in Markstrat identify the simulation’s realism as one of its greatest strengths.

Sample and Data Sources

We conducted the simulation in a core masters class on strategy at a major U.S. university. Groups of three students were randomly assigned to each team, with each student-team constituting a “firm” in our data. We gathered data during eight academic quarters, spanning 1999-2006. The data cover 32 industries (i.e., runs of the simulation) and 160 firms (i.e., five firms per industry). The average age of participants is 24 years old. Most have at least two years of work experience.

Sequence and Regression Analysis

To find temporal patterns in competitive moves, we utilize *sequence analysis*, a method that takes sequences as input instead of individual data points. To compare the sequences quantitatively, we further use a sequence analysis algorithm called “optimal matching.” This algorithm calculates the distance between two sequences as the transformation cost of turning one sequence into another through the use of three operations: insertion, deletion, and substitution (Abbott & Tsay, 2000). In our study, we set the insertion/deletion (indel) costs to one, while substitution costs are calculated as absolute differences between the substituted elements.

In our data, we identified four sequences of competitive moves (i.e., Sonite R&D product, Sonite market entry, Vodite R&D product, and Vodite market entry) coded as a count of a given move made over six rounds. For example, an R&D product sequence [2 2 0 0 1 1] shows that the firm made two R&D moves in periods 1 and 2, none in periods 3 and 4, and one in periods 5 and 6. To compare sequences to each other, we generated pair-wise distance matrices that compare sequences of the same type (e.g. compare Sonite R&D to Sonite R&D). We then ran cluster analysis on each distance matrix to group proximate sequences together (Abbott & Tsay, 2000). We generated the clusters by running Ward's minimum variance procedure and employed the Duda-Hart stop test to select the optimal number of clusters. We then used Bluedorn's (2002) conceptualization of temporal depth to characterize each cluster as featuring movement that was primarily early, middle, or late. We validated the clusters using a t-test comparing within versus between-cluster distances. Finally, to aid in interpretation, we identified a typical sequence in each cluster. A cluster's typical sequence is the sequence that has the lowest average distance from the others in the cluster. To test our hypotheses on the performance consequences of prototypical sequences and non-conformity, we used OLS regression.

Measures

Firm performance. Our dependent variables were Sonite and Vodite market share. We measure performance at the end of round six, the last round in our data. As a robustness check, we also test profit and stock price (Katila, 1997, 2007), with consistent results.

Non-conformity with rivals. We compute the average distance between the focal firm's sequence and their four competitors' sequences. A higher average distance from competitors indicates that the focal firm is non-conforming.

Sequence category membership. We apply the following rules to identify typical sequences in each cluster and to distinguish between our three prototypes. *Continuous sequences* feature moves in at least five out of six rounds, or, in at least four consecutive periods. *Periodic sequences* feature moves in two to four rounds, either in an on-off pattern or in three consecutive periods. *Sporadic sequences* include moves only in one period, or, only in two consecutive periods. We create binary indicator variables for each category, with the "no moves" category omitted.

Control variables. To isolate the effects of sequences, we control for the firm's aggregate move repertoire characteristics, namely *move repertoire diversity*, and *move repertoire timing.* We also control for starting position with *initial firm size*. At the industry level, we control for *industry growth, demand diversity* (diversity of market segments served), and *industry rivalry* (number of moves by competitors).

RESULTS

To test hypothesis 1 on conformity, we regress performance on distance from competitors. In three out of four cases, the coefficient on distance is positive and significant, indicating that firms with non-conforming sequences perform better. Overall, then, we find support for hypothesis 1. For each unit of distance (essentially equal to one non-conforming move), firms increase market share by 3-5%. This positive effect of non-conformity is intriguing given that prior work has suggested that firms' sequences should confirm rather than misalign with those of their rivals (e.g., Ancona & Chong, 1996 on institutionalized norms and practices). Our results show that when we focus on sequences of competitive strategy moves (i.e., R&D product development and market entry) rather than institutionalized practices and norms, conformity with competitors is harmful rather than performance-enhancing.

In hypothesis 2 we propose that regular (continuous and periodic) sequences are higher-performing than irregular sequences. To test this hypothesis, we regress performance on dummy variables for regular sequences. Regular sequences have a positive and significant effect on market share for Sonite R&D, Vodite R&D, and Vodite market entry. In Sonite R&D, regular sequences increase market share by 8%, while in Vodite market and R&D, the effects of regularity are particularly substantial, increasing market share by 20-21%. The only exception is Sonite market entry where the coefficient on regular sequences is positive but not significant. Again, hypothesis 2 received strong support.

