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NONRESPONSE AND DELAYED RESPONSE TO COMPETITIVE MOVES: THE ROLES OF COMPETITOR DEPENDENCE AND ACTION IRREVERSIBILITY

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Competitive moves that are unchallenged or to which response is delayed are important weapons in a strategist's arsenal, so variables that discourage or delay response are of great interest. Using a game theoretic framework, this study investigated the effects on dimensions of competitive response of competitor dependence on a market under attack and the irreversibility of an aggressor's move. The hypothesized relationships were tested with data on competitive moves by U.S. airlines. The results suggest that competitor dependence depresses chances of nonresponse and increases response delay and the likelihood that a responder will match a move. Action irreversibility generally has the opposite effect. In addition, the interaction of competitor dependence and action irreversibility is significant. Analyses of the performance implications of competitive exchange indicated that attackers and early responders gain market share at the expense of late responders and nonresponders.

Firms constantly undertake offensive and defensive actions in their struggle for competitive advantage. Therefore, a basic knowledge of the drivers of competitive rivalry is of paramount importance to strategic management (Chen, 1988; Chen, Smith, & Grimm, 1991; MacMillan, McCaffery, &

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Van Wijk, 1985; Porter, 1980, 1985; Smith, Grimm, Gannon, & Chen, 1991). However, except for the few preliminary investigations cited, almost no attempt has been made to examine directly actual competitive interaction.

As Porter (1980) noted, the ultimate effectiveness of any competitive action depends largely on whether that action goes unchallenged, or, if it does not, on whether the response is delayed; a firm generally benefits most from moves that prevent or delay response.[1] An important issue for strategists, then, is the degree to which they can predict whether a competitive move will go unchallenged.[2]

Game theory is particularly useful for framing such predictions because game theoretic decisions are based on selecting optimal strategies according to the interdependency of the payoffs to both players (Weigelt & MacMillan, 1988). In actual strategic decision situations, the incompleteness of information about payoffs often hampers players, who must therefore make competitive decisions on the basis of estimates of the distribution of payoffs for their opponents. In such circumstances, strategists should welcome any vehicle that significantly reduces the variance of this assumed distribution. This research identified two important yet largely unexplored variables that may play such a role in variance reduction: (1) a competitor's dependence on the markets affected by an action and (2) the irreversibility of a competitive action.

The research had as its unit of analysis the basic building block of competitive interaction, the action-response dyad. The study attempted to explore some fundamental, yet unanswered, questions in competition: Why do some actions fail to elicit responses from competitors, but others provoke rapid responses? When responses do occur, can delay be predicted, and will the challenge match the action or be an escalation?

Drawn from an extensive review of competition in the airline industry, this study used irreversibility of action and competitor dependence to predict the following dimensions of response: (1) the likelihood of nonresponse from a given competitor, (2) response delay, and (3) the likelihood that a response will match an initial move.

THEORETICAL FRAMEWORK AND HYPOTHESES

This study responds to Caves's appeal for research focusing on "rivalrous moves among incumbent producers" (1984: 127). Despite this appeal, only a few attempts have been made to study empirically the issues that shape actual exchanges of action and response, and these studies have con-

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[1] An obvious exception is the price leadership signal used to encourage competitors to raise prices too.

[2] Of course, it is possible that an action will fail to elicit a response because competitors view it as a poor strategic decision. It is equally possible that failure to respond may itself be a poor strategic decision. We did not assume that all actions and responses will lead to successful outcomes.

fined their focus to actions that provoked responses. In a study of competition in the banking industry, MacMillan and colleagues (1985) found that "organizational inertia" delayed competitive response, but "strategic challenge" accelerated it. Using comprehensive data on airline competition, Chen and colleagues (1991) showed that actions that require substantial implementation effort delay a rival's retaliation. Implementation effort is related to an attacker's degree of commitment and is part of a broader notion of irreversibility examined in the present study.

Employing the airline data base at the organizational level, Smith and colleagues (1991) suggested that such organization-related variables as strategic orientation, unabsorbed slack, and structural complexity can explain the general response profile of a firm, its proclivity to react and to imitate, and average response delay and order. Firms' response behavior over time was also found to relate, albeit marginally, to their organizational performance.

Unlike most previous research, which has been conducted at the organizational level, this study restricted its focus to the fundamental level of actions and responses. Underlying this work is a belief, consistent with Caves's appeal, that if scholars are ever to understand the complexity of competitive rivalry, it is important to move the level of analysis down to the basic building block of competition—the competitive action-response dyad. At this very fundamental level, competitors face decision choices whose payoffs are a function not only of what they decide to do, but also of what their opponents decide to do. The action-response dyad is theoretically consequential because it is at this level that actual competitive engagement occurs, in which competitors enact their strategies, test their opponents' mettle and capabilities, defend their reputations, and signal their toughness, via their responses or lack of responses.[3]

The current study represents a refinement and extension of Smith and colleagues' (1991) article and responds directly to their suggestions for future research.[4] Specifically, this research differs from, and complements, Smith and colleagues in two aspects: (1) it investigates competitive actions from a more fundamental and game theoretic level of analysis, and (2) in pursuing a game theoretic approach, it includes both actions that did not provoke response and those that did.

Understanding Action-Response Dyads

The studies cited above focused exclusively on actions that provoked responses, leaving the strategically more important issue of nonresponse unaddressed. Of crucial interest are situations in which a competitive move

[3] In game theory terms, the action-response dyad is where signals of true type are exchanged.

[4] Although some of this study's measures appear similar to those of Smith and colleagues, we focused on an entirely different level of analysis, exploring different theoretical questions and constructs.

goes unchallenged and the aggressor is allowed to make a move that provokes no, or minimal, response.

From the point of view of a strategist, it is important to understand the conditions that will allow a firm to make a competitive move that will be beneficial if there is a lack of, or a delay in, response (Porter, 1980). Whether or not this situation will occur is determined by the payoffs of both the firm that made the move and the firms that could respond. The interdependence of the payoffs associated with competitive moves and countermoves is a fundamental assumption in game theory (Axelrod, 1984; Rasmusen, 1990; Weigelt & MacMillan, 1988). A study of the capacity expansion process in the corn wet-milling industry illustrated this interdependence (Porter & Spence, 1982).

In recent years, game theory approaches have considerably expanded academic understanding of strategic decision making in the face of potential competitive responses, but these investigations have generally been made under strict assumptions of complete information. In the more general case of incomplete information, both strategists and strategy researchers must find ways to estimate the distribution of payoffs for opponents; any technique that can be used to decrease the variance of the estimated distributions of payoffs should be valuable. Weigelt and MacMillan (1988) illustrated how a game theory framework can help to structure and analyze a competitive situation in which information is incomplete. As Camerer (1990) pointed out, such a framework provides a taxonomy useful in helping competitors understand critical variables and identify those that can be used as indicators of actual payoffs. We used such a game theoretic framework to lay out the structure of the action-response decision.

