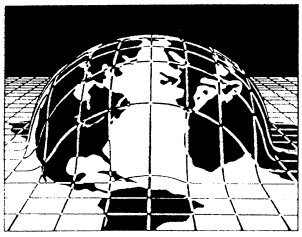


PERSPECTIVE

The following "Perspective" article by Wiggins and Ruefli poses a deceptively simple question relevant to the strategy, economics, and macroapproach to organizations literature: Is there evidence that firms actually obtain persistently superior economic performance as a consequence of attaining sustained competitive advantage? While many have investigated the impact of sustained competitive advantage on economic performance, most studies have examined only limited time frames, and few have addressed the temporal dynamics of sustained economic performance over long periods of time. The authors ask whether superior economic performance actually persists over time. If so, is this a rare event, or is it readily observed across a large number of firms and industries?

This paper departs from the typical Perspective article because the authors have assembled substantial data to investigate their question: a sample of 6771 public firms in 40 industries over 25 years. The authors find that only a very small percentage of firms exhibits superior economic performance, and the phenomenon rarely persists for long time frames. Why should these findings capture our attention?

Reviewers of this paper have noted that it addresses an important problem in economic and strategic literature, using unusual and appropriate analyses, which bear on a number of theoretical perspectives. Because achieving the outcomes associated with sustained competitive advantage are found to be limited to only a handful of firms, and for most firms this is limited to relatively short periods of time, the reviewers believe that it may be time to re-examine several theories of the firm. The reviewers recommend this paper to you and suggest that we reflect on our favorite theories or worldviews of competitive advantage in strategic management—i.e., industrial organization economics, the resource-based view of the firm, neoclassical economics, the Austrian school of economics, the hyper-competitive model, and the edge of chaos approach—in light of these findings.

Claudia Bird Schoonhoven
Editor-in-Chief, *Organization Science*

1047-7039/02/1301/0081/$05.00
1526-5455 electronic ISSN

Sustained Competitive Advantage: Temporal Dynamics and the Incidence and Persistence of Superior Economic Performance

Robert R. Wiggins • Timothy W. Ruefli
A.B. Freeman School of Business, Tulane University, 7 McAlister Drive, New Orleans, Louisiana 70118–5669
Department of Management Science and Information Systems, McCombs School of Business and IC² Institute, University of Texas at Austin, Austin, Texas 78712
robert.wiggins@tulane.edu • tim.ruefli@bus.utexas.edu

Abstract

Competitive advantage is a key concept in strategic management research for a number of reasons—not the least of which is that an avowed consequence of its attainment is held to be superior economic performance. However, few prior empirical studies have directly and systematically documented the incidence or prevalence of persistent superior economic performance. The research reported here is based on empirical studies of a large number of industry samples for which longitudinal data were stratified by levels of performance using a new methodology and then analyzed in terms of their dynamics. This new stratification technique was used in lieu of autoregressive methods employed in prior studies of performance persistence to allow for a true outlier analysis because persistent superior economic performance both has been argued theoretically, and found empirically, to be rare. Detailed results from a sample of 6,772 firms in 40 industries over 25 years are presented to illustrate the findings that: (1) while some firms do exhibit superior economic performance, (2) only a very small minority do so, and (3) the phenomenon very rarely persists for long time frames. These results, while not providing direct support for a particular extant strategic management or economic theory concerning firm performance, are most consonant with the resource-based view of the firm and have implications for significant aspects of other received strategic management and economic theories.

(*Competitive Advantage*; *Firm Performance*; *Resource-Based View*)

One of the fundamental missions of strategic management research is to investigate and explain differences in performance among firms. The reigning incumbent explanation for the heterogeneity of firm economic performance is based on the concept of competitive advantage. This concept appeared in the strategy literature in the early work of Ansoff (1965), but is probably most associated with the Harvard Business School as popularized by the work of Michael Porter in the early 1980s (Porter 1979, 1980). More recently, in a special issue of the *Strategic Management Journal* on the search for new paradigms, the editor-in-chief wrote: "Competitive advantage has become for the field a central matter to understand and explain in terms of causality. It has not proven a simple task" (Schendel 1994, p. 3). More recent work by Porter and others (Amit and Schoemaker 1993, Barney 1991, Conner 1991, Ghemawat 1986, Oliver 1997, Porter 1985, 1996) has focused on the expanded concept of *sustained* competitive advantage, which, simply put, is the idea that some forms of competitive advantage are very difficult to imitate and can therefore lead to persistent superior economic performance (hence the subtitle of Porter (1985): *Creating and Sustaining Superior Performance)*.

