Hypercompetition in a Multimarket Environment: The Role of Strategic Similarity and Multimarket Contact in Competitive De-escalation

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Abstract

The effect of intra-industry heterogeneity on hypercompetitive escalation and de-escalation in a multimarket environment is examined. The authors study two critical dimensions of intra-industry heterogeneity: strategic similarity, which captures similarity in competitive orientation, and multimarket contact, which captures the degree of overlap between rivals in the multiple markets of the industry. Theory predicts that both variables influence the intensity of rivalry and competitive disruption.

The predictions in the literature about the effect of strategic similarity on the intensity of rivalry are mixed. While strategic group theory proposes that strategic similarity may lead to lower rivalry, other theories (focusing on product differentiation, the resource-based view of the firm, and hypercompetitive escalation) predict that strategic similarity may actually increase rivalry. Those diametrically opposed propositions are captured as alternative hypotheses of the effect of strategic similarity. With respect to the effect of multimarket contact on the intensity of rivalry, the existing literature on multiple point competition predicts that multimarket contact should decrease rivalry, since it provides credible threats which discourage competitive escalation.

The paper performs an empirical analysis of these hypotheses with data on over 3,000 city-pair markets of the U.S. airline industry. The paper focuses on the effects of changes in strategic similarity and multimarket contact in a city-pair market on the prices charged by airlines in that market. Other important factors which influence prices, such as service attributes, market characteristics, cost positions, market structure and firm-specific advantages, are rigorously controlled. The methodology used for the empirical analysis, a panel data regression with fixed-effect intercepts, also serves to control for other sources of stable differences across airlines and city-markets.

The results show that strategic similarity moderately increases the intensity of rivalry, whereas multimarket contact strongly decreases it. Interestingly, the findings suggest that the effect of strategic similarity on intensity of rivalry may be biased if the effect of multimarket contact is not explicitly accounted for. This is due to the fact that strategic similarity may capture some of the strong de-escalation effect of multimarket contact when this variable is not controlled. This finding explains and challenges prior literature which found that strategic similarity reduces rivalry.

The findings have important theoretical implications. For strategic group theory, they suggest two distinct dimensions of strategic heterogeneity (strategic similarity, multimarket contact), which *should not* be aggregated because they have opposite effects on the intensity of rivalry. These two dimensions should be separately considered to produce more rigorous analysis of rivalry within and between strategic groups. For hypercompetition theory, the findings indicate that hypercompetition in the cost-quality arena and stronghold invasion arena may lead in the future to greater competitive restraint. If hypercompetition in the cost-quality arena leads to greater differentiation in the market positions of firms, this could de-escalate competition. In addition, if hypercompetition in the stronghold invasion arena leads firms to obtain a broader multimarket overlap with their rivals, this condition could also provide the basis for deterrence and hypercompetitive de-escalation.
(*Hypercompetition*; *Strategic Similarity*; *Multimarket Contact*; *Strategic Groups*; *Multiple Point Competition*; *Rivalry*)

The problem of competitive adaptation and response to new and heterogeneous rivals is at the heart of hypercompetition (D'Aveni 1994). When heterogeneous firms engage in competitive interaction, their heterogeneity affects the intensity of their rivalry in

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several ways. Firms tend to imitate and leapfrog each other in their positioning within their markets (hypercompetition in the cost-quality arena), in building their resource base (timing and know-how arena), in the competitive creation and destruction of dominant positions in product or geographic markets (stronghold creation/invasion arena), and in the use of attacks and counterattacks based on size and financial advantages (deep pocket use/neutralization arena). We examine the competitive disruption effect of two critical dimensions of interfirm differences: differences in the markets served by the firms (captured by the multimarket contact construct), and differences in the competitive orientation within those markets (captured by the strategic similarity construct).

As D'Aveni (1994) argues, the degree of intra-industry heterogeneity among competing firms (and potential entrants) may be an important force for hypercompetitive disruption and an obstacle to the tacit de-escalation that potentially could end it. Rivals with different skill bases, competitive orientations, and home market strongholds are likely to use their idiosyncratic differences to their own advantage, possibly leading to hypercompetitive escalation in the four competitive arenas (D'Aveni 1994, p. 221). Moreover, intra-industry heterogeneity may prevent tacit de-escalation among competitors by reducing firms' ability to tacitly coordinate a de-escalation move (Newman 1978, D'Aveni 1994, p. 225). Therefore, it is important to analyze the effect of intra-industry heterogeneity (i.e., heterogeneity among competing firms in terms of strategies, resource bases, home markets, etc.) on the onset of hypercompetition (through competitive escalation) and, possibly, on its ending (through competitive de-escalation).

Our study expands the literature by examining the effects of multiple dimensions of intra-industry heterogeneity on the intensity of rivalry experienced by firms within the context of an industry composed of multiple markets. Although multiple markets or niches within an industry are the norm rather than the exception (Abell 1980, Carroll 1985), little empirical work has explicitly considered the implications of multimarket environments within the context of an industry (Barnett 1993, Baum and Singh 1994, Smith and Wilson 1995). The consideration of a multimarket environment adds complexity and realism to the analysis of intra-industry heterogeneity. We define a multimarket environment as a group of distinct markets (i.e., markets for products or services that are not strong demand substitutes) that are strongly related on the supply side by the use of similar technologies and capabilities. Examples of multimarket environments include the chemical, pharmaceutical, airline, and electronics industries, among others. The concept can also be applied to the study of competition in industries with geographically defined markets, such as regional competition in the U.S. brewing industry (Carroll and Swaminathan 1992) or triad competition in international markets (Ohmae 1985).

Hypercompetition in a multimarket environment has special characteristics due to the multiplicity of markets present. Multimarket environments allow great firm diversity and strategic heterogeneity. Firms can differ in their product-market scope in terms of breadth (narrow vs. broad scope) as well as the specific markets targeted. Hence, the heterogeneous firms in a multimarket environment vary in the degree to which their scope overlaps with that of specific competitors, a construct known as multimarket contact (Edwards 1955) or market commonality (Chen 1996). Multimarket overlap presents opportunities for multiple point competition, "a situation when firms compete against each other simultaneously in several markets" (Karnani and Wernerfelt 1985, p. 87). Multimarket contact has a direct relationship with D'Aveni's fourth arena of hypercompetitive interaction, stronghold invasion. Firms with substantial multimarket contact hold positions in each other's markets, and therefore have the ability to retaliate not only in the markets where a competitive action occurs, but also in markets that are more salient to the competitor. In contrast, firms with little multimarket contact maintain a substantial portion of their markets out of the reach of their rivals. Multimarket competition theory (Edwards 1955, Porter 1981, Karnani and Wernerfelt 1985, Bernheim and Whinston 1990, Witteloostuijn and Wegberg 1992) predicts that the lack of stronghold overlap may induce firms with little multimarket contact to be bolder in their competitive actions. We used that theory to develop predictions about the effects of multimarket contact.

In addition to multimarket contact, firms may differ in their competitive orientation to the markets they serve (Caves and Porter 1977, Porter 1980). For instance, different firms may position themselves at different points of the cost/quality space, using unique resources and capabilities to serve the market. Such lack of strategic similarity also has bearing on the intensity of rivalry, because it influences how directly firms compete in the markets they serve. Although D'Aveni (1994) recognizes that hypercompetition in the cost/quality arena can occur both between firms with similar positioning and between firms with different positioning, a large body of theoretical work, particularly in the strategic group literature (Caves and Porter

1977, Peteraf 1993b) and the resource-based literature (Rumelt 1984, Barney 1991, Peteraf 1993a) provides conflicting predictions about the intensity of rivalry of firms with similar or different strategic positions. We build on those conflicting theories to illuminate the effect of hypercompetition in intra-market positioning.

We investigate the *simultaneous* effect of the two dimensions of strategic heterogeneity (multimarket contact and strategic similarity) on the intensity of rivalry between U.S. airlines in the city-pair markets they serve. Our multidimensional model enables us to make distinctions between different dimensions of competitor heterogeneity and their effects on rivalry. For instance, our work suggests a distinction between the "breadth" and the "intensity" of rivalry between two firms. In fact, theory suggests that broad rivals (rivals with multimarket contact) are not necessarily the most intense rivals. Our work also suggests a distinction between broad and similar rivals. Firms that compete in many markets may have very different competitive orientations in serving those markets. Moreover, firms that use similar competitive orientations in serving their markets may not actually compete with one another in any market. Our results suggest that the two dimensions of heterogeneity have diametrically opposed effects on the intensity of rivalry between airlines in their markets.

In the following section we develop the theoretical arguments for the effects of strategic similarity and multimarket contact on competitive de-escalation in multimarket environments, and suggest hypotheses obtained from the literature. We then specify our model and test the hypotheses with data from a large sample describing the position of 48 airlines in more than 3000 city-pair markets of the U.S. airline industry. Finally, we report the results, discuss the implications for hypercompetition theory, and suggest directions for future research.