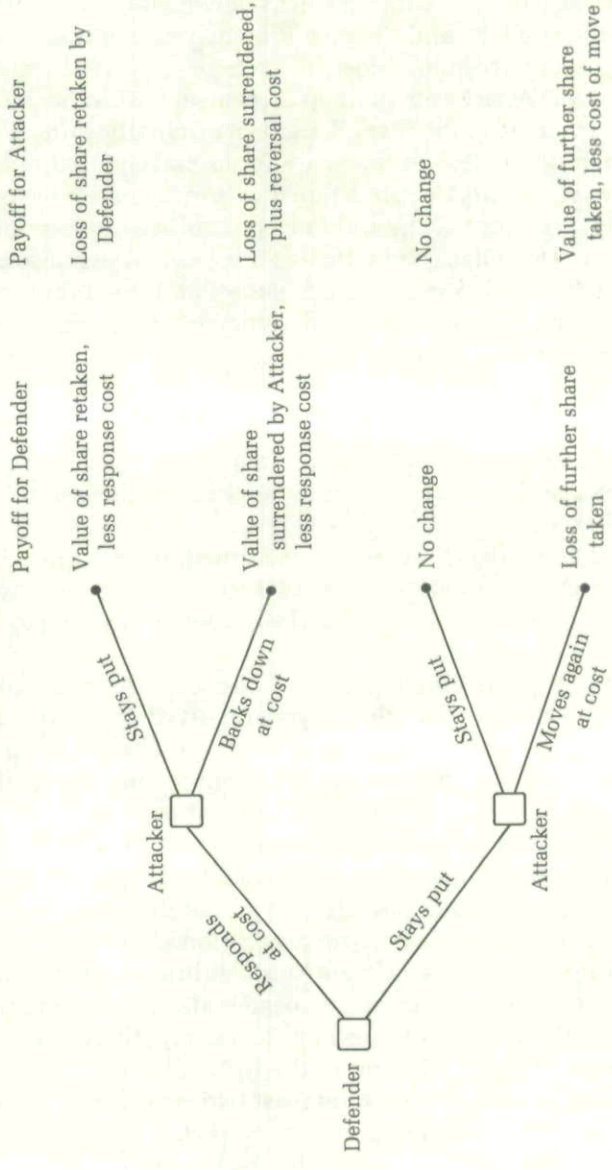
Illustrative Action-Response Game

Figure 1 illustrates a two-person game in which two competitors, Attacker and Defender, are exchanging competitive moves.[5] In predicting whether or not a competitor will respond, it is necessary to assume that Attacker has already made a move in which it has invested a certain initiating cost and has gained market share at the expense of Defender. The value of the share in question will not necessarily be the same to both Attacker and Defender. (The reason for specifying market share instead of simply specifying a payoff will become apparent below.) Defender must now decide whether to respond, aware that if it does not Attacker may make a second move. If both Defender and Attacker stay put, there is no change in the payoff for either of them.[6] However, if Attacker does make a second move, again

[5] Actual competitive situations normally involve many players. The argument is not materially affected, however.

[6] Implicit in this argument is the understanding that the cost associated with a move is sunk once the move is made and should not enter a player's decision about future moves. That is, once Attacker has made the attacking move, a new competitive era begins. Defender and Attacker should both consider their best strategies and interests from that point on.

FIGURE 1
Game to Illustrate Defender's Problem



incurring an initiating cost, it gains further share from Defender.

If Defender wants to head off a second attack, it must incur a response cost. Now, if Attacker stays put after the response, Defender will retake a certain market share, so the payoff will be the value of the share retaken, less the response cost. If Attacker backs down, Defender entirely regains the share it initially lost, and the payoff is the value of the share surrendered by Attacker less the response cost.[7]

However, Attacker may incur a reversal cost in backing down, in addition to surrendering the market share it originally gained. Attacker's payoff would then be the loss of the share it has surrendered to Defender plus the reversal cost. Figure 1 depicts the situation Defender faces. (For the sake of simplicity, we ignored the unlikely possibility of a second move against a response by Defender or of Attacker's backing down against no response.)

In the framework of this game situation, three problems arise that need to be addressed in studying and understanding competitive exchange in actual strategic situations.

Estimating Payoffs

To develop a game theoretic solution in real exchange situations, a strategy researcher needs to know the actual values of the payoffs for both the attacker and defender, or more realistically, to assume that the competitors are making decisions with incomplete information. Under conditions of incomplete information, it is hard to tell what the payoffs are for each competitor or to assess the probabilities each will assign to the other player's strategies.

Price moves are clearly a special case of estimating payoffs. Even in the absence of cost data about the players involved, it is much easier for both an attacker and a defender to estimate the marginal effects of price changes than those of other competitive moves. Therefore, any study of action-response characteristics should take special account of price moves, an idea further explored below. For other types of competitive moves, the estimation of payoffs and probabilities is more intractable, so some practical surrogates are necessary for estimating payoffs and probabilities.

This leads to our first research question: Are there variables that can be used to indicate the payoffs and probabilities of each player's strategies? Such variables would act as surrogates allowing estimation of whether a defender will decide not to respond to a competitive move, thereby conceding immunity from retaliation to the initiator.

Relevant research suggests at least two such variables: a defender's competitor dependence on the market or markets under attack, and the irreversibility of the competitive move launched by an attacker.

Competitor dependence. In the illustrative game shown in Figure 1,

[7] The case in which Defender recovers less than the original share does not change the argument.

Defender, in deciding whether or not to react, must balance the payoff for not responding against the payoff for doing so. Defender has several options here: Depending on the estimated probabilities of Attacker backing down or staying put if Defender responds, Defender must select a strategy to optimize the payoffs.

In every case, except that in which Attacker and Defender both stay put, the share to be gained or lost by Defender is a major determinant of Defender's payoff. Defender's decision about response is thus very sensitive to its dependence for revenues and profits on that part of its total markets that the move has attacked. The more Attacker's move affects Defender's key markets, the greater the payoffs involved for Defender. This reasoning suggests that in the absence of actual payoff data, strategy researchers can use competitor dependence as a surrogate.

Previous research supports employing competitor dependence in anticipating competitive responses. Competitors are generally motivated to respond and to make quicker and stronger responses if they view an action as a threat to important markets (Chen et al., 1991; Dutton & Jackson, 1987; MacMillan et al., 1985; Porter, 1980).

In estimating the likelihood of nonresponse, obviously the reverse applies—low dependence increases the likelihood that Defender will decide not to respond. Hence,

> *Hypothesis 1a: The greater a defender's dependence on the markets under attack, the lower the likelihood of nonresponse.*

Irreversibility. Less obvious, yet potentially just as important as competitor dependence in shaping response, is the irreversibility of an attacker's original move. If Defender in Figure 1 in fact responds, Attacker will back down only if it stands to lose more from Defender's response than it does from surrendering the share it originally took. However, in backing down, Attacker incurs a reversal cost. So the greater the cost of reversing a move, the more likely it is that Attacker will stay put.[8] Further, the more aware Defender is that the reversal cost is high, the more aware it will be that Attacker is unlikely to back down. Therefore, the cost to Attacker of reversing its move is a signal to Defender of Attacker's commitment not to back down and to play tough. Attacker's "true type" (Rasmusen, 1990)—its strategic and behavioral characteristics—can never be fully known without Attacker honestly disclosing this information, an act that is not in its interest and therefore unlikely to occur. Defender therefore must seek signals from Attacker's past or current behavior to infer Attacker's true type. The less certain Defender is of Attacker's true type, or of how fiercely it can be

[8] Even if Defender assumes that the value of the share surrendered by Attacker is negative, the reversal cost increases the right-hand side of the inequality and therefore depresses the likelihood of Attacker's backing down.

expected to defend its interests, the more important irreversibility is as a signal that Attacker intends to play tough.

In the absence of complete information, the cost to Defender itself of reversing such a move is an important estimate of Attacker's reversal cost. The more similar Attacker is to Defender in terms of their scopes of operations, strategies, asset and work force profiles, market shares, degrees of diversification, and so on, the more comfortable Defender can be with using its own costs as a proxy for Attacker's cost structure. Thus, when Attacker and Defender are similar, the more irreversible a move is for Defender, the more irreversible it is likely to be for Attacker, and the more such an irreversible move by Attacker signals its commitment not to back down.

Thus, the irreversibility of any competitive move should be taken into account when predicting responses to a competitive action, since it serves as a credible signal of commitment to the course of action an attacker has undertaken. Schelling (1960) argued that when competitors can make damaging countermoves, one key to success is the aggressor's apparent commitment to an action. In support of Schelling's argument, Porter noted: "Perhaps the single most important concept in planning and executing offensive and defensive competitive moves is the concept of commitment. . . . The persuasiveness of a commitment is related to the degree to which it appears binding and irreversible" (1980: 100–101). This argument is also consistent with Porter and Spence's (1982) research on preempting entry in the corn wet-milling industry.