Finally, in hypothesis 3 we proposed that continuous sequences are more performance-enhancing than periodic sequences. To test this hypothesis, we regress performance on dummy variables for continuous, periodic, and irregular sequence membership, and then run an F-test to compare each pair of continuous and periodic coefficients. This allows us to test whether the coefficient on continuous sequences is significantly different than the coefficient on periodic sequences. We find strong support for hypothesis 3 for R&D sequences, but not for market sequences. The F-statistic for Sonite R&D is 4.28 with a p-value of 0.04. The F-statistic for Vodite R&D is 2.82 with a p-value of 0.09. Thus, continuous R&D sequences have a significantly greater positive effect on performance than periodic sequences in both the established and new markets. Overall, then, hypothesis 3 is supported for R&D but not for market sequences. Finally, it is worth noting that competitive sequences are more significant predictors of high performance in Vodite compared to Sonite, thus suggesting that the choice of competitive sequence may be more important when firms compete in an emerging product market compared to competing from an entrenched position in an established industry. Full descriptive statistics and regression tables are available from the authors.

DISCUSSION

In this paper, we explored competitive sequences, i.e. time-paced patterns in competitive moves made by a focal firm. We found that competitive sequences cluster around a few prototypical patterns, and that firms that carry out certain types of sequences and do so in a manner that does not conform to the behavior of competitors perform better. We thus make several contributions to the competitive dynamics and evolutionary learning literatures.

First, we show that a sequence approach to competitive dynamics yields valuable new insights in understanding competitive behavior. Competitive behavior follows rhythmic patterns that can be observed systematically over time, and an analysis of sequences of competitive moves through the lens of those three archetypes adds explanatory power beyond the traditional characteristics of competitive move repertoires, such as timing and diversity. Specifically, we find that regular sequences are consistently higher-performing than irregular sequences, and that continuous sequences often outperform periodic sequences, especially in R&D.

Second, we expand the scope of competitive dynamics to include R&D activities. Extant work in competitive dynamics has typically focused on market-oriented moves, such as price changes and advertising campaigns. As a consequence, internal moves such as R&D investments have received less attention, despite their importance to effectively competing with rivals, particularly in high technology industries. However, our results show that R&D sequences are particularly intriguing because their performance effects are different from those of market sequences.

Finally, we contribute to an emerging line of work on competitive sequences that has primarily focused on sequences at the level of individual firms but only rarely compared them across firms. Our findings on conformity are intriguing: firms whose sequences conform to those of their competitors have lower, rather than superior, performance. By providing evidence about non-conformity and its performance benefits we thus contribute to recent work in learning and search that argues for the need to incorporate competition (Katila & Chen, 2008).

Overall, our analysis addresses a substantial gap in strategy research regarding how longitudinal patterns of firm behavior influence performance. Competitive sequences represent distinctive paths of firm activity that differentially impact performance. Making the right series of moves over time facilitates effective search, learning, and the development of routines, thereby increasing the returns to future competitive activity. We have therefore extended the literature to offer a new way to analyze competitive moves that is complementary to existing work in competitive dynamics.

REFERENCES

Abbott, A., & Hrycak, A. 1990. Measuring resemblance in sequence data: An optimal matching analysis of musicians careers. ***American Journal of Sociology***, 96(1): 144-185.

Abbott, A., & Tsay, A. 2000. Sequence analysis and optimal matching methods in sociology. ***Sociological Methods and Research***, 29(1): 3-33.

Ancona, D. G., & Chong, C. 1996. Entrainment: Pace, cycle, and rhythm in organizational behavior. In L. L. Cummings & B. M. Staw (Eds.), ***Research in Organizational Behavior***, Vol. 18: 251-284, Greenwich, CT: JAI Press.

Bluedorn, A. 2002. ***The Human Organization of Time***. Stanford University Press.

Gersick, C. J. 1994. Pacing strategic change: The case of a new venture. ***Academy of Management Journal***, 37(1), 9-45.

Katila, R. 1997. Technology strategies for growth and innovation - A study of biotechnology ventures. In Reynolds, P. et al. (Eds.), ***Frontiers of Entrepreneurship Research***: 405-418. Waltham, MA: Babson College.

Katila, R. 2007. Measuring innovation performance. In Neely, A. (Ed.), ***Business Performance Measurement – Theory and Practice***, 304-317. Cambridge, UK: Cambridge University Press.

Katila, R., & Chen, E. L. 2008. Effects of search timing on innovation: The value of not being in sync with rivals. ***Administrative Science Quarterly***, 53: 593-625.

Katila, R., Chen, E. L., & Piezunka, H. 2012. All the right moves: How entrepreneurial firms compete effectively. ***Strategic Entrepreneurship Journal*** 6(2): 116-132.

Levitt, B., & March, J. G. 1988. Organizational learning. ***Annual Review of Sociology***, 14(1), 319-338.

Tushman, M., & Romanelli, E. 1985. Organizational Evolution: A Metamorphosis Model of Convergence and Reorientation, in L.L. Cummings and B.M. Staw (Eds.), **Research in Organizational Behavior**, Vol. 7: 171-222, Greenwich, CT: JAI Press.

Young, G., Smith, K. G. & Grimm, C. M. 1996. “Austrian” and industrial organization perspectives on firm-level competitive activity and performance. ***Organization Science***, 7(3): 243-254.