Intra-Industry Heterogeneity and Competitive Intensity

Since its inception, the field of strategic management has paid close attention to the causes and consequences of intra-industry heterogeneity (Hatten and Schendel 1977, Rumelt 1984, Barney 1991, Peteraf 1993a). A dominant stream of work examining the effect of intra-industry heterogeneity on competitive intensity has been strategic group research, particularly the studies following the Harvard tradition of such research (Hunt 1972, Porter 1976, 1979, Caves and Porter 1977, Newman 1978, Cool and Dierickx 1993, Peteraf 1993b), which has addressed the effect of strategic similarity on the intensity of rivalry by comparing the intensity of rivalry *within* and *between* groups (Peteraf 1993b).

The operationalizations of strategic similarity have often included some measure of product-market scope similarity, commonly in terms of scope breadth (Hatten and Schendel 1977, Cool and Schendel 1987, Feigenbaum and Thomas 1990). Although that definition of strategic similarity can closely overlap the construct of multimarket contact in some situations (e.g., large multimarket generalist firms are likely to have a high degree of multimarket contact), the multimarket contact construct captures a dimension that is not totally captured by current operationalizations of strategic similarity in strategic group research: the fact that firms compete in the *same* markets.

Nowhere in the literature does that distinction appear more clearly than in the work of Hatten and Hatten (1987, p. 333), who have argued that strategic groups should be formed by firms pursuing similar strategies, irrespectively of whether or not they actively compete against each other. Two firms that are strategically similar in their narrow product-market scope (e.g., two regional brewers in the U.S. brewing industry or two feeder airlines in different hubs) may in fact have no multimarket contact at all. In other words, in a multimarket environment, strategic similarity between two firms (as defined by current strategic group theorists) does not imply that they are broad rivals, or even that they compete at all.

Following Hatten and Hatten's (1987) definition, we can distinguish conceptually between two dimensions of inter-firm similarity: *strategic similarity*, defined as similarity in the general pattern of resource deployments and competitive orientations independent of the specific markets served by the firm, and *multimarket contact*, which captures the homogeneity in terms of the specific markets served by the firms. Those two dimensions may in some cases be correlated in some industry contexts, but it is possible to find industry contexts in which their correlation is low enough to allow the empirical estimation of their idiosyncratic effects on the intensity of rivalry. The expected effects of those variables on the intensity of rivalry are discussed next.

Strategic Similarity

A leading theoretical view of the relationship between strategic similarity and intensity of rivalry is derived from the Harvard approach to strategic groups (Hunt

1972, Porter 1976, Caves and Porter 1977, Newman 1978), strongly influenced by the industrial organization economics paradigm. In that stream of research, strategic distance (the inverse of strategic similarity) is seen as an impediment to interfirm tacit coordination. When interfirm tacit coordination fails because of lack of strategic similarity, strong rivalry ensues that eventually drives down firm performance. Porter (1979, p. 218) defines strategic distance as "the degree to which strategies in different groups differ in terms of the key strategic decisions variables, such as advertising, cost structure, R & D, organization of production, etc. The greater this distance, other things being equal, the more difficult tacit coordination becomes and the more vigorous is rivalry likely to be in the industry." The logic is developed more extensively by Newman (1973, 1978), who argues that when firms differ in their strategies, such differences may lead to lack of goal congruence, which would reduce their ability to tacitly collude. That argument has become known as the Caves-Porter hypothesis (Peteraf 1993b).

Despite the centrality of the relationship between strategic similarity and rivalry (Cool and Dierickx 1993) for strategic group theory, only one test of the relationship has been reported in the literature. In a study of the pricing patterns of airlines in monopoly markets, Peteraf (1993b) found significant differences between monopolists facing a similar potential entrant (higher prices) and those facing a dissimilar potential entrant (lower prices). Although this finding is in agreement with the proposition that similar firms compete less intensely, the test lacks generalizability in terms of the competitive market structures considered (only monopoly markets).

The hypothesis that strategic similarity leads to reduced rivalry has been subject to significant caveats and challenges. Porter (1976, p. 86) warned that strategic similarity per se does not have a determinate effect on rivalry, because increased strategic similarity is often associated with increased market interdependence (the product offerings of the firms are closer substitutes). Hence, although similar firms may be able to coordinate their actions better in avoiding intense rivalry, their lack of differentiation also means that, if coordination were absent, their rivalry could be substantially more intense than that between differentiated firms. Such reasoning agrees with the predictions of IO models of product differentiation (Hotelling 1929, Beath and Katsoulakos 1991), which suggest that a critical advantage of product differentiation is the relaxation of direct price competition (D'Aspremont et al. 1979). Thus, strategic similarity in intra-market positioning could actually be associated with more intense rivalry if the effect of lack of product differentiation outweighs the effect of increased coordination. That notion is defended by D'Aveni (1994) in his view of hypercompetition in the cost/quality arena. He suggests that similarly positioned rivals are most likely to engage in intense price wars with little restraint (p. 44), but also explicitly recognizes that differentiated rivals may in some cases be just as active and disruptive as similar rivals (p. 49).

The resource-based view of competitive advantage suggests that similarity of rival firms in terms of resource endowments may increase rivalry (Barney 1991, Peteraf 1993a). Peteraf (1993a) contends that (resource) heterogeneity is a necessary condition for competitive advantage, because without it rent erosion can occur. Firms that do not have unique resources and capabilities are thus likely to compete away any supranormal profits. That argument closely mirrors the argument by Porter (1976) that the close substitutability of the products of similar firms may increase the likelihood of their rivalry if tacit interfirm coordination is not effectively recognized and exercised.

The hypothesis that tacit interfirm coordination is more successful among similar firms has also been challenged. For instance, strategic distance (lack of similarity) may facilitate tacit coordination by making it easier to know whether a rival has overstepped its tacit boundary. Thus, from the combined literature of strategic groups, product differentiation, and the resource-based view of the firm, conflicting predictions emerge, each with its own logic, about the effect of strategic similarity on the intensity of interfirm rivalry. Following Zajac and Kraatz (1993), we present two alternative, diametrically opposed predictions, the results of which illuminate the theoretical tension on the issue.

H1. *The average strategic similarity of a firm to competitors in a market will decrease the intensity of rivalry experienced by that firm in that market if everything else is constant.*

H1 (Alternative). *The average strategic similarity of a firm to competitors in a market will increase the intensity of rivalry experienced by that firm in that market if everything else is constant.*

Multimarket Contact

Another way in which intra-industry heterogeneity can affect the intensity of rivalry in a multimarket environment is by influencing the degree of multimarket contact with rivals. For any pair of competing firms in a market within the industry, multimarket contact reflects the number of other markets in the industry in which the same pair of firms meet as competitors. Thus, multimarket contact between two competing firms in a given market reflects the degree of market overlap between those firms in the other markets of the industry.

The theory of multimarket competition suggests that multimarket contact between two firms will reduce the intensity of rivalry between them in each of the markets in which they compete (Edwards 1955, Feinberg 1984, Bernheim and Whinston 1990, Witteloostuijn and Wegberg 1992). Thus, although multimarket contact implies that firms are competitors across a large set of markets ("breadth" of competition), the theory predicts that the intensity of rivalry in each of the mutually contested markets will be low. The reason for such an effect, according to the theory, is that firms with high multimarket contact have an extended scope for retaliation to actions taken by the rival (Feinberg 1984), because the opportunity for cross-market retaliation is added to the set of retaliation possibilities.

The development of multimarket contacts may spark episodes of intense rivalry, as firms enter each other's markets (Karnani and Wernerfelt 1985), in a process of hypercompetitive interaction in the stronghold invasion arena (D'Aveni 1994). However, once the multimarket contacts are in place, and as firms mutually recognize that actions taken in one market may have implications in other markets, the theoretical prediction (Karnani and Wernerfelt 1985, Bernheim and Whinston 1990), supported by substantial empirical work (Scott 1982, Phillips and Mason 1992, Evans and Kessides 1994), is that firms will forbear from additional disruption (Edwards 1955).

Although most of multimarket competition theory has evolved independently of strategic group theory, a few authors have studied the differences and connections between the two theories (Greening 1980, Broadman 1981, Barnett 1993). Greening (1980) argued that the effect of multimarket contact discussed in the multipoint competition literature is in fact evidence of the tacit coordination effect of strategic similarity postulated by strategic group theory. Greening's argument raises the important issue of empirically distinguishing between strategic similarity and multimarket contact, but his conception of strategic similarity is substantially broader than ours. From our definition, based on more current strategic group theory developments (Hatten and Hatten 1987), it is clear that firms can pursue similar strategies without necessarily being in the same markets of a multimarket environment.