Clearly, some actions are easier to change or reverse than others, since there are multiple sources of irreversibility: economic, institutional, organizational, psychological, and political. Both economists (e.g., Lieberman, 1987; Spence, 1977) and organization theorists (e.g., Staw, 1981) have emphasized such tangible asset-investment components of irreversibility as capacity and capital cost, so a competitive move involving major expenditures is considered more irreversible than other moves. However, irreversibility can go beyond simple economic investment; an action is highly irreversible if it creates legal or moral obligations to other parties, involves a significant degree of interdepartmental coordination or disruption of systems and procedures in an organization (MacMillan et al., 1985), or is formally approved or announced by senior management or otherwise put in "the social context" of the organization (Salancik, 1977: 408). If the reversal of a competitive move will affect the existing political equilibrium in an organization, the move is more irreversible than it would be otherwise.

Whatever its source, the irreversibility of an action can significantly shape competitors' response behavior since it acts as a strong signal of the true type (toughness) of an attacker. Well noted in the relevant literature but empirically untested is Porter's remark: "If the firm can convince its rivals that it is committed to a strategic move it is making or plans to make, it increases the chances that rivals will resign themselves to the new position and not expend the resources to retaliate or try to cause the firm to back down. Thus, commitment can deter retaliation" (1980: 101). To sum up, the irreversibility of a move can signal commitment, and therefore, the likelihood that a defender will elect not to respond to a competitive move by an attacker is shaped in part by the move's irreversibility.

> *Hypothesis 1b: The more irreversible an action, the greater the likelihood of nonresponse.*

In addition to main effects, competitor dependence and irreversibility may generate an interaction effect. Specifically, recent work on reputation effects (Camerer & Weigelt, 1988; Weigelt & Camerer, 1988) has suggested that an action's degree of irreversibility will moderate the hypothesized relationship between competitor dependence and the likelihood of nonresponse. Those authors showed that under conditions of incomplete information, strong incumbents in a market segment have a vested interest in demonstrating their toughness, in order to discourage others from seeking to increase share in that segment. So when an attacker has made a highly irreversible move in a market that is very important to a defender, it becomes crucial for the defender to signal a willingness to fight, even if the attacker has signaled a willingness to play tough. If the defender does not counterattack, it runs the risk of losing its reputation of willingness to fight for its key markets, thus encouraging further attacks, both from the original attacker and others.

Simply put, although the irreversibility of a competitive move generally increases the likelihood of nonresponse, if a highly irreversible attack is made on markets on which a defender is very dependent, the lines of battle have been drawn for a major market contest, and a counterattack by the defender is called for to protect its position and reputation. Therefore, the likelihood of nonresponse will be low when dependence and irreversibility are both high.

> *Hypothesis 1c: Although the likelihood of nonresponse will generally increase with an action's irreversibility, when high irreversibility and high dependence occur together, this positive relationship will be reversed, and the likelihood of nonresponse will decrease.*

Response Delay

The second problem that arises in developing a game theoretic solution in real exchange situations is the need to take response delay into account. In the game situation shown in Figure 1, if Defender does decide to challenge the move, the time it takes to respond is also a consideration. If Attacker makes a move that gains share and Defender delays its response, then Attacker can generate profits from its gain in share for as long as Defender hesitates. If this period of temporary share gain results in a payoff, then as long as this payoff is greater than the potential reversal cost, Attacker can at a minimum make the move, then back down once Defender reacts.

Thus, response delay is important in that it represents a period during which an initiator reaps the economic benefits of an action,[9] provided the action is effective (Ansoff, 1984; Chen, 1988; Hambrick & Mason, 1984; MacMillan et al., 1985; Porter, 1980; Smith, Grimm, Chen, & Gannon, 1989). As Porter pointed out, "Finding strategic moves that will benefit from a delay in retaliation, or making moves so as to maximize the delay, are key principles of competitive interaction" (1980: 98).

Several empirical studies have shown the payoff implications of response delay. Studying firms responding to various competitive actions in the electronics industry, Smith and colleagues (1981) found a negative relationship between the length of time a firm took to react and its performance. Mansfield (1968) also found that the length of time a firm waited before using a new technique developed by a competitor tended to be inversely related to the profitability of its investment in the innovation. Similarly, Damanpour and Avian (1984) found an inverse relationship between organizations' delay in adopting new technical and administrative ideas and the performance of those organizations.

Furthermore, both Schelling (1960) and Axelrod (1984) drew attention to the fact that response time has important signaling properties—the longer the delay between an action and a response, the less clear the "power" of the signal. The connection between action and response is less obvious than it would be with no or little delay. This point leads to the second research question: When nonresponse is unlikely, can the variables used to estimate likelihood of nonresponse also be used to estimate delay in response?

The same logic used to develop the predictions for the likelihood of nonresponse should be applicable here: both competitor dependence and action irreversibility should influence the eagerness and hence, the speed, with which a competitor will respond.

First, it is likely that competitors will hasten to defend markets they depend on:

> *Hypothesis 2a: The greater a defender's dependence on the markets affected by an attacker's action, the quicker its response will be.*

On the other hand, if an attacker makes a very irreversible move, the defender faces the problem that the attacker is now highly committed to stay the course. This situation suggests that if the defender does elect to countermove, it will be circumspect about reacting and is likely to spend some time conceiving and generating an appropriate countermove.

Chen and colleagues (1991) demonstrated empirically that actions involving a significant "implementation requirement," as measured by the length of time it takes to execute them, are positively associated with com-

[9] This scenario excludes cases in which a competitor is attempting a price leadership signal by raising prices to encourage others to do likewise. In such a case, a response delay is undesirable from the initiator's point of view.

petitors' response delay. Implementation requirement, which is related to an attacker's degree of commitment to a course of action, led to the broader notion of irreversibility under examination here.

> *Hypothesis 2b: The more irreversible an action, the longer a defender will take to respond.*

Competitor dependence and irreversibility may also create an interaction effect for response delay, with the hypothesized relation between competitor dependence and response delay moderated by irreversibility. Although in general, we would expect high irreversibility to delay response, if a highly irreversible attack is made in markets on which a defender is very dependent, there are at least two reasons for a rapid response: (1) pressure on the defender to defend its reputation (Camerer & Weigelt, 1988; Weigelt & Camerer, 1988) and (2) need to act quickly to ensure that the signal has maximum impact and power (Axelrod, 1984; Schelling, 1960). Thus, response delay will be especially short when both dependence and irreversibility are high.

> *Hypothesis 2c: Although response delay will generally increase with increasing irreversibility, when high irreversibility and high dependence occur together, this relationship will be reversed, and response delay will decrease.*

Matching Response

The third problem in applying game theory to real-world competitive exchanges is the need to assess the likelihood of the special case of a matching response. In the situation Figure 1 illustrates, Defender could undertake a large array of strategies, each of which obviously could be depicted by another branch in the diagram. However, one particular kind of countermove is worth special attention: the matching move, in which Defender simply duplicates the action of Attacker. Matching a move is a powerful signal in its own right (Schelling, 1960), indicating a commitment to defend the status quo, neither giving up position nor escalating the competition into mutually destructive "warfare." Therefore, we posed the following research question: Can the same variables used to predict nonresponse also be used to estimate the likelihood that competitors will exactly match a move that elicits a response?

The same logic used to develop the hypotheses for nonresponse and response delay also applies here, suggesting that a defender with a high dependence on affected markets will tend to match an initial move to signal commitment to defend its markets, but that the greater its dependence, the more it will be inclined to match the move so as to avoid escalation.

> *Hypothesis 3a: The greater a responding defender's dependence on the markets affected by an attacker's action, the higher the likelihood that it will directly match the action.*

The irreversibility of a move should also play an interesting role here: if a highly irreversible attack is made on a market on which a defender is highly dependent, there is great pressure on the defender to protect its reputation by responding, as we argued above. However, there is also a great incentive for the defender to do so in such a way as not to escalate hostilities. Thus, the likelihood of a matching move will be especially high in this situation. We would expect the interaction of irreversibility and dependence to be important in explaining the likelihood of a matching response.