While there have been numerous theories and empirical studies of competitive advantage and its effect on firm performance, most of them have examined only limited time frames, and almost none have addressed the important issue of the dynamics of the sustainability of the rewards of competitive advantage over long time frames. Specifically, if it is in fact feasible to achieve a sustained competitive advantage, then one should be able to observe persistence in superior economic performance over time. This research continues and extends the effort to determine if this persistence is observed, and, if so, its incidence. Popular extant theories of competitive advantage in strategic management research, based on industrial organization economics (Porter 1980, 1985) and the resource-based view of the firm (Barney 1991, Conner 1991) predict that the factors that sustain competitive advantages will generate superior economic performance

that persists over time. On the other hand, historical economic theories such as those arising from neoclassical economics and the work of the Austrian school of economics (Jacobson 1992, Schumpeter 1934), as well as the hypercompetitive model (Brown and Eisenhardt 1997, 1998; D'Aveni 1994) of strategy, predict the opposite: that temporal dynamics, resulting from factors such as imitation, entry, and the introduction of substitutes, will erode almost all competitive advantages, and thus prevent superior economic performance from persisting. More recently, Foster and Kaplan (2001) have presented an empirically based, managerial view of the transitory nature of competitive advantage and some of the economic and management mechanisms that generate it.

Whatever the theoretical underpinning, a common link in most of the research on competitive advantage is a focus on firm performance as the dependent variable. As a result of this focus, there has been considerable study of the nature of a wide range of independent variables that affect performance but little attention paid to the "topography" of performance itself (with a few notable exceptions, described below). This is akin to an epidemiologist studying the various factors that might affect a medical condition—without determining the incidence and prevalence of the condition in the population. This research attempts to shed additional light on the dynamics of the behavior over time of one of the primary dependent variables of strategic management and economic research, economic performance, and in so doing reflect on the implications of those findings for strategic management and economic theories. As will be seen, however, the results here do not provide significant positive support for any extant theory.

There have been few prior investigations into the topography of performance, but some are worthy of note. Mueller (1986), in a time-series regression-based study of ROA (operationalized as variation from the mean ROA of the sample) for 600 large industrial firms over the period 1950–1972 utilizing COMPUSTAT and FTC databases, found that profit levels tended to converge toward the mean, but that the highest-performing firms converged the most slowly, and some of the high-performing firms' profitability even increased over time. Geroski and Jacquemin (1988), Schohl (1990), Droucopoulos and Lianos (1993), and Goddard and Wilson (1996), in studies of German, French, and U.K. industrial companies; German industrial companies; Greek industrial companies; and U.K. industrial and service companies, respectively, all found similar results to Mueller (1986), as did Waring (1996) in a large-scale study of 68 U.S. industries. Jacobsen (1988), in a time-series regression-based study of ROI over the period 1970–1983 utilizing the PIMS SBU-level database, also found that profit levels converged over time but did not find persistence, and concluded that "the conditions under which market forces do not drive return back to its competitive rate seem remote, if present at all" (Jacobsen 1988, p. 415). Because most of these studies found that there was, in fact, some persistence of superior economic performance, the questions this research addresses as to the incidence and prevalence of such performance form a natural continuation of this line of research. By using a new methodology that is better suited to the identification of outliers, though, the present research avoids the problems of the autoregressive time-series methodologies used by all of the previous studies, which were all focused on examining the *decay* of persistence (because, as economists, the authors all *assumed* that above-average profits would decay), rather than the *achievement* of persistent superior performance, which is the focus of this study. Further, the time frame of this research, 1974–1997, complements the time period (1950–1972) studied by Mueller (1986). Finally and importantly, the present research also supplements the accounting measures of performance used in these prior studies with a market-based performance measure.

The Research Questions

The primary empirical question addressed in this research is: Does superior economic performance persist over time in a manner consistent with sustained competitive advantage? If such persistence is found to exist (even if it is found to be rare), a set of derivative questions can also be investigated. How long does such performance persist? What fraction of firms in an industry exhibit persistent superior economic performance? If groups of firms exhibit this behavior, do the groups remain stable over time? Is persistent performance related to industry concentration or market share?