Some empirical attempts to integrate the concepts of multimarket contact and strategic groups have been reported (Broadman 1981, Barnett 1993). Broadman (1981) studied geographic multimarket contact among petroleum firms classified into strategic groups based on their patterns of vertical integration, finding a strong performance effect for some groups. Barnett (1993) studied geographic multimarket contact within and across groups of telephone service companies defined by their core business, finding a forbearance effect for some groups. However, both researchers used the strategic group construct not as a possible alternative hypothesis to multimarket contact, but as a context variable for the effects of multimarket contact. That approach hinders the direct comparison of strategic similarity and multimarket contact as predictors of rivalry.

In summary, the theoretical predictions are in agreement about the rivalry-decreasing effect of multimarket contact. They are captured in our second hypothesis.

H2. *A firm's average multimarket contact with competitors in a market will decrease the intensity of rivalry experienced by that firm in that market if everything else is constant.*

Model Specification

In a multimarket environment, the intensity of rivalry as a firm-level construct has meaning only as an aggregate, because the rivalry experienced by a firm will differ among markets depending on the firm's choice of markets, its competitive advantage in those markets, the set of competitors the firm meets in those markets, and other variables. Thus, a multimarket firm could experience very intense rivalry to win customers in one market while experiencing little rivalry for the customers in another. The implication is that the natural unit of analysis is the *rivalry experienced by a firm within a particular market*. Although aggregation of within-market rivalries to the firm level is possible (Cool and Direickx 1993), it is likely to sacrifice information about the intra-firm variation of the variables.

Studying the intensity of rivalry experienced *by a firm within a given market* of a multimarket environment facilitates controlling for the sources of rivalry. Because a multimarket environment, as defined here, is characterized by little or no cross-elasticity between the markets (products or services offered to different markets are not close substitutes), the only source of competition for a firm within a market is the set of relevant competitors (other incumbents and potential entrants) in that specific market. Hence, defining the focus of study at that level simplifies the specification and identification of the expected rivalry effects.

The intensity of rivalry experienced by a firm in a market can be captured by two alternative methods well established in the literature. A method used increasingly in strategy research is to evaluate rivalry from direct observation of competitive moves and countermoves by rivals (Smith et al. 1992, Smith and Wilson 1995, Chen 1996). The intensity of rivalry is evaluated by the aggressiveness, speed, and pattern of competitive actions and responses in the market (Chen 1996). Another method, well-established in empirical IO economics, focuses on the impact of such a pattern of actions and reactions in the price-cost margin of a firm in a market. The former method has the advantage of directly observing the dynamic ordering of competitive actions (who moves and who responds), but the latter is superior in evaluating the magnitude of the actual impact of those interactions on the firm's operations. Given the data available for our study and their direct measurement of the impact or outcome of rivalry, we used the latter method. However, replications of our study using dynamic interaction data would add a very valuable perspective on the competitive effects of intra-industry heterogeneity.

Combining the IO and resource-based views of performance, we can specify the price-cost margin of a firm in a market as composed of firm-specific rents from its unique capabilities and product-market profits from reduced rivalry in the market. Product-market profits can be decomposed into three sources: (1) market structure effects, which capture the effects of number and size distribution of incumbents and potential entrants, regardless of their degree of heterogeneity, (2) firm-specific dominance effects, which capture the firm-specific market power, and (3) intra-industry heterogeneity effects, which represent the aggregate effect of intra-industry heterogeneity of relevant competitors in the specific market. Thus, the price-cost margin of a firm i in a market m at a period of time t can be specified as:

$$P_{\text{imt}} - C_{\text{imt}} = f(\text{rents}_{\text{imt}}, \text{market structure}_{\text{imt}}, \text{firm-specific dominance}_{\text{imt}}, \text{intra-industry heterogeneity}_{\text{imt}}).$$

Even if cost per unit information is not available at the market level, such information can be estimated on the right side of the equation by estimating the firm's cost per unit as a function of a set of independent variables X_{imt},:

$$P_{\text{imt}} = C(X_{\text{imt}}) + f(\text{rents}_{\text{imt}}, \text{market structure}_{\text{imt}}, \text{firm-specific dominance}_{\text{imt}}, \text{intra-industry heterogeneity}_{\text{imt}}).$$

We used that equation for estimating the effects of intra-industry heterogeneity (strategic similarity, multimarket contact) on the intensity of rivalry.

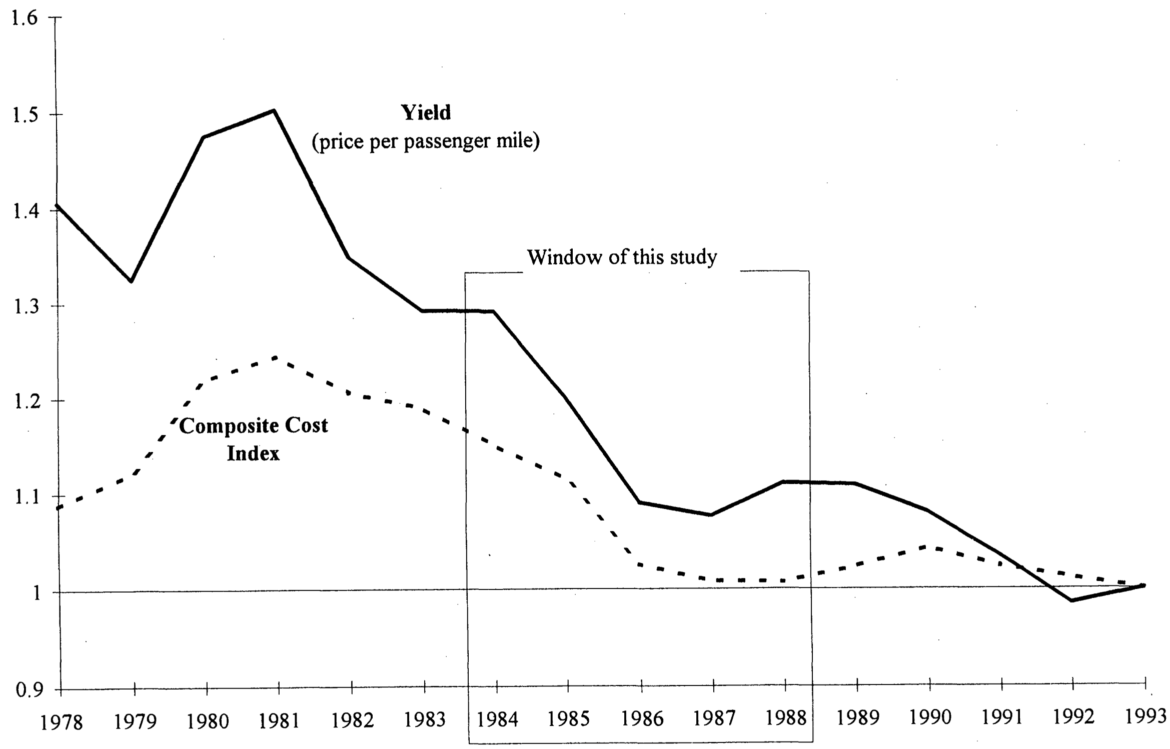
Empirical Test

Sample

We selected a sample of city-pair markets in the U.S. scheduled passenger airline industry for the period 1984 through 1988 to test the hypotheses with the described specification. A city-pair market is defined as the set of customers demanding air travel between any given pair of cities, irrespectively of how that demand is satisfied in terms of the trip structure (direct flight, one-stop flight). Only city-pair markets at least 100 miles apart and with at least 10 passengers a day were considered. That sample provided an ideal context for our study of hypercompetition among heterogeneous firms for four reasons. First, hypercompetition swept the airline industry after deregulation in 1978, including increased differentiation of strategic orientation and a wave of stronghold creation/invasion. As Figure 1 shows, the sampled period is particularly dynamic because it included not only the largest drop in real (deflated) prices (1984–1986), but also a period of relative de-escalation with increasing real prices (1986–1988). Thus, it enabled us to explore both hypercompetitive escalation and de-escalation. Second, the definition of a market as a city-pair market is very convenient for narrowing the set of relevant competitors for a firm in a market, because there is no cross-elasticity across city-pair markets and firms serving the same market compete head-to-head with little differentiation. Third, there was great intra-industry heterogeneity in the strategies used by airlines (Bailey and Williams 1988). Fourth, the fact that air transportation was the primary business of almost all of the airlines provided control for the effects of diversification outside the industry.

A panel data sample describing the activities of 48 airlines across 3,171 markets for five periods (fourth quarters of 1984 through 1988), totaling 48,644 observations, was obtained from the U.S. Department of

Figure 1 Yield and Cost Changes in the U.S. Airline Industry Since Deregulation
(Constant 1993 dollars. Index: 1993 = 1.0.)