> *Hypothesis 3b: The likelihood of a matching response will increase as dependence increases, and when high irreversibility and high dependence occur together, this positive relation will be augmented.*

Price Moves

The final problem for our analytic framework was the need to recognize the distinctive informational content of price moves. As we have argued, the difficulty competitors face when considering moves and countermoves in situations of incomplete information is that they do not have sufficient data with which to estimate payoffs and hence, probabilities. Also, when it comes to estimating payoffs, price moves are a special case because they impart much more information than other moves. Since price changes directly affect a business's bottom line, it is much easier to estimate their impact on the profits of both an attacker and a defender than it is to estimate the impact of other types of competitive moves.[10] Because of their immediate visibility and the ease with which their effect on market share can be determined, price moves tend to be more provocative than other kinds of moves.

> *Hypothesis 4: When an action is a price move, (a) the likelihood of nonresponse will be lower, (b) response delay will be shorter, and (c) the likelihood of a matching response will be greater than will be the case with other types of moves.*

RESEARCH METHODS

Data

The data for this study concerned the competitive moves exchanged by the 32 U.S. airlines with annual operating revenues over $100 million that were reported in *Aviation Daily* between the years 1979 and 1986. Our data collection method was similar to that of Miller and Friesen (1977); Jauch, Osborn, and Martin (1980) called this method "structured content analysis."

[10] If sales volumes are reported or can be estimated, and if we have rough estimates of price elasticities, it is possible to make a fairly good estimate of how much a price change will affect the profits of each competitor. Moves not involving price are much more difficult to fathom than price moves because the cost structures of the players are seldom known.

The method also resembles Harrigan's (1980) chronological identification of specific endgame strategic moves taken by firms in declining industries.

The U.S. domestic airline industry was used not only because of its acknowledged competitiveness and rigidly defined boundary, but also because it offers a clearly identifiable set of competitors and a rich source of public information. In addition, the potential influence of the corporate-business relationship on intraindustry competition is low, since almost all airlines are single or dominant-business firms (Rumelt, 1974).

After a survey of various publications, we concluded that *Aviation Daily*, a 50-year-old industry journal, offered the most complete and detailed information on airline competition. Since this publication functions as an industry mouthpiece intended to report objectively airlines' announcements and actions, our potential concern over post hoc rationalization of competitive moves was minimized. Personal interviews with several airline executives and industry analysts confirmed this conclusion.

Identification of Actions and Responses

Competitive moves were identified through an extensive eight-year review of every issue of *Aviation Daily*. This study examined almost all market moves; we excluded internal actions like organizational restructuring. To assure further the strategic significance of price actions, we included only those with a change magnitude greater than 10 percent.

A major challenge in studying competitive interaction is objectively identifying competitive responses (Chen et al., 1991; MacMillan et al., 1985; Smith et al., 1991). We distinguished responses from ordinary actions by searching out such key words in *Aviation Daily* as "in responding to," "following," "match," "under the pressure of," and "reacting to."[11] For example, *Aviation Daily* reported that "*under the pressure of* American Airlines' planned [Nashville] hub creation . . . Piedmont revealed a statewide expansion program in Florida" (July 10, 1985). Thus, Piedmont's Florida expansion was identified as a response to American's hub creation.

Competitive interaction constitutes a complex and dynamic process. The method used was extremely rigorous in tracing actions and responses and in identifying the initial action in a sequence. Step one involved reading chronologically through *Aviation Daily*, searching for all market moves, both actions and responses. Then, to connect all responses to their initial actions, we worked backward through issues of *Aviation Daily*, starting with December 31, 1986, and ending with January 1, 1979. Employing the key word method described above, we first identified responses and then traced back to find the reporting of the initial actions. An important strength of the

[11] Certainly, a set of similar competitive moves may be motivated by a common industry change rather than by one another. To exclude such moves from the study, we supplemented the key word search method described in the text with additional analysis. Thus, the data include only confirmed action-response pairs. We thank an anonymous reviewer for bringing this issue to our attention.

method lies in its ability to identify every initial action and all responses to it reported in *Aviation Daily*.

The total data set consisted of 856 actions, 103 of which provoked at least one response, and 203 responses.[12] To test the accuracy of the information published in *Aviation Daily*, we drew a random subgroup of 20 moves and tried to find evidence of them in other major business publications and newspapers. We thus cross-validated 17 moves; the high degree of confirmation (85%) indicates the reliability of the data.[13]

The first author and three doctoral students in the field of strategy then classified all the actions and responses into the 13 generic types presented in Table 1.

Measurement

Competitor dependence was defined as the extent to which a competitor relies on the markets affected by an action. We first identified the competitors affected by each action for the airlines providing service in at least one studied airport affected by the action. The airports studied were the 37 U.S. "large air traffic hubs" as defined by the U.S. Department of Transportation. The competitor dependence of an action for each affected competitor was defined as the proportion of the passengers served by an airline in the year an action was taken affected by the action. For example, if an airline served 250,000 passengers in a particular year, of whom 50,000 were affected by an action, we assigned a competitor dependence measure of 0.2 to this airline for this action. All required data were drawn from the Department of Transportation's *Airport Activities Statistics of Certified Route Carriers*.

The *irreversibility of competitive moves* was assessed using a questionnaire mailed to 430 senior airline executives and experts. We constructed the mailing list primarily from the winter 1989 edition of *World Aviation Directory*. The respondents represented the highest-level executives and experts associated with the airline industry.

Of 430 questionnaires distributed, 177 were returned (a 41 percent response rate), of which 176 were usable. The ten-page questionnaire was substantially pretested and professionally produced. A personalized letter guaranteed the confidentiality of the responses, and two follow-up mailings were sent to initial nonrespondents. These practices may account for the 41 percent response rate, considered high for any kind of mail survey (Warwick & Lininger, 1975) and, in the opinion of industry experts, exceptionally high for a survey in airline-associated industries.

A statistical comparison of respondents and nonrespondents indicated they did not differ in such surface characteristics as firm size, industry

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[12] This study shared the data base Smith and colleagues (1991) used for actions provoking responses; however, we also included 753 actions that did not provoke responses.

[13] The accuracy of the data reported in *Aviation Daily* is illustrated further by the fact that corporate executives at the level of senior vice president or higher formally announced 45 percent of the competitive moves from two years' data.

TABLE 1
Types of Competitive Moves and the Dimensions Used to Assess Irreversibility

Moves	Irreversibility Index[a]	Irreversibility Dimensions
Price cut	2.660	Amount of financial investment required for implementation
Promotion	2.067	Amount of management effort required for implementation
Service improvement	2.276	Degree of disruption of staff, systems and/or procedures caused by implementation
Increase in commission rate for travel agents	2.464	Degree of bureaucratic and regulatory commitment once the move is implemented
Feeder alliance with a commuter airline	3.078	The likely resistance from employees and/or unions to reversing the move
Merger and acquisition	4.528	Degree of support from external parties, e.g., investment banks and regulatory agencies, required for execution
Copromotion with nonairlines	2.016	Likelihood that the move will be publicly announced by top management
Increase in daily departures	2.869	Amount of industry publicity the move would receive
Exit from a route	2.249	Degree to which the move creates obligations to major stakeholders (e.g., suppliers and travel agents)
Entry into a route	2.791	Financial cost of reversing the move
Decrease in daily departures[b]	2.544	Extent to which relocation of staff and/or equipment would be required
Cooperation with another airline	3.078	Likelihood that top management approval would be required
Hub creation	3.934	Degree of interdepartmental coordination required for implementation
		Degree to which facilities other than aircraft used for this move could not be deployed for other purposes should the move be reversed

[a] Respondents rated each dimension on a five-point scale (1, very low; 5, very high) for each competitive move. The index is the average rating of a move across dimensions.

[b] Decrease in daily departures was dropped in the final analysis because of relatively low agreement between our initial classification and those of the industry executives and experts in the supplementary survey.

affiliation, management level, age, functional background, and education level. Overall, respondents had substantial experience in the industry; the average length of industry experience for respondents—excluding academics—is over 25 years. Table 2 profiles the respondents.