These questions are important both managerially and theoretically. From a managerial perspective, much of the published thinking on sustained competitive advantage implies that managers need to invest (perhaps considerable) resources in a search for an advantage and, if the search is successful, the firm can then reap consequent rewards, possibly over a long period of time. If, in fact, such rewards are difficult or impossible to sustain over time, then managers cannot condone extensive expenditures in the search for singular advantages, and must instead continually work to find new sources of temporary advantages in a sequence of short-run circumstances (D'Aveni 1994).

From a theoretical perspective, there are competing disciplinary worldviews that address the idea of sustained

competitive advantage. If, for example, competitive advantage can be demonstrated to be sustainable, at least for an arguably long period of time, then, in the extreme, economic theory needs to be adapted to explain these findings. On the other hand, if competitive advantage is not sustainable, or only sustainable in the short run or the medium run, then strategic management theories need to be changed to reflect this reality. If competitive advantage is sustainable in the long run but is found to be very rare, this research may add to the growing impetus behind investigating hypotheses derived from the resource-based view of the firm in strategic management research.

Key Concepts

The concept of competitive advantage has a long tradition in the strategy literature. Ansoff (1965, p. 110) defined it as follows:

> . . . (To) isolate characteristics of unique opportunities within the field defined by the product-market scope and the growth vector. This is the *competitive advantage*. It seeks to identify particular properties of individual product markets which will give the firm a strong competitive position.

South (1981, p. 15), drawing on the work of the McKinsey & Co. consulting firm in the late 1970s, defined competitive advantage as the "philosophy of choosing only those competitive arenas where victories are clearly achievable." Thus, much of the recent focus has been on identifying such sources of competitive advantage. In particular, Porter (1985) states that there are, in general, only two possible competitive advantages a firm may possess, a cost advantage or a differentiation advantage. Others, particularly proponents of the resource-based view of the firm (Barney 1991, Conner 1991), have extended the definition to include a wider range of possible advantages such as physical capital (Williamson 1975), human capital (Becker 1964), technological opportunities and learning (Teece 1980, 1983, 1986), organizational capital (Tomer 1987), and even institutional context (Oliver 1997). For the purpose of this research, we will adopt the wider definition of competitive advantage as a capability (or set of capabilities) or resource (or set of resources) that gives a firm an advantage over its competitors which *ceteris paribus* leads to higher relative performance. This follows the definition offered by Besanko et al. (1996) of competitive advantage as a firm outperforming its industry.

Received economic theory tends to view superior economic performance as abnormal profits or rents, where rents are profits in excess of those predicted by equilibrium models (Bain 1959, Klein et al. 1978, Ricardo 1817, Schumpeter 1934). This definition, however, assumes the existence of "normal" profits, which in turn assumes that the equilibrium model is valid. Rather than make any such assumption, this research will start with the less restrictive definition of statistically significantly above-average performance relative to a reference set of comparable firms (in this research, an industry).

Of particular interest to strategy researchers is the notion that advantages can continue for long periods of time, and thus yield sustained superior performance. One of the more interesting aspects of conceptual discussions of this phenomenon is that theorists are fairly vague about what exactly is meant by "sustained." Porter is the least ambiguous, and uses the phrases "long-term profitability" (Porter 1985, p. 1) and "above-average performance in the long run" (Porter 1985, p. 11) when describing the consequences of sustained competitive advantage, clearly implying that "sustained" in his usage is a long-term concept. Barney (1991), on the other hand, argues against the use of calendar time as a referent, and instead defines a sustained competitive advantage as a competitive advantage that "continues to exist after efforts to duplicate that advantage have ceased" (Barney 1991, p. 102). While this latter definition is theoretically more precise, it is virtually impossible to meaningfully operationalize quantitatively.

For the purpose of this research, we will adopt Porter's approach, and use calendar time to determine if superior performance can be called "sustained." Thus, persistent superior economic performance is defined here as statistically significant above-average performance relative to a reference set (such as an industry) that persists over a long-term period of calendar time (such as ten years or more). The time frame that determines the persistence of superior economic performance may vary from industry to industry depending on such exogenous variables as product life cycles, patent protections, copyrights, or other variables specific to an industry. For example, computer products generally have a product life cycle of only a few years, while auto parts and accessories tend to have much longer product life cycles.