Source: Air Transport Association

Transportation (DOT). The DOT databases used were the Ticket Price Origin and Destination Survey (DB1A), the service segment data, and the Form 41 reports of financial and operational data. The unit of analysis was defined as the *airline-route*: the position as incumbent that a given airline i has in a given city-pair market m. The sample included 15,207 airline-routes. For each airline-route, an observation was obtained for each time period in which the firm was incumbent in that market. The subscripts i, m, and t refer to the airline, city-pair market, and time period of the observation, respectively. A firm was considered to be an incumbent if it had at least a 5% share of the market or carried at least 10 passengers a day. That definition eliminated cases in which passengers flew an airline-route through combinations unintended by the airline, but maintained in the sample small competitors that target niches of demand in high density markets. A potential entrant was defined as a firm with operations at both end cities of the city-pair but not serving the demand in the city-pair market. Berry (1989) provides support for that definition by finding that the odds of entry for a potential entrant already established at both end points are more than 18 times greater than those for a firm established in only one end city and 77 times greater than those for a firm not established in either end city.

Operationalization of Variables

The *dependent variable* in our study (yield_{imt}) is the average price charged by a firm to passengers in a city-pair market divided by the distance of the market. The division of the price level by the market distance is a normal practice in the industry, which often reports such data as "yield" or "revenue per passenger-mile." Dividing by distance also scales all observations to be comparable for different markets, facilitating the use of linear methods (eliminating some heteroscedasticity). The use of actual prices rather than announced or advertised prices is important, because airlines can easily change prices by changing the availability of seats to different fare categories, without necessarily changing their advertised prices for those categories.

The critical *independent variables* describe the constructs of strategic similarity and multimarket contact.

The operationalization of *strategic similarity*, the first dimension of inter-firm heterogeneity, has received considerable attention and debate in the strategic groups literature (Hatten and Hatten 1987). Whereas early studies used simple dimensions specifically relevant for the industry under study, later studies have increasingly used multiple dimensions that are generalizable (product-market scope and resource deployments have been the dimensions most widely used to define strategic similarity). A data reduction method, usually cluster analysis, then has been used to reduce the pattern of strategic similarities among firms to a discrete set of strategic groups. Barney and Hoskisson (1990) have severely criticized both the variable selection methods (small differences in the selected variables lead to radically different results) and the data reduction methods (the assumption of having a few homogeneous strategies in the market is not often met).

Instead of attempting to find the "right" measure of strategic similarity, we considered three alternative operationalizations and thus could evaluate the sensitivity of results to alternative measures of strategic similarity. Moreover, we avoided the problems raised by clustering techniques by using the actual pairwise similarity data without data reduction. For any pair of the 48 airlines in the sample, i and j, the measure of strategic similarity is distributed between zero and one, with zero representing the maximum inter-firm difference in that dimension and one representing maximum similarity. We developed those measures by comparing some firm-level characteristics of the firms' strategies that are independent of the *specific* markets served.

The first operationalization of strategic similarity follows the discrete classification scheme used by the Department of Transportation, based on annual operating revenues of the airlines. DOT distinguishes between the following categories: majors (over \$1 billion), nationals (\$100 million to \$1 billion), large regionals (\$10 million to \$100 million), and medium regionals (up to \$10 million). The numbers of airlines in the sample in those categories are 12, 19, 13, and 4, respectively. Although the DOT classification is based strictly on revenues, it is strongly associated with the product-market strategies pursued by the firms (Bailey and Williams 1988). Firms with the same DOT classification are likely to be strategically similar in their intra-market positioning, which should influence the intensity of their rivalry. Hence,

$$d_{ij}^{\text{DOT}} = \begin{cases} 1 \text{ if firms } i \text{ and } j \text{ have different DOT classification,} \\ 0 \text{ if firms } i \text{ and } j \text{ have the same DOT classification.} \end{cases}$$

A second operationalization of strategic similarity can be obtained from Stinchcombe's (1965) hypothesis about structural stability and date of founding. Stinchcombe suggests that firms originating in a given period are "imprinted" by the environment prevalent at that time, and choose their structures and strategies accordingly. Those strategies and structures thus become ingrained in the firm and are difficult to change because of organizational inertia and path dependence. If Stinchcombe's hypothesis is correct, the date of founding can be used as a unidimensional proxy for strategy, and firms that are similar in year of founding (i.e., firms that experienced similar environments at their founding dates) are likely to follow similar strategies. A measure of strategic similarity is thus constructed by one minus the difference in years of founding (normalized to a zero-to-one range):

$$\text{similarity}_{ij}^{\text{date}} = 1 - \frac{|\text{Founding date}_i - \text{Founding date}_j|}{\max\limits_{k,l} |\text{Founding date}_k - \text{Founding date}_l|}.$$

The measure takes the value of zero (minimum similarity) when the difference in founding dates between two firms equals the maximum difference in our sample (62 years) and it equals one (maximum similarity) when the founding dates are the same for two firms.

The third operationalization of strategic similarity is more attuned to the multivariate methods currently in use in strategic group research. We selected a set of seven variables (z_{i1} to z_{i7}) that describe the competitive strategy of the firm in terms of the type of markets in which it competes and its positioning within those markets. The strategic orientation variables are (1) the passenger-weighted average *density* of the markets in which the firm competes, (2) the passenger-weighted average *distance* of those markets, (3) the percentage of *tourist markets* among all markets served by the firm (tourist markets are defined as those for which one end-point is Aspen, Atlantic City, Las Vegas, Reno, and any destinations in Florida, Hawaii, Virgin Islands, Guam, American Samoa, Marianna Islands, and Puerto Rico), (4) the passenger-weighted percentage of *direct flights* over all flights, (5) the passenger-weighted average daily *frequency*, (6) the passenger-weighted *market share* of the firm in its markets, and (7) the passenger-weighted average *premium over standard industry fare level* (*SIFL*) per mile. The seven dimensions capture the most critical differences in the strategies of U.S.

airlines, such as being short haul versus long haul, high frequency versus low frequency, and point-to-point versus hub-and-spoke systems. The variables were averaged across the multiple markets and time periods, so that only one seven-dimensional datapoint represents the strategy of each airline over the five-year period. Strategic similarity is then represented by one minus the Euclidean distances between the standardized points in the seven-dimensional space (normalized to the zero to one range):

$$\text{similarity}_{ij}^{\text{strat}} = 1 - \frac{\sqrt{\sum_{v=1}^{7} (z_{iv} - z_{jv})^2}}{\max_{k,l} \sqrt{\sum_{v=1}^{7} (z_{kv} - z_{lv})^2}}.$$

The measure takes the value of zero (minimum similarity) when the Euclidean distance in the strategic space between two firms is the largest for all pairs in the sample, and it equals one (maximum similarity) when the Euclidean distance is zero (firms are equal in competitive orientation).

Because the intensity of rivalry experienced by a firm in a market is affected by the rivalry with all relevant competitors in the market (other incumbents and potential entrants), we aggregated the effect of strategic similarity to those competitors by calculating the average strategic similarity to all other (actual and potential) competitors j in market m. If total competitors$_{\text{imt}}$ represents the number of competitors, actual or potential, competing with firm i in market m at t, the aggregate measures are calculated as follows.

$$\text{average similarity}_{\text{imt}}^{\text{DOT}} = \frac{1}{\text{total competitors}_{\text{imt}}} \cdot \sum_{j \neq i} \text{similarity}_{ij}^{\text{DOT}}$$

$$\text{average similarity}_{\text{imt}}^{\text{age}} = \frac{1}{\text{total competitors}_{\text{imt}}} \cdot \sum_{j \neq i} \text{similarity}_{ij}^{\text{age}}$$

$$\text{average similarity}_{\text{imt}}^{\text{strat}} = \frac{1}{\text{total competitors}_{\text{imt}}} \cdot \sum_{j \neq i} \text{similarity}_{ij}^{\text{strat}}$$

For the second important construct, *multimarket contact*, several measures are available in the literature (Scott 1982, Feinberg 1985, Evans and Kessides 1994). For simplicity we used a count measure of multimarket contact, which sums the number of markets outside market m where firms i and j also compete. The average multimarket contact measure is the average of multimarket contacts with all of firm i's relevant competitors in market m. We go beyond the previous measurements of multimarket contact used in the literature by including potential contacts with competitors as well as actual contacts in the count of multimarket contact. Thus, an instance of multimarket contact occurs according to our definition when a firm i, an incumbent in a focal market m, and another (actual or potential) competitor j in market m meet in another market n, in which competitor j is an incumbent and firm i is an incumbent or potential entrant. That instance is coded as multimarket contact$_{ij,mn,t} = 1$. The multimarket contact of firm i with competitor j is the sum of multimarket contacts over all markets outside market m:

$$\text{multimarket contact}_{ij,m,t} = \sum_{n \neq m} \text{multimarket contact}_{ij,mn,t}.$$

The overall measure of multimarket contact is the average number of multimarket contacts with the competitors (actual and potential) in market m, calculated as:

$$\text{average multimarket contact} = \frac{1}{\text{total competitors}_{\text{imt}}} \cdot \sum_{j \neq i} \text{multimarket contact}_{ij,m,t}.$$

Several other *control variables* are used to control for the effects of relevant factors influencing prices and costs, including firm-specific factors designed to control for the heterogeneous resource endowment and market positions of the firms. Those variables can be associated with four major constructs that have well-reported influence on airline yields: (1) controls for heterogeneous *service attributes* (circularity of flight, being a direct flight, frequency of flights, percentage of first/business class passengers, and percentage of round trip tickets), (2) controls for *exogenous market characteristics* (cost of inputs captured by the SIFL, and density in the market), (3) controls for the *cost position* in the airline-route (load factor, scale of the firm, presence at end cities, and hub-and-spoke network effects), (4) controls for *market structure* (market's Herfindahl index of concentration, total number of potential entrants, and Herfindahl index of concentration at the end cities) and the *firm-specific dominance* in the market (firm's share of enplanements at the end cities and firm's market share in the city-pair market). In addition, sets of dummy variables are used to control for unobserved fixed effects of time periods (average industry trends in yields) and mergers. The exact definitions of the control variables are given in Table 1.