The questionnaire requested each respondent to rate on a five-point scale the effect of each of 13 moves along 14 dimensions of irreversibility (see Table 1), such as investment required, organizational disruption, and degree of industry publicity.[14] We constructed a composite irreversibility index for each move by averaging ratings on the 14 items. Table 1 reports index values. The reliability of the irreversibility index yielded a Cronbach alpha of .91, a highly acceptable value (Nunnally, 1978).

To assure the accuracy of the classification scheme further, we asked all respondents except the academics to complete a supplementary short questionnaire. The second survey asked respondents to classify the eight moves we considered to be most easily confused for each other. The questionnaire was completed by 106 experts, yielding a very high response rate of 66 percent; no nonresponse bias was detected. Results show a high level of agreement between the authors' classifications and those of industry executives and experts for seven types of move, with an average confirmation rate of 84 percent. For one move, decrease in daily departures, the agreement rate was a relatively low 65 percent, so we dropped it from analyses.

Likelihood of nonresponse was defined as the estimated probability that an action would not provoke retaliation from a given competitor. If a competitor was reported in *Aviation Daily* as reacting to an action, we identified it as an actual responder. Likelihood of nonresponse thus constitutes a dichotomous variable: 1 represents a competitor who could have responded but did not respond, and 0 represents response.

Response delay was defined as the length of time a responding competitor took to react to an action. It was measured as the number of days between the date a specific action was first reported in *Aviation Daily* and the date that journal first made public the competitor's response to the action.

Likelihood of a matching response was defined as the estimated probability that a responder would imitate an action. This measure was based on the concurrence of the types of an action and a response. If the response was of the same type as the action (for example, a price cut responding to a price cut), we identified it as a matching response.

Statistical Analysis

The 11 hypotheses relate four independent variables (competitor dependence, irreversibility of action, their interaction effect, and price) to three

[14] We carefully selected 13 specific competitive moves reported in *Aviation Daily*, one from each generic type, through a series of pilot studies involving industry experts.

TABLE 2
Selected Characteristics of Survey Respondents[a]

Roles in Airline Industry	Average Years of Industry Experience	Percentage of Respondents
Senior vice presidents or above of major airlines[b]	25	25
CEOs or presidents of regional airlines[c]	24	19
CEOs or presidents of travel agencies[d]	27	12
Presidents and senior vice presidents of aircraft manufacturers[e]	28	3
Consultants[c]	32	20
Security analysts[f]	21	10
Senior managers, Federal Aviation Administration	15	2
Professors and researchers in competitive strategy[g]	not applicable	9
All industry respondents	26	100

[a] $N = 176$.

[b] Major airlines were those with annual operating revenues greater than $100 million.

[c] Airlines and consultants listed in the *World Aviation Directory* were used.

[d] These were the 65 top U.S. travel agencies in terms of revenues.

[e] Firms were Boeing and McDonnell Douglas.

[f] Analysts were those listed in the 1989 edition of *Nelson's Directory of Investment Research* and the October 1989 edition of *Institutional Investor*.

[g] Institutions were those the authors were affiliated with.

characteristics of response. Since the likelihood of nonresponse and the likelihood of a matching response are dichotomous variables, we performed logistic regression analysis, using ordinary least squares (OLS) multiple regression analysis to test the effects on response delay. All these regression equations take the general form of the following equation for likelihood of nonresponse:[15]

$$LN = a_0 + a_1X_1 + a_2X_2 + a_3X_1X_2 + a_4P + e, \tag{1}$$

where

LN = likelihood of nonresponse,
X_1 = competitor dependence,

[15] To reduce collinearity between the interaction term (competitor dependence by action irreversibility) and its component variables, we standardized all except the dependent variables before undertaking the numerical analysis. Table 5 reports the resulting reduction in multicollinearity. Although this process has no effect on the sign and significance of the interaction term, it did allow for a simultaneous examination of the main and interaction effects in the same equation. For details, see Southwood (1978), Gupta and Taylor (1990), and Neter, Wasserman, and Kunter (1990).

X_2 = action irreversibility,
X_1X_2 = the interaction term,
P = price actions,

and

e = the error term.

Significant values in the correct direction for the four regression coefficients a_1, a_2, a_3, and a_4 in Equation 1 would support Hypotheses 1a, 1b, 1c, and 4, respectively.

Table 3 summarizes the hypothesized relationships.

RESULTS

Table 4 gives means, standard deviations, and correlations for all variables used in the regression analyses.

Table 5 presents the regression coefficients and related statistics resulting from testing the hypotheses.

Likelihood of Nonresponse

As indicated in model 1 in Table 5, Hypothesis 1a was supported: the greater a defender's dependence on the markets affected by an action, the greater the likelihood that it will respond to the action. The result for action irreversibility was consistent with Hypothesis 1b: the more irreversible an action, the more likely that a defender will not respond. Findings also supported Hypothesis 4a: price moves are less likely to be immune from defenders' responses than are other moves. The result on the interaction effect was consistent with Hypothesis 1c; there is a significant, negative interaction between competitor dependence and action irreversibility.

The partial differentiation of model 1 with respect to competitor dependence offers further insight on the effect of the interaction of that variable and action irreversibility on the likelihood of nonresponse:

$$\partial(LN)/\partial(X_1) = -.51 - .19\, X_2. \quad (2)$$

TABLE 3
Summary of Expected Relationships

Independent Variables	Likelihood of Nonresponse	Response Delay	Likelihood of Matching Response
1. Competitor dependence	−	−	+
2. Action irreversibility	+	+	not applicable
3. Competitor dependence by action irreversibility	−	−	+
4. Price	−	−	+

TABLE 4
Means, Standard Deviations, and Correlations

Variables	Affected Competitors[a]					Actual Responders[b]					
	Means	s.d.	1	2	3	Means	s.d.	1	2	3	5
1. Competitor dependence	0.35	0.34				0.54	0.33				
2. Action irreversibility	2.64	0.49	−.12***			2.55	0.33	−.07			
3. Price	0.15	0.36	−.05***	.02**		0.46	0.50	−.28***	.29***		
4. Likelihood of nonresponse	0.99	0.11	−.02**	.03***	−.09***						
5. Response delay						14.13	24.27	.23***	.06	−.33***	
6. Likelihood of matching response						0.89	0.32	.15	.09	.27	−.06

[a] $N = 17{,}069$.
[b] $N = 203$.
* $p < .05$
** $p < .01$
*** $p < .001$

TABLE 5
Results of Regression Analysis of Response Characteristics[a]

Variables	Likelihood of Nonresponse: Model 1	Response Delay: Model 2	Likelihood of Matching Response: Model 3	Response Irreversibility: Model 4
Competitor dependence	−0.51***	3.15*	0.82**	0.10*
	(0.07)	(1.70)	(0.28)	(0.04)
Action irreversibility	0.42***	7.32***	0.23	−0.06†
	(0.13)	(2.24)	(0.24)	(0.04)
Competitor dependence by action irreversibility	−0.19**	−4.34**	−0.41*	0.13**
	(0.09)	(1.92)	(0.20)	(0.05)
Price	−0.62***	−8.98***	1.27***	−0.13**
	(0.05)	(1.82)	(0.40)	(0.05)
Constant	4.82	14.16	2.74	2.64
	(0.10)	(1.61)	(0.38)	(0.04)
Adjusted R^2		.15		.56
F		9.64***		7.73***
χ^2	178.63***		32.35***	
N	17,069	203	203	23

[a] Standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$

It can be calculated from Equation 2 that the value of $\partial(LN)/\partial(X_1)$ is 0 when $X_2 = -2.73$. Since we standardized all the independent variables prior to conducting the regression analysis, this finding implies that competitor dependence decreases the likelihood of nonresponse unless irreversibility is less than 2.73 standard deviations below its mean.