It is important to note that this research focuses on the outcomes—superior economic performance and persistent superior economic performance—rather than the antecedents—competitive advantage and sustained competitive advantage. Equally important, this research does not incorporate those variables that would permit a direct positive test of particular causes for sustained competitive advantage. By studying the temporal dynamics of the outcomes associated with competitive advantage, however, we study the raison d'être of the construct.

Hypothesis Development

Because almost all economic perspectives allow for at least temporary superior economic performance, they are

all compatible with the concept of competitive advantage in the short run—it is in the viability of medium- to long-term advantage that disagreements arise. In neoclassical economics, superior economic performance is viewed as an aberration that disappears when equilibrium is achieved (Arrow and Hahn 1971, Debreu 1959). Both the structure-conduct-performance (SCP) school of industrial organization (IO) (Bain 1959, Mason 1939, 1949) as well as the price theory IO perspective (Stigler 1968) allow for superior economic performance in the medium to long term. Such sustained performance is posited to result either from differing levels of industry profitability with entry barriers as the mechanism for protecting these abnormal profits—which is why price theory makes the distinction for contestable markets (Baumol 1982), where entry barriers are not present—or from differing levels of profitability within industries due to the structure of the industry with concentration (particularly monopoly and oligopoly) and market share as primary determinants (Schmalensee 1985). Evolutionary economics (Nelson and Winter 1982), as well as the Austrian school of economics from which it draws (see Jacobson 1992 for an excellent summary of the Austrian school), deem superior economic performance to be the result of cycles of innovation and entrepreneurial activity that will both create and then erode any advantages. Most strategic management theories have adopted these economic explanations, as well as the resource-based view's concept of inimitable resources, to explain persistent superior economic performance. In addition, the majority of strategic management theories posit that the fundamental objective of the firm is profit maximization, which implies that all firms will seek a competitive advantage wherever possible to help achieve maximum profits. The resource-based view goes even farther, making the fundamental objective of the firm "above-normal returns" (Conner 1991, p. 132).

Selecting neoclassical economics as the base case leads to the following null hypothesis:

HYPOTHESIS 1. *No firm will achieve persistent superior economic performance in an industry.*

Should Hypothesis 1 be supported, as Jacobsen (1988) found, and no firm achieves persistent superior economic performance, that would be evidence favoring either the zero-profit equilibrium of neoclassical economics or the very short cycles of competitive advantage and decline of Austrian and evolutionary economics. This research would be unable to continue as outlined, and additional research would be indicated to determine which of these theories offers the better explanation for the lack of persistence. Should at least one firm achieve persistent superior economic performance, as Mueller (1986) and many others found, that would be evidence in favor of industrial organization economics, organizational economics, and strategic management theories. However, these theories predict different avenues for achieving such performance, and further hypothesis tests are necessary to determine which of these sets of theories has the most support.

Small Numbers, Concentration, Market Share, and Performance

Both the SCP IO paradigm and evolutionary economics predict that sustained competitive advantage will be associated with industry concentration and firm market share, so that a few large firms will be the beneficiaries of sustained competitive advantage. Strategic group theory (Hunt 1972, Newman 1973, Porter 1973) predicts that a group or groups of firms following the same or similar strategies could be able to achieve sustained competitive advantage. The resource-based view of strategic management relates sustained competitive advantage to rare resources, which implies that persistent superior economic performance should also be rare. These four sets of theories all lead to the following hypotheses:

HYPOTHESIS 2. *Small numbers of firms will achieve persistent superior economic performance in an industry.*

If Hypothesis 2 is supported, the firms that achieve persistent superior economic performance must be examined relative to the industry or reference set to determine if industry concentration and/or market share, the predictions of SCP IO and evolutionary economics, is associated with the performance. This will be examined as Subhypotheses 2a and 2b.