Method

The structure of the data, an unbalanced panel data sample of 15,207 airline-routes observed over five years, allowed use of panel data methodology (Hsiao 1986) with a fixed-effect intercept model, also known as the least squares dummy variable (LSDV) model. The LSDV model has the unique advantage (in comparison with other cross-sectional time-series methods) of being able to control for unobserved cross-sectional heterogeneity among the airline-routes by allowing the intercept of the testing equation to vary for each airline-route. We included a set of 15,207 dummy variables to control for any observed or unobserved effects that are constant for an airline-route for the five years

Table 1 Definition of Control Variables Used in the Study

Controls for heterogeneous service attributes:	
circularity_{imt}	Circularity of the firm's flights in the market (actual miles traveled by passengers / great circle distance between cities)
$\text{direct flights}_{imt}$	Percentage of passengers flying direct (without connection) in the airline-route
frequency_{imt}	Number of flights per day by the firm serving the city-pair market
$\text{round tickets}_{imt}$	Percentage of round trip tickets of all the firm's tickets in the airline-route
class_{imt}	Percentage of first and business class tickets in the airline-route
Controls for exogenous market attributes:	
$\text{cost of inputs}_{imt}$	Index of changes in the cost of labor and fuel inputs: the Standard Industry fare level (calculated by FAA and adjusted by changes in costs of inputs) divided by distance
$\sqrt{\text{Density}_{mt}}$	Square root of total number of passengers traveling the market with any air-line (1 = 100,000 passengers)
Controls for the cost position of the firm in the airline market:	
load factor_{imt}	Distance-weighted average of the load factors of the segments of the market
firm scale_{imt}	Number of passengers carried in all other markets outside the market (m) under study (1 = 1,000,000 passengers)
$\text{hub economies}_{imt}$	Average number of enplanements by the firm at both end-cities (1 = 100,000 passengers)
$\text{network economies}_{imt}$	Percentage of the passengers traveling in the same flight segments as the passengers of the city-pair market who are not flying that city-pair market (a large number indicates high network economies)
$\text{high network economies}_{imt}$	$\text{Max}\{\text{network economies}_{imt} - 0.95, 0\}$, which captures a change in slope of the network economies variable after the 95% level.
Controls for market structure and the firm's dominance within the market:	
$\text{market concentration}_{mt}$	Herfindahl-Hirshman index of concentration at city-pair
$\text{potential entrants}_{mt}$	Number of potential entrants (firms with presence at both end-cities that do not serve the city-pair)
$\text{hub concentration}_{mt}$	Average of the Herfindahl-Hirshman index of concentration of total enplanements at both end-cities
$\text{market share}_{imt}$	Market share of the airline in the market
hub share_{imt}	Average of the firm's share of total enplanements at both end-cities
Other controls:	
airline-route controls	15,207 dummies controlling for the observed and unobserved airline-route effects that are constant for the five year period.
merger controls	11 dummy variables which compare pre-merger to post-merger main effect for 11 major mergers during the period: American Airlines-Air California, USAir-Pacific Southwest, Alaska Airlines-Jet American / Horizon, Braniff-Florida Express, Continental-People Express / New York Air, Delta-Western, Northwest-Republic, People Express-Frontier Airlines, Piedmont-Empire, TWA-Ozark, and Southwest-Muse.
time period controls	4 dummy variables that control for unobserved year effects by comparing each year to the base year (1984)

of observation. This dummy variable intercept thus controls for a wide variety of factors that would otherwise be impossible to capture explicitly.

The practical implication of using LSDV must be well understood for correct interpretation of the results. An entirely equivalent method of estimation, known as *absorption* (Searle 1971), is to transform all dependent and independent variables to deviations with respect to the airline-route mean for those variables and run an OLS regression on the transformed variables. The implication is that the LSDV coefficients will not be influenced by cross-sectional differences among airline-routes that remain stable over the five-year period. That feature serves to control for any stable airline-route specific advantages (i.e., rents), such as slot constraints in airports or special landing rights for an airline. The LSDV coefficients are affected only by the covariations of variables from year to year within a given airline-route. Thus, an LSDV coefficient can be interpreted as describing longitudinal changes occurring *within* an airline-route, and closely approximates the marginal effect that a change in an independent variable would have on the yield of a heterogeneous firm in a given market, other things being constant.

We carried out a diagnosis of violations of the basic assumptions of the LSDV model, including heteroscedasticity, autocorrelation, and linearity of effects. Marketwise heteroscedasticity in the LSDV residuals was identified and corrected by using weighted least squares, with weights equal to the inverse of the market variance of residuals. No significant autocorrelation was found, which indicated lack of unaccounted-for lagged effects from one year to the next, a finding consistent with the fluid nature of airline prices. Through the use of spline linear regression, we found two variables to have a significant and meaningful nonlinear effect on yield: density and network economies. In response, we transformed the density variable to its squared root and defined a two-step function of network economies. The assumption that the airline-route specific intercepts are fixed effects rather than random effects was tested by the Hausman (1978) test, which showed the fixed-effect specification to be appropriate for the data.

Results

Table 2 gives the descriptive statistics of the dependent, independent, and principal control variables, including means and standard deviations of the original variables, as well as the within-airline-route correlation matrix. We report the within-airline-route correlation, rather than the zero-order correlation, because that is the correlation matrix underlying the LSDV model. A positive *within-airline-route* correlation coefficient between two variables indicates that, over the period of five years, values of the first variable above (below) its five-year mean for a given airline-route tended to be associated with values of the second variable above (below) its five-year mean for the same airline-route.

The descriptive statistics show that all three strategic similarity variables have positive and significant correlations with yield, indicating a negative bivariate association between strategic similarity and intensity of rivalry. The operationalizations of strategic similarity have a correlation between 0.60 and 0.81, indicating a high degree of reliability among the measures. All three measures of similarity are positively correlated with multimarket contact at levels between 0.23 and 0.38. Such moderate correlation between the two dimensions of heterogeneity is helpful, as it allows a better identification of the effects of each. Multimarket contact has a small but positive correlation with yield, indicating a negative bivariate association between multimarket contact and intensity of rivalry. Thus, univariate analysis provides some initial support for the de-escalation effects of both strategic similarity and multimarket contact.

The multivariate analysis was carried out in several steps. Only the strategic similarity variables were included in models 1a, 1b and 1c and only multimarket contact was included in model 2 (see Table 3). Both strategic similarity and multimarket contact were included in models 3a, 3b and 3c (see Table 4). In addition to those independent variables, all the multivariate models included a large number of control variables, as is the norm in this literature (Borenstein 1989, Peteraf 1993b, Evans and Kessides 1994).