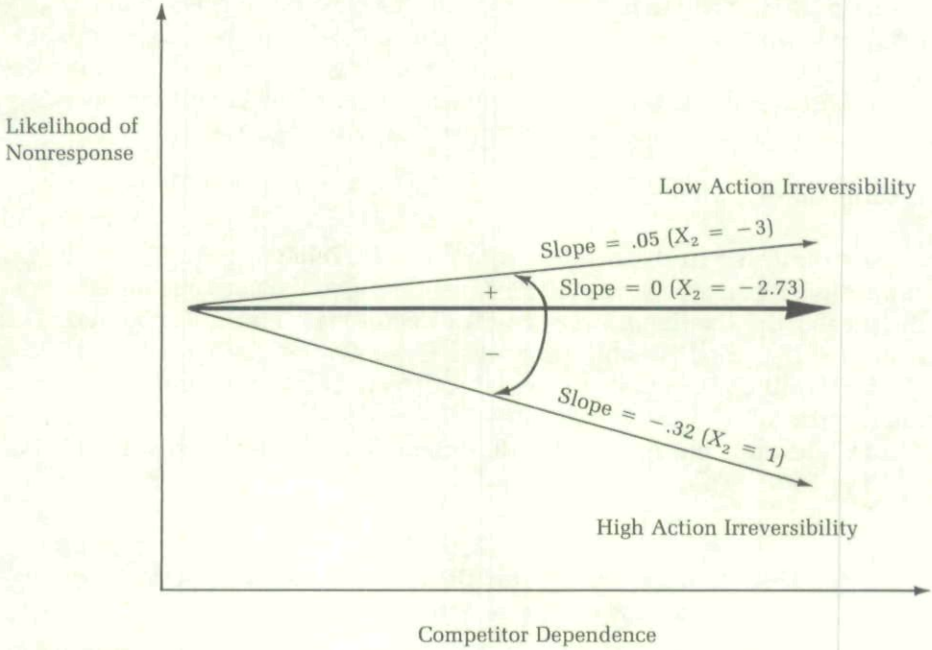
Figure 2 illustrates the implications of the partial derivative expressed by Equation 2. It plots the slope of the relation between competitor dependence and likelihood of nonresponse for different values of action irreversibility.

The moderating effect of irreversibility is demonstrated via Figure 2's three slopes, which vary with the changing values of irreversibility. Increasing competitor dependence sharply decreases the likelihood of nonresponse when irreversibility is high ($X_2 = 1$). The slope remains negative until irreversibility reaches the turning point ($X_2 = -2.73$), when increasing competitor dependence actually starts to increase the likelihood of nonresponse. However, under the assumption of normal distribution, 2.73 standard deviations below the mean is at the 99 percentile. So it is clear from this plot that likelihood of nonresponse increases with dependence only when irreversibility is very low; in general, the likelihood of nonresponse decreases with increasing dependence.[16]

[16] Thus, though the interaction is statistically significant, for all intents and purposes it can be ignored in discussion of the results. This finding is also applicable to the results on the likelihood of a matching response.

FIGURE 2

Relationship Between Competitor Dependence and Likelihood of Nonresponse for Various Levels of Action Irreversibility



Response Delay

As the results for model 2 in Table 5 show, contrary to the prediction of Hypothesis 2a, the finding implies that when a defender's key markets are strongly threatened, retaliation tends to be slow. We examine this unexpected finding at length in the discussion section.

Hypothesis 2b was supported: the more irreversible an action, the longer a defender will take to respond. Hypothesis 4b was also supported: price moves are more likely than other moves to provoke speedy responses.

The result for the interaction effect supported Hypothesis 2c. The partial differentiation of model 2 with respect to competitor dependence offers further insight on this effect:

$$\partial(RD)/\partial(X_1) = 3.15 - 4.34\,X_2, \tag{3}$$

where

$$RD = \text{response delay.}$$

It can be calculated from Equation 3 that the value of $\partial(RD)/\partial(X_1)$ is 0 when $X_2 = 0.73$, which implies that competitor dependence decreases response delay unless action irreversibility is less than 0.73 standard deviations below its mean.

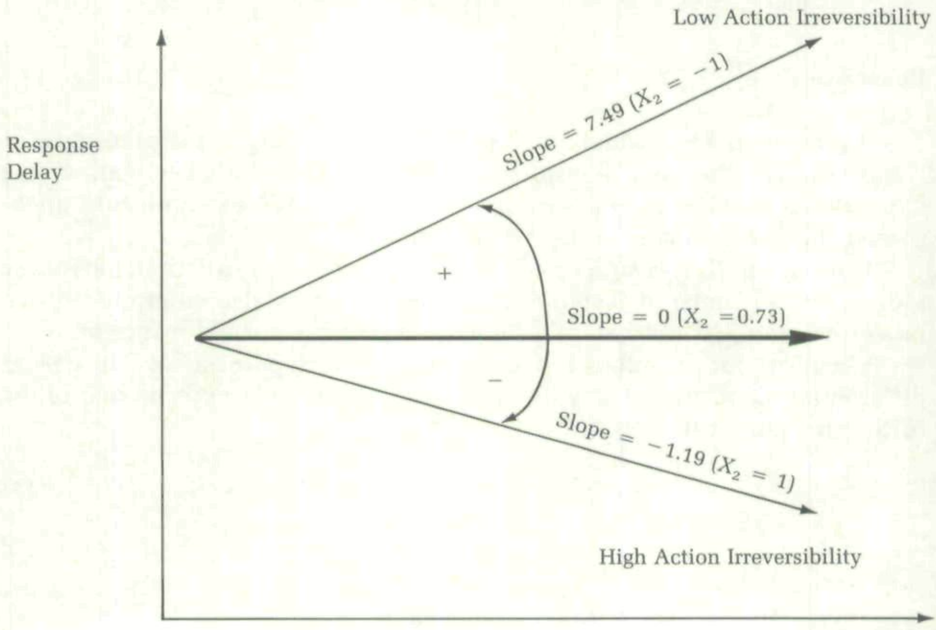
As Figure 3 shows, increasing competitor dependence increases response delay when action irreversibility is low ($X_2 = -1$). The slope remains positive until action irreversibility reaches the turning point ($X_2 = 0.73$), when response delay starts to decrease with increasing competitor dependence. The figure implies that for high values of irreversibility, response delay decreases with increasing dependence, whereas for moderately low irreversibility, response delay increases with dependence.

Likelihood of a Matching Response

As indicated in the results for model 3 in Table 5, Hypotheses 3a was supported: the greater a defender's dependence on the markets under attack, the greater the likelihood that it will directly match an initial action. The result for the price variable supported Hypothesis 4c: a price action has a greater likelihood than other types of actions of being countered by a matching response.

In addition, the finding for the interaction effect was significant, but

FIGURE 3
Relationship Between Competitor Dependence and Response Delay for Various Levels of Action Irreversibility



opposite to the prediction made in Hypothesis 3b. The partial differentiation of model 3 with respect to competitor dependence offers further insight on this effect:

$$\partial(LM)/\partial(X_1) = .82 - .41\ X_2, \tag{4}$$

where

$$LM = \text{likelihood of a matching response.}$$

Equation 4 suggests that the value of $\partial(LM)/\partial(X_1)$ is 0 when $X_2 = 2.00$, implying that competitor dependence would increase the likelihood of a matching response unless action irreversibility is more than 2.00 standard deviations above its mean; under this condition, competitor dependence would reduce the likelihood of a matching response.

As Figure 4 suggests, increasing competitor dependence increases the likelihood of a matching response when action irreversibility is low ($X_2 = -1$). The slope remains positive until competitor dependence reaches the turning point ($X_2 = 2.00$), when increasing competitor dependence starts to reduce the likelihood of a matching response. It is only at very high levels of action irreversibility that competitor dependence depresses the likelihood of matching. In general, increasing competitor dependence increases the likelihood of matching responses.

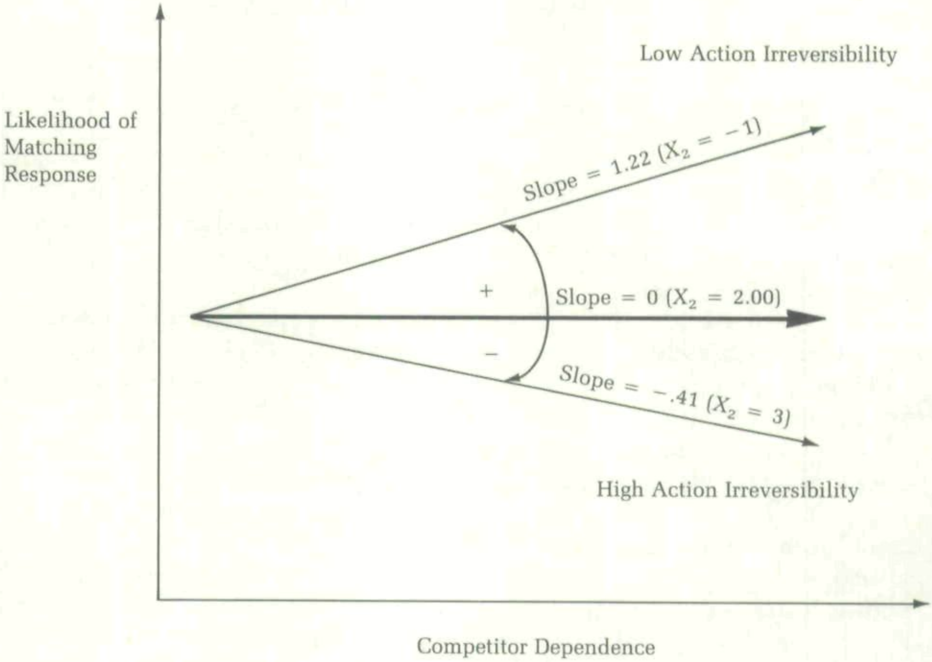
An additional analysis was conducted to explore nonmatching responses further—specifically, to see if we could predict their irreversibility. We performed a regression analysis using irreversibility of response as a dependent variable. The results, reported in model 4 in Table 5, suggest among other things that if a defender decides not to match an attacker's aggressive move, the greater its dependence on the markets under attack, the more irreversible its countermove will be. Table 6 indicates that all the relationships presented above would also exist for non–price actions only. In other words, findings still support the hypotheses even if price actions are removed from the data.

DISCUSSION

A principal purpose of this research was to identify variables strategy researchers can use to compensate for incompleteness of information when studying action-response dyads. Using a game theoretical framework, we developed the basic argument that in the absence of complete information about players' payoffs, competitor dependence and irreversibility are useful variables. Further, we have demonstrated empirically that these variables can be used to estimate the likelihood of nonresponse, response delay, and the likelihood of a matching response.

As expected, competitor dependence can act as a surrogate for estimating a defender's payoffs from an action. Consistent with the hypotheses, the stronger a defender's dependence on the markets affected by an action, the more likely it is both to respond and to match the initial action. These

FIGURE 4
Relationship Between Competitor Dependence and Likelihood of Matching Response for Various Levels of Action Irreversibility



findings are consistent with Tsai, MacMillan, and Low's (1991) conclusion that competitors who are highly dependent on a particular market react aggressively to the threat of new entry. It is also in line with Porter's (1980) and Dutton and Jackson's (1987) proposition that competitors are motivated to take quicker and stronger responses if they view an action as threatening.

As predicted, the more irreversible a competitive challenge, the more unlikely a defender is to respond; if the defender does retaliate, its response is likely to be delayed and to be nonescalatory. Thus, irreversibility may signal an aggressor's true type and its commitment to a course of action. These results to a large extent demonstrate the validity of Schelling's (1960) and Porter's (1980) conceptual discussions of the role of commitment in decision making in conflict situations; when high payoffs are at stake (competitor dependence is high), the degree of commitment signaled by an aggressor (action irreversibility) significantly shapes competitive moves and countermoves. This study thus empirically supports Porter's (1980) previously untested argument that such commitment can discourage and delay retaliation.

In general, competitor dependence appears to affect outcomes more than does the irreversibility of an action. However, the role of action irreversibility should not be underestimated: it not only affects two of the three

TABLE 6
Results of Regression Analysis of Response Characteristics for Non–Price Actions[a]

Variables	Likelihood of Nonresponse: Model 5	Response Delay: Model 6	Likelihood of Matching Response: Model 7	Response Irreversibility: Model 8
Competitor dependence	−0.70***	4.55†	1.09***	0.08*
	(0.10)	(3.01)	(0.31)	(0.04)
Action irreversibility	0.56***	7.63**	0.12	−0.07†
	(0.16)	(3.41)	(0.28)	(0.05)
Competitor dependence by action irreversibility	−0.28**	−5.29†	−0.51*	0.12**
	(0.10)	(3.41)	(0.27)	(0.05)
Constant	5.20	21.61	1.83	2.67
	(0.13)	(3.00)	(0.33)	(0.04)
Adjusted R^2		.04		.38
F		2.57*		5.01**
χ^2	69.45***		16.96***	
N	14,508	110	110	21

[a] Standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$

outcome variables, but also is a contingency variable moderating the impact of dependence on such variables as response delay.

Price actions were shown to be especially provocative of all dimensions of response, thus demonstrating that they have special importance in provoking competitive retaliation, a commonly argued yet previously untested idea. Competitors are more likely to retaliate against price actions than against other actions, and they are likely to counter quickly and directly; presumably, the immediate impact price moves have on payoffs and the strong possibility of estimating these payoffs account for this pattern. The message from this finding is clear: avoid initiating a price move if you can use any other approach to attract customers. The airlines' recent emphasis on "frequent flyer" promotion, which is to a large extent a disguised and deferred price cut, provides a good example of such a strategy.

The research yielded some other interesting, and in some cases, unexpected, results. First, the proportion of nonresponses to the set of initial actions was surprisingly high; only 103 of 856 actions provoked at least one response. The theory section specifies some conditions under which a competitor, in anticipation of an attacker's further moves, may appear to capitulate. There are many other possible reasons: for instance, an action may go undetected, as might be the case with a confidential contract; be misperceived, as, perhaps, an internal change in operating procedures; or simply be considered unimportant—an example is the initial assumptions the International Business Machines Corporation and Digital Equipment Corporation made about network computing (Gannes, 1988). Of course, it may be that some proportion of responses went unobserved by the information source the study used, however comprehensive it may be.

As expected, action irreversibility is an important contingency variable that appears to moderate the impact of competitor dependence on key dimensions of response. When the unexpected results for response delay are examined in conjunction with other results, some especially interesting patterns emerge. Although there is an interaction effect between competitor dependence and action irreversibility for all dimensions of response, the moderating effect of action irreversibility occurs only in extreme cases of irreversibility for all response dimensions except response delay. Thus, for all practical purposes, the interaction effects on likelihood of nonresponse and likelihood of matching can be disregarded.

In the case of response delay, the main effect of competitor dependence was the opposite of what was expected. Instead of a negative effect on delay, dependence has a significant, positive main effect. If main and interaction effects are considered together, response delay rapidly decreases with increasing competitor dependence when the irreversibility of an action is moderately high. On the other hand, response delay rapidly increases with increasing competitor dependence when irreversibility is moderately low.

The unexpected result begs explanation. On reflection, the following explanation seems plausible: when attacked in their key markets, competitors in general tend to act with determination but also with deliberation and caution, for fear of precipitating escalation. Research on decision making has addressed the risk-averse propensity of decision makers in such large-stake situations (e.g., Bass, 1983), and risk aversion appears to play a role here. Recent findings in the strategy literature on American managers' general tendency to avoid taking high risks also echo this idea (Hitt, Hoskisson, & Harrison, 1991). It is also possible that competitors may have a desire to wait and see if an action really works or may be using a second-to-the-market strategy in order to minimize risk.

This risk-averse tendency manifests as follows: Facing attack in markets on which they have high dependence, defenders will react decisively, by responding rather than declining to react, thus signaling a willingness to protect their key markets and bolstering their reputations for doing so. If the action launched by an attacker has low irreversibility (and thereby signals lack of commitment), defenders will delay their reaction in order to develop a countermove, not necessarily a matching one, but one that will discourage further incursions.