Table 3 reports the results for the multivariate test of H1 and H2 when we include one dimension of heterogeneity at a time. The results of the test of H1 (Models 1a, 1b, and 1c), which states that strategic similarity decreases/increases the intensity of rivalry, seem to partially support the coordination-enhancing view of strategic similarity. Changes in the set of relevant rivals that increase (decrease) the average strategic similarity to those rivals appear to be associated with an increase (decrease) in yields, other things being constant. The coefficients for strategic similarity in terms of DOT classification and year of founding are both positive and significant at the $\alpha < 0.01$ level. The coefficient for strategic similarity in the seven-dimensional strategy space is also positive but not signifi-

Table 2 Descriptive Statistics

				Within-airline-route correlation																				
Variable	Units	Mean	Std. Dev	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]
[1] Yield	dollars / mile	0.17	0.10																					
[2] Circularity	ratio of distances	1.09	0.16	.00																				
[3] Direct flights	percentage	0.18	0.38	-.01	-.49																			
[4] Frequency	flights / day	3.27	1.99	.04	.16	-.25																		
[5] Class	percentage	0.01	0.03	.21	.03	-.02	-.04																	
[6] Round tickets	percentage	0.82	0.20	-.16	.00	.05	.13	-.10																
[7] Cost of inputs	dollars / mile	0.16	0.04	.24	-.02	.01	-.11	.11	-.08															
[8] $\sqrt{\text{Density}}$	100,000 pass.	0.42	0.41	-.30	-.06	.11	.13	-.09	.15	-.14														
[9] Load factor	percentage	0.56	0.09	-.14	.13	-.10	.04	-.03	.06	-.12	.21													
[10] Firm scale	1,000,000 pass.	5.57	2.53	.03	-.01	.02	.26	-.09	.26	-.10	.21	.15												
[11] Hub economies	100,000 pass.	1.99	2.95	.07	-.04	.11	.30	-.07	.16	-.12	.18	.17	.53											
[12] Network economies	percentage	0.87	0.24	.11	.39	-.80	.26	.03	-.08	-.03	-.15	.12	.04	.01										
[13] High Network Economies	percentage	0.02	0.02	.10	.30	-.26	.13	.04	-.14	-.03	-.12	.08	.04	-.03	.32									
[14] Hub share	percentage	0.16	0.11	.13	-.09	.13	.22	.03	.06	.01	.03	.14	.37	.60	-.04	-.08								
[15] Hub concentration	Herfindahl [0, 1]	0.25	0.10	.07	-.02	.00	.15	-.05	.14	-.10	.12	.10	.35	.34	.05	.02	.27							
[16] Market share	percentage	0.29	0.24	.06	-.21	.26	.13	-.01	.16	.06	-.11	.04	.06	.19	-.31	-.51	.36	.04						
[17] Market concentration	Herfindahl [0, 1]	0.37	0.16	.12	-.02	.05	.04	.01	.01	.10	-.01	.01	.03	.10	-.05	-.03	.18	.19	.37					
[18] Potential entrants	number of p.e.	3.12	2.29	-.08	-.04	.06	-.08	.01	-.04	.02	-.07	.00	-.08	-.09	-.09	-.05	-.05	-.14	.08	.14				
[19] Average similarity (DOT)	range [0, 1]	0.83	0.27	.03	.00	.00	.06	-.03	.08	-.09	-.02	.04	.11	.09	.02	.03	.05	.18	.02	.08	-.19			
[20] Average similarity (age)	range [0, 1]	0.84	0.16	.04	.00	.00	.05	-.03	.07	-.01	-.02	.04	.12	.08	.02	.03	.05	.16	.03	.09	-.21	.81		
[21] Average similarity (strat)	range [0, 1]	0.82	0.01	.04	.01	.00	.00	.00	.00	-.04	-.04	.01	.02	.01	.00	.00	.03	.08	.03	.05	-.21	.60	.60	
[22] Average multimarket contact	100 contacts	5.66	2.62	.03	.01	.00	.24	-.10	.26	-.20	.17	.12	.68	.41	.06	.05	.23	.36	.03	.03	-.22	-.38	-0.37	-0.23

N = 48,644 observations

Correlations above 0.018 are significant at the $\alpha < 0.001$ level.

Table 3 Sequential Tests of Hypotheses 1 and 2

Dependent Variable: Yield	Model 1a		Model 1b		Model 1c		Model 2	
	coeff.	*beta*	coeff.	*beta*	coeff.	*beta*	coeff.	*beta*
15207 airline route intercepts[a]	NOT SHOWN		NOT SHOWN		NOT SHOWN		NOT SHOWN	
4 year fixed-effects	NOT SHOWN		NOT SHOWN		NOT SHOWN		NOT SHOWN	
11 merger fixed-effects	NOT SHOWN		NOT SHOWN		NOT SHOWN		NOT SHOWN	
Circularity	−0.0056	*−0.008*	−0.0057 +	*−0.008*	−0.0058 +	*−0.008*	−0.0062 +	*−0.009*
Direct flights	0.0374***	*0.143*	0.0373***	*0.143*	0.0374***	*0.143*	0.0384***	*0.147*
Frequency	0.0016***	*0.053*	0.0016***	*0.053*	0.0016***	*0.054*	0.0017***	*0.055*
Class	0.1721***	*0.207*	0.1721***	*0.207*	0.1720***	*0.207*	0.1703***	*0.205*
Round tickets	−0.0418***	*−0.162*	−0.0417***	*−0.162*	−0.0417***	*−0.162*	−0.0416***	*−0.161*
Cost of inputs	0.6746***	*0.242*	0.6681***	*0.239*	0.6668***	*0.239*	0.5704***	*0.204*
$\sqrt{\text{Density}}$	−0.0913***	*−0.216*	−0.0914***	*−0.216*	−0.0917***	*−0.217*	−0.0878***	*−0.207*
Firm scale	0.0019***	*0.111*	0.0019***	*0.112*	0.0019***	*0.110*	0.0009***	*0.055*
Hub economies	0.0013***	*0.042*	0.0013***	*0.042*	0.0012***	*0.041*	0.0013***	*0.045*
Network economies	0.0498***	*0.151*	0.0497***	*0.150*	0.0496***	*0.150*	0.0515***	*0.156*
High network economies	0.1258***	*0.049*	0.1259***	*0.049*	0.1256***	*0.049*	0.1324***	*0.052*
Load factor	−0.0511***	*−0.139*	−0.0512***	*−0.139*	−0.0511***	*−0.139*	−0.0497***	*−0.135*
Hub share	0.0311***	*0.053*	0.0310***	*0.053*	0.0314***	*0.054*	0.0266***	*0.045*
Hub Concentration	0.0316***	*0.057*	0.0318***	*0.058*	0.0318***	*0.058*	0.0317***	*0.057*
Market share	0.0016	*0.008*	0.0016	*0.008*	0.0015	*0.007*	0.0024 +	*0.011*
Market concentration	0.0215***	*0.087*	0.0215***	*0.087*	0.0218***	*0.088*	0.0204***	*0.083*
Potential entrants	−0.0020***	*−0.102*	−0.0020***	*−0.102*	−0.0020***	*−0.103*	−0.0017***	*−0.088*
Average similarity (DOT)	0.0027**	*0.012*						
Average similarity (age)			0.0046**	*0.012*				
Average similarity (strat)					0.0063	*0.006*		
Average multimarket contact							0.0016***	*0.124*
N = 48,644 observations								
Overall R^2 (including airline-route intercepts)	95.40%		95.40%		95.40%		95.43%	
F-value of model (including airline-route intercepts)	45.49		45.49		45.48		45.85	
R^2 of absorbed model (deviations from airline-route means)	38.43%		38.43%		38.42%		38.89%	
F-value of absorbed model (deviations from airline-route means)	631.88		631.88		631.62		644.19	

[a]The airline-route dummies are absorbed first. Based on type I sum of squares, their F-value is 43.41, which is significant at the 0.0001 level. Hausman test supports fixed-effects specification.

Significance: + at $\alpha < 0.1$, * at $\alpha < 0.05$, ** at $\alpha < 0.01$, and *** at $\alpha < 0.001$.

cantly different from zero ($\alpha = 0.19$). Thus, although the support is not entirely robust to alternative specifications of strategic similarity, all three alternative specifications point in the same direction, albeit with different degrees of significance. Those results apparently replicate Peteraf's (1993b) findings that similar firms compete less intensely, even after control for a much larger set of possible competing explanations.

Table 3 also reports the results when only multimarket contact is included (model 2). The coefficient of multimarket contact on yield is positive and strongly significant ($\alpha < 0.001$), a finding strongly supporting the prediction of H2 that multimarket contact significantly reduces the intensity of rivalry experienced by a firm in a market. The standardized (beta) coefficient also shows that average multimarket contact$_{imt}$ has an effect on yield greater than that of any of the market structure and firm dominance variables commonly specified in strategy and IO economics as strong predictors of rivalry. Thus, the result strongly suggests that, at least in the airline industry, the ultimate outcome of hypercompetition in the stronghold creation/invasion arena may eventually facilitate competitive de-escalation, because as the mutually invading firms gain greater overlap of each other's strongholds, the likelihood of additional disruption is reduced by fear of cross-market retaliation.

Table 4 reports the results for the hypothesis when both strategic similarity and multimarket contact are *simultaneously* included in the model. The simultaneous inclusion of the two dimensions of similarity is important because, although the two dimensions are theoretically distinct, they are likely to be correlated empirically to some extent. That is in fact the case in our data, with correlations between multimarket contact and strategic similarity operationalizations ranging from 0.23 to 0.38. The correlation makes it important to evaluate the distinct effect of each measure of heterogeneity after controlling for the other. The findings for models 3a, 3b, and 3c show that whereas the effect of multimarket contact remains stable with control for strategic similarity, the effect of strategic similarity is substantially different with control for multimarket contact. In fact, when multimarket contact is included in the model, all three measures of strategic similarity become negative and significant, indicating that when multimarket contact is kept constant, additional strategic similarity actually increases rivalry in a significant way.