On the other hand, if an attacker makes a highly irreversible, and therefore highly threatening, move against one of a defender's key markets, the defender is obliged to act both decisively and swiftly, to signal toughness and to defend its reputation, so that the likelihood of both nonresponse and response delay is low. As both Axelrod (1984) and Schelling (1960) argued, it is important to react fast because the power of a signal fades with time. To avoid escalation, however, the defender will also tend to match the attacker's move, signaling a willingness to defend its position but not to escalate.

The results have thus empirically demonstrated the importance of matching moves as a signaling device (Schelling, 1960); when stakes are high, there is a propensity to match, signaling a willingness to play tough while avoiding escalation. These findings also support the theoretical arguments of Schelling and of Axelrod that the timing of retaliation serves as an important signal in competitive exchange.

Naturally, the question arises of how competitive exchange affects performance. We collected market share data to investigate the performance implications of moves and countermoves. In actual competition, the outcomes of a move and countermove occur in an *n*-person context—in other words, every move involves many airlines, not just a single rival. Therefore, it seems likely that any move that does not provoke responses from every airline will result in market share gains for its initiator. Furthermore, any response not accompanied by responses from all other affected airlines will result in market share gain at the expense of slower responders or nonresponders. Thus, all initiators and quick responders in a contest are likely to benefit at the expense of slow responders and nonresponders. It therefore seemed likely that the following market share changes would occur following aggressive actions and responses: (1) attackers will gain share, (2) responders will gain share at the expense of nonresponders, (3) attackers will gain more share than responders, and (4) early responders will gain more share than late responders.

To test the above expectations, we obtained monthly data on passenger shares for airlines making competitive moves. Increases and decreases in share for each attacking and responding airline were calculated as a percentage of total passengers. We then measured these percentages at three points in time: the end of the month in which a move was made, reflecting market share change from the previous month; one month after the move was made; and two months after the move was made. These time periods are represented in Table 7 as the one-, two-, and three-month lags.

As Table 7 indicates, the average market shares gained by attackers are

TABLE 7
Monthly Market Share Changes[a]

	Attacker		Defender	
Intervals	Means	Standard Deviations	Means	Standard Deviations
One-month lag	.05**	.03	.04	.04
Two-month lag	.20**	.06	.09	.06
Three-month lag	.27**	.07	.09	.10

[a] Mean percentages are shown; Ns = 856 for attackers and 203 for defenders.

* $p < .05$

** $p < .01$

all positive and significantly greater than zero for all three time periods. For responders, the average market shares gained are also all positive, although they are not statistically significant. (However, the medians for market share changes are all significantly greater than zero for all three time periods.) The results of a mean difference test contrasting attackers and responders are as follows: one-month lag, $t = .24$, n.s.; two-month lag, $t = 1.36$, $p < .10$; and three-month lag, $t = 1.59$, $p < .05$. The correlations between response delay and responders' market share changes are as follows: one-month lag, $r = -.11$, $p < .10$; two-month lag, $r = -.08$, n.s.; and three-month lag, $r = -.02$, n.s. Although results are not all statistically significant, the signs are in the expected direction for all three periods.

In every case, then, the expectations were generally supported for all three time periods measured. The findings indicate that both attackers and responders gain share at the expense of nonresponders. Responders, however, gain less share than attackers, and quick responders tend to gain more share than slow responders.

Limitations

An important question is, To what extent can these results be generalized? The U.S. domestic airline industry possesses some idiosyncratic features that, on the one hand, made it an ideal setting for testing the proposed theory, but, on the other hand, can affect the generalizability of the research findings. For instance, competitive information is readily available through the unusually comprehensive industry publication *Aviation Daily*, through the powerful and pervasive computerized reservation systems, and through the airlines' consistent reporting of operating information (a carryover from the regulation era). The airline industry has been undergoing a significant change as a result of deregulation; competitive actions, especially price moves, may thus be followed very intently, since no companies want to be left behind in this new game. Although these industry features might have implications for the generalizability of the study, similar features could also be found in such industries as banking, consumer products (e.g., soft drinks), and car rental.

The kind of competitive moves identified, the significance of irreversibility and competitor dependence to competitive exchange, and the selection of important characteristics of responses for study may also vary across industries. For example, the high incidence of matching responses in the data could be a result of the effects of recent deregulation. The very detailed and comprehensive reporting by *Aviation Daily* could also have increased the visibility of competitive actions.

The competitive impacts of the actions studied were very clear because the industry's statistics are comprehensive, so the number of each competitor's passengers affected by an action can easily be assessed. Another interesting issue worth exploration is the role that the clarity of competitor dependence plays in predicting responses. It would be interesting to undertake a study in an industry in which competitor dependence has less clarity.

In spite of these special features of the airline industry, the theory and methods of this study should be applicable to research on other industries. Specifically, the sampling of the action-response pairs to capture firm rivalry and the method of linking responses to their initial actions should be generalizable to studies of competitive exchange across a variety of industries.

Implications

Future research can make several extensions of the present research. First, the study should be replicated in other settings—different industries in the same time frame or different time frames in the same industry—to test the theory and the findings further.

Second, irreversibility has multiple sources—economic, institutional, organizational, psychological, and political ones. Here, we used irreversibility as an aggregated construct. Once the general relationships between irreversibility and other important variables in competitive exchange are outlined, it would be valuable to investigate further different types of irreversibility and their effect on competitive responses.

Third, researchers seem to have underestimated the significance of price actions for understanding competitive exchange, as a result of their apparently tactical nature. Price actions are by no means homogeneous: they involve increases as well as decreases, and they vary in magnitude. Thus, the competitive implications of major price moves should be analyzed explicitly. In addition, objective information is usually more available for price moves than it is for other types of moves, which should make it possible to examine the directionality and magnitude of effect of competitive moves on responses, another unexplored yet important issue in strategy.

Fourth, competitive interaction constitutes a very complex and dynamic process in which actions trigger strings of responses and counterresponses. Instead of regressing into infinite iteration, this study focused only on the first iteration of an action-response dyad. This focus provides a starting point for studying competitive interaction; nonetheless, future studies should attempt to develop a more extensive, multistage framework.

Fifth, to examine theories proposed by Porter (1980), Axelrod (1984), Rasmusen (1990), and Smith and colleagues (1991), and to extend the results of performance effects demonstrated in Table 7, further studies of performance should be carried out. We kept our focus at the action-response level in order to explore fully the phenomenon of competition at a micro level. Although reliable performance data at this level of analysis are very difficult to obtain, future research may be able to aggregate strings of actions and responses, either within the multistage framework proposed above or at the organizational level. As understanding of competitive exchange grows, it will be important to analyze further the performance effects that result from action-response dynamics.

Finally, this study has demonstrated that competitor dependence and irreversibility are major forces in explaining lack of competitive retaliation. However, the somewhat unexpectedly high incidence of nonresponses in the data may call into question the emphasis on competitive dynamics per se. Thus, it appears that more serious attention should be paid to the resource-based view of firms (Barney, 1986, 1989; Dierickx & Cool, 1989; Wernerfelt, 1984), according to which, firm attributes, often idiosyncratic and thus nonimitable, may impede competitive responses. This study focused on the basic building block of the action-response dyad. It focused specifically on characteristics of the market segments under attack and the attacking moves made. We did not look at the specific internal attributes of the firms making moves and how those attributes might shape the initial selection of a move or of the market to attack. Future study investigating such firm-specific attributes as an attacker's reputation, product-market selection, and motive for attack should add significantly to this line of research.

These findings should also be valuable to practicing strategists. For example, a key question for an attacker is whether an action will deter or discourage retaliation. By attacking markets that rivals do not prize highly, a strategist may be able to preclude retaliation long enough to gain a valuable foothold. Thus, tactics based on forays into neglected or hitherto unprized territory may have their rewards. Similarly, the irreversibility of a competitive move has important implications for likely responses, a phenomenon managers should take into account.

In summary, the present study adds to an underresearched yet important area in strategic management. The focus on action-response dyads in competitive interaction provides preliminary evidence that the nature of an action, its impact on competitors, and its irreversibility are significant predictors of response and response delay. The analysis of actual competitive interaction demonstrates the action-response level as basic for understanding the dynamics of competitive behavior and opens the way for further studies of more complex competitive interaction.

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