Several potential conditions could account for the unexpected change of signs of the strategic similarity variables, and we investigate them in detail because the conclusion of that diagnosis would influence the credibility of our findings. A necessary condition for such sign reversal is a correlation between the two dimensions of heterogeneity after the effect of the remaining control variables is partialed out. If the correlation is very high, a multicollinearity problem is present that could lead to flawed results. It is well known (Judge et al. 1985, Greene 1990) that high levels of multicollinearity can lead to unstable and unreliable coefficients because of the near singularity of the cross-product matrix. We investigated that possibility by using two popular multicollinearity diagnostics: variance inflation factors and ridge regression (Neter et al. 1985).

Variance inflation factors (VIF) reflect the impact of multicollinearity on each independent variable in the model. No multicollinearity appears as a VIF value of 1, but VIFs above 10 are commonly considered to reflect excessive multicollinearity (Neter et al. 1985). In models 3a, 3b, and 3c, VIFs for the strategic similarity variables are 1.26, 1.24, and 1.19, respectively, whereas the VIF of the multimarket contact variable in those models ranges from 3.47 to 3.62. Thus, VIFs do not indicate the presence of multicollinearity in a way that could render the coefficients unreliable. In addition, we used ridge regression to evaluate the stability of the coefficients to the degree of multicollinearity. Ridge regression introduces a small bias in the cross-product matrix that reduces the impact of multicollinearity, although at the cost of slightly biasing the coefficients. If the sign reversal were due to multicollinearity, we would expect the coefficient estimates to be very sensitive to small ridges, even to the extent of reversing signs. Using ridges from 0 to 0.1, we found the coefficients to be relatively stable to increases in the ridge parameter. Those findings suggest that the sign reversal cannot be attributed to high levels of multicollinearity.

Another possible explanation of the sign reversal is the phenomenon known in the econometric literature as *bias from the omission of relevant variables* (Greene 1990, 259). It occurs when a variable that has a strong effect on the dependent variable is excluded from the model. Other variables that may be moderately correlated with the omitted variable then pick up part of the effect of the omitted variable, thus becoming biased. In that case, the sign reversal may hinge not on the high correlation between the independent variables (although some correlation is necessary for the effect to occur), but on the relative strength of the effect of the omitted variable. Because the direct effect of multimarket contact in our study is positive and very strong,

Table 4 Simultaneous Test of Hypotheses 1 and 2

Dependent Variable: Yield	Model 3a		Model I 3b		Model 3c	
	coeff.	*beta*	coeff.	*beta*	coeff.	*beta*
15207 airline route intercepts[a]	NOT SHOWN		NOT SHOWN		NOT SHOWN	
4 year fixed-effects	NOT SHOWN		NOT SHOWN		NOT SHOWN	
11 merger fixed-effects	NOT SHOWN		NOT SHOWN		NOT SHOWN	
Circularity	−0.0063 +	*−0.009*	−0.0062 +	*−0.009*	−0.0062 +	*−0.009*
Direct flights	0.0385***	*0.147*	0.0385 ***	*0.147*	0.0384 ***	*0.147*
Frequency	0.0017***	*0.056*	0.0017 ***	*0.055*	0.0017***	*0.055*
Class	0.1701***	*0.205*	0.1701 ***	*0.205*	0.1701 ***	*0.205*
Round tickets	−0.0416 ***	*−0.161*	−0.0417 ***	*−0.161*	−0.0417 ***	*−0.162*
Cost of inputs	0.5605***	*0.201*	0.5677 ***	*0.203*	0.5739 ***	*0.205*
$\sqrt{\text{Density}}$	−0.0882 ***	*−0.208*	−0.0881 ***	*−0.208*	−0.0881 ***	*−0.208*
Firm scale	0.0009***	*0.051*	0.0009 ***	*0.051*	0.0009 ***	*0.052*
Hub economies	0.0013***	*0.044*	0.0013 ***	*0.044*	0.0013 ***	*0.044*
Network economies	0.0514***	*0.156*	0.0515 ***	*0.156*	0.0514 ***	*0.156*
High network economies	0.1321***	*0.052*	0.1320 ***	*0.052*	0.1319 ***	*0.052*
Load factor	−0.0497 ***	*−0.135*	−0.0496 ***	*−0.135*	−0.0496 ***	*−0.135*
Hub share	0.0269***	*0.046*	0.0269 ***	*0.046*	0.0271 ***	*0.046*
Hub concentration	0.0319***	*0.058*	0.0317 ***	*0.057*	0.0318 ***	*0.058*
Market share	0.0023 +	*0.011*	0.0023 +	*0.011*	0.0023 +	*0.011*
Market concentration	0.0207***	*0.084*	0.0207 ***	*0.084*	0.0205 ***	*0.083*
Potential entrants	−0.0018 ***	*−0.090*	−0.0018 ***	*−0.090*	−0.0018 ***	*−0.091*
Average similarity (DOT)	−0.0028**	*−0.013*				
Average similarity (age)			−0.0045 *	*−0.012*		
Average similarity (strat)					−0.0144 **	*−0.013*
Average multimarket contact	0.0017***	*0.131*	0.0017 ***	*0.130*	0.0017 ***	*0.130*
N = 48,644 observations						
Overall R^2 (including airline-route intercepts)		95.44%		95.44%		95.44%
F-value of model (including airline-route intercepts)		45.85		45.85		45.86
R^2 of absorbed model (deviations from airline-route means)		38.90%		38.90%		38.91%
F-value of absorbed model (deviations from airline-route means)		625.55		625.51		625.62

[a]The airline-route dummies are absorbed first. Based on type I sum of squares, their F-value is 43.41, which is significant at the 0.0001 level. Hausman test supports fixed-effects specification.

Significance: + at $\alpha < 0.01$, * at $\alpha < 0.05$, ** at $\alpha < 0.01$, and *** at $\alpha < 0.001$.

and the correlation of multimarket contact with strategic similarity is positive though moderate, that combination has an effect of biasing the estimated effect of strategic similarity upward if we do not control for multimarket contact. The researcher would be led toward accepting the Caves-Porter hypothesis (rivalry-reducing effect of strategic similarity) when in fact, at least for the U.S. airline industry, the de-escalation effect originates in multimarket contact rather than in strategic similarity.

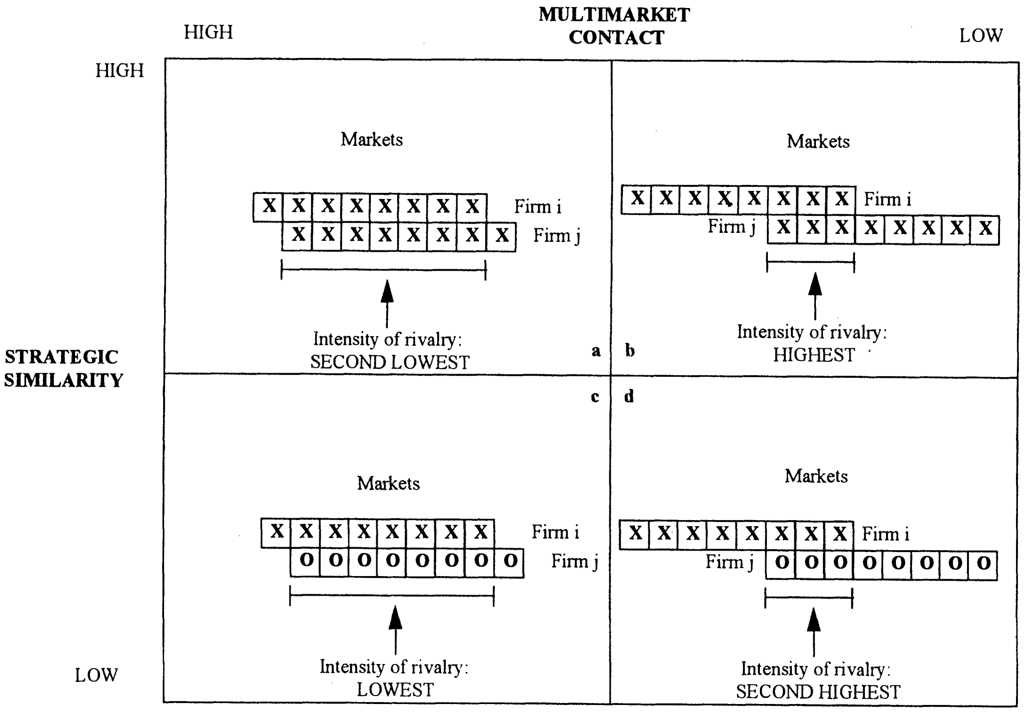
Discussion and Conclusions

Recent work on strategic group theory (Cool and Dierickx 1993, Peteraf 1993b) has stressed the importance of re-examining the relationship between intra-industry heterogeneity and intensity of rivalry as a way to strengthen the theoretical content of that literature. Our study contributes to the theoretical development by identifying two distinct dimensions of intra-industry heterogeneity that have different effects on the intensity of rivalry. In agreement with Chen (1996), we highlight the relevance of distinguishing between market overlap (captured in our research by the multimarket contact construct) and strategic similarity. Although those two dimensions may sometimes be correlated, unfolding them provides important insights. First, it forces the researcher to recognize cases in which the two dimensions are not collinear (strategically similar firms with little market overlap, and strategically different firms with substantial market overlap). Consideration of the two dimensions increases the quality of competitor analysis and provides new theoretical understanding of inter-firm rivalry (Chen 1996). Moreover, our research shows that the dimensions actually have different effects on rivalry, an additional reason for considering them separately. Our findings, summarized graphically in Figure 2, suggest that the off-diagonal cases have a greater effect on rivalry. We find that the most intense rivalry is between similar firms with little multimarket contact, whereas the least intense rivalry is between strategically different firms with high multimarket contact. Further, our results suggest that not separating these dimensions empirically could lead to biased results about the effect of strategic similarity, as one might conclude that strategic similarity reduces rivalry when in fact it is the multimarket contact dimension that produces competitive restraint. We urge researchers interested in the heterogeneity-rivalry relationship to differentiate the two dimensions empirically.

For the competitive effects of strategic similarity, our robust results falsify the Caves-Porter hypothesis that similarity leads to lower rivalry. Multimarket contact being constant, similar competitors actually compete more intensely. The finding that firms with similar strategies compete more intensely is not foreign to strategy research. Research in product differentiation (D'Aspremont et al. 1979) and the proponents of the resource-based view (Rumelt 1984, Barney 1991, Peteraf 1993a) and of organizational ecology (Carroll and Swaminathan 1992) have suggested that firms with similar strategies compete more intensely because of the high cross-elasticity of the products, the lack of unique resources, or the dynamics of competition in the same organizational niche. Our finding does not negate the possibility of tacit coordination among strategically similar rivals but tends to indicate that such coordination is not successful at eliminating all the potential for disruption when rivals seek similar market positions, use similar resources, or develop similar organizational capabilities. The finding is in agreement with D'Aveni's (1994, 45) suggestion that competitive restraint is difficult to exercise among rivals with similar market positions. Another possible explanation of the result is that strategically similar rivals develop similar competitive profiles, a set of organizational routines for how to engage and respond in competitive interaction. Such routines may be effective in coping with different rivals, but they may be incompatible with rivals using similar routines. For instance, firms such as Southwest that use low-price predatory competitive routines geared toward market dominance may be incompatible with rivals using similar competitive routines. More research is needed to study in detail the dynamics of hypercompetition in the positioning arena, as well as the compatibility of profiles among similar and differentiated sets of competitors.

For multimarket contact, our findings show that competitive de-escalation is strongly and significantly facilitated by increasing multimarket contact among competing firms, that is, by increasing overlap among competing firms in other markets in the industry. The strength of the de-escalation effect of multimarket contact is highly noticeable. Beta coefficients suggest that multimarket contact in other city-pair markets in the airline industry has a stronger effect on de-escalation among competing airlines than high seller concentration or low number of potential entrants in the focal city-pair market. Hence, at least in industries characterized by a multimarket environment, multimarket contact should be considered a leading factor in com-

Figure 2 Graphic Representation of Results for the Effects of Strategic Similarity and Multimarket Contact



petitive de-escalation, similar in importance to the structural conditions of the local markets.

According to multipoint competition theory (Karnani and Wernerfelt 1985), the de-escalation effect of multimarket contact is due to managers' concern that an aggressive move in one market may provoke a response to in other mutually contested markets, thus leading to a multimarket escalation of rivalry. Managers therefore behave more conservatively toward multimarket rivals. Such a de-escalation effect does not come cheaply, however. To benefit from the mutual forbearance effect, competing firms need to increase their multimarket overlap, thus increasing the percentage of their activities that are at risk of attack by their competitors. Although multimarket contact decreases the mean level of intensity of rivalry in the overlapping markets, it may also have the effect of making any incidents of rivalry particularly virulent, as they would spread quickly throughout the range of overlapping markets. That is probably why, in the airline industry, price changes are matched quickly not only in the originating markets, but also in other markets where the same competitors overlap.

Our findings for multimarket contact contrast interestingly with D'Aveni's discussion of hypercompetition in the stronghold creation/invasion arena, and other articles in this issue. D'Aveni presents a model in which market invasion spurs intense rivalry, leading to counterattack in the attacker's home markets. Craig (this issue) observes a pattern of stronghold invasion in the Japanese brewing industry. Those episodes clearly represent escalating hypercompetitive interactions, but our research suggests that such mutual invasions carry the seeds of future de-escalation. As the markets of rivals become increasingly overlapping, the aggressiveness of the actions diminishes because of the risk of retaliatory reaction in some or all of the overlapping markets, thus decreasing the intensity of rivalry, at least in the price dimension we studied. Perhaps the apparently sustainable standoff actually means that hypercompetition has shifted to another arena, such as new product introductions (Craig, this issue). An example of that type of shift, occurred in the case of the pet food industry (Collis 1991), in which a period of intense reciprocal entry that increased multimarket contact among the major firms in the industry was followed by a shift toward the introduction of new premium products. High multimarket contact may have also been a factor in the Japanese beer wars by preventing direct price competition and perhaps encouraging rivalry in new product development.

The temporal stability of our results is a potential concern. We calculated the strategic similarity variables by averaging strategic dimensions for a five-year period, thus ignoring possible shifts in competitive orientation by firms during the sample window. Future research with a longer time period should investigate firms' changes in strategic orientation (repositioning) and its effect on rivalry through shifts in strategic similarity among rivals. Another concern is the temporal stability of the coefficients of strategic similarity and multimarket contact. Cool and Dierickx (1993) found that rivalry within and between strategic groups changed over a 20-year period in the pharmaceutical industry. We minimized the impact on the results by selecting a sampling window that included periods of escalation and de-escalation. The temporal stability of the mutual forbearance effect also should be examined in future work.

Our findings have major implications for the theory of hypercompetition. First, they suggest that hypercompetition may occur in cycles, rather than being continuously escalating, and that hypercompetitive escalation may establish a basis for competitive de-escalation in the future. At the initial stages of hypercompetition, firms will try to outmaneuver each other in the different arenas, including entering each other's markets. As reciprocal entry occurs, firms become increasingly interdependent in multiple markets. The cost of an additional aggressive move increases as the opportunities of retaliation in multiple markets also increase. Eventually, aggressive behavior in localized markets becomes too risky, and firms relax their competitive activities to avoid extended confrontation. Thus, hypercompetition may occur in cyclical waves, originating from radical changes in the environment (such as deregulation) and the entry of new rivals, and eventually receding into more traditional forms of oligopolistic rivalry.

Second, the combined findings about strategic similarity and multimarket contact have value for predicting the evolution of industries entering hypercompetitive periods and those for which industry boundaries are becoming blurred. An interesting case in which our framework could be applied relates to the effects of deregulation in cable and local telephone communications. Deregulation will have the effect of bringing into competition firms with different positioning and capabilities (cable companies and the Baby Bells) that have not experienced multimarket contact in their service operations because of previous local market regulations. Our findings can be used to predict which particular competitive interactions will be more intense, helping managers develop strategies that enable them to motivate some restraint by rivals.

Third, our findings have implications for successful de-escalation strategies to cope with hypercompetition. They show that relying on strategic similarity as a method of competitive de-escalation is not effective, but multimarket contact is. Although strategic similarity may facilitate understanding of the competitors' strategies and intentions and promote tacit coordination, it does not by itself provide an economically credible rationale for reducing the aggressiveness of competition. In contrast, multimarket contact provides hostages that can be used effectively and credibly as a deterrence mechanism. The deterrence effect of multimarket contact will depend on the profits currently achieved by the rival in the market. Thus, hypercompetitive strategies, such as entering the home market of a foreign competitor, afford enforcement power over that competitor which could ultimately be used to reduce its disruptive power (Watson 1982, Karnani and Wernerfelt 1985). Paradoxically, aggressive escalation moves in the stronghold-invasion arena may carry the seeds of future competitive de-escalation.

In summary, our findings provide a more detailed understanding of how intra-industry heterogeneity may have a disruptive effect by influencing rivalry among heterogeneous rivals. That understanding has substantial implications for the development of a microdynamic view of how rivalry evolves in an industry, and how it affects and is affected by changes in heterogeneity in an industry. In turn, an understanding of those microdynamics would substantially contribute to our understanding of hypercompetition, strategic group formation and dissolution, and the sustainability or erosion of competitive advantage.

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