HYPOTHESIS 2A. *Industry concentration will be associated with the small numbers of firms that achieve persistent superior economic performance in an industry.*

HYPOTHESIS 2B. *Large market shares will be associated with the small numbers of firms that achieve persistent superior economic performance in an industry.*

Stability of Performance over Time

In the absence of industry concentration, an additional test can be performed to determine if strategic group theory from SCP IO economics (Hunt 1972, Newman 1973, Porter 1973) is supported as the mechanism. One of the assumptions of strategic group theory is that the strategic groups have predictive validity, i.e., firms in a strategic group have equivalent performance. If the firms demonstrating persistent superior economic performance, which form a group with equivalent performance, are in fact a strategic group, then the presence of mobility barriers

(Caves and Porter 1977) should make this group relatively stable, since other firms cannot readily change their strategies in order to enter the strategic group (Barney and Hoskisson 1990). This leads to the following hypothesis:

HYPOTHESIS 3. *Groups of firms exhibiting persistent superior economic performance will remain stable in membership over time.*

Both evolutionary economics (Nelson and Winter 1982) and the Austrian school (Schumpeter 1934) predict cycles of innovation followed by imitation and competition. Under these theories, different firms will experience various cycles of competitive advantage and decline, leading to turnover in the membership of the groups of firms exhibiting persistent superior economic performance.

If the groups of superior performing firms are stable, and industry concentration (H2a) and market share (H2b) are not associated with the small number of firms achieving superior performance (H2), then strategic group theory receives some support. If industry concentration (H2a) is found to be associated with sustained superior economic performance, then stability of group membership could be construed only as additional evidence of industry concentration. If the groups are not stable, and industry concentration (H2a) is not associated with the small number of firms achieving superior performance (H2), then it is the resource-based view of the firm that offers a theory that is not contradicted by any of the observed outcomes, and the argument that it is the rarity of resources that leads to sustained competitive advantage receives some support, if only by eliminating the alternative explanations of the other theories. If industry concentration (H2a) was associated with the small number of firms achieving superior performance (H2), then instability of group membership offers some support for Austrian and evolutionary economics.

Method

Data

Data were collected from the COMPUSTAT PC-Plus database for the twenty-year period from 1978 to 1997 inclusive, and additional data were collected from the COMPUSTAT Back History database for 1972 to 1977 to extend the number of 5-year periods to 20 (1974–1997), plus two additional years (1972–1973) to mitigate some of the left-censoring problem. Because the COMPUSTAT Back History database does not include SIC codes for firms that exited the database prior to 1978, those 1,145 firms were classified using the CRSP/COMPUSTAT Cross Reference database maintained by the Johnson Graduate School of Management at Cornell University, an earlier version of the COMPUSTAT PC-Plus database (1973–1992), and the Moody's Industrial, OTC, Transportation, Financial, and Utilities Manuals. Additional data on lines of businesses were collected from the COMPUSTAT Segment Tapes for 1978–1996 (business segment data is unavailable prior to 1978). The COMPUSTAT databases have been widely used in both economics and strategic management inquiry because they are among the most comprehensive collections of financial data available.

COMPUSTAT is limited to information on publicly held firms, and only limited line-of-business data are available. The former limitation is not severe, as most large companies in the United States are publicly held. The latter limitation has been viewed as a major drawback, but is accommodated in this research via sample selection, a methodological step to test the effects of the inclusion of diversified firms, and the use of the business segment data available to control for diversification. Forty industries defined at the three and four-digit SIC levels were selected for study and are described below.

Dependent Variables

Economic performance was operationalized with two measures: an accounting measure, return on assets (ROA), and an economic measure, Tobin's q, the ratio of firm market value to the replacement cost of its assets. ROA, net income divided by total assets, was selected because much prior strategic management and economic research has employed a measure of accounting returns, often ROA. Tobin's q was selected because some studies have found results to vary between accounting and economic measures (Hoskisson et al. 1993), and because Mueller (1990) suggested its potential but did not follow up and use it in his studies. Tobin's q was operationalized as the ratio of market to book value. This ratio has been shown to be theoretically equivalent to Tobin's q (Varaiya et al. 1987) as well as empirically equivalent, with a correlation greater than 0.92 with all alternative operationalizations (Perfect and Wiles 1992), and has been used previously in management research (Nayyar 1993, Woo et al. 1992).

Superior economic performance was operationalized as statistically significant above-average (relative to the industry or reference set) economic performance over a five-year period, determined using the Iterative Kolmogorov-Smirnov stratification technique (Ruefli and Wiggins 1994, 2000) described later in this section. A rolling five-year window (Cool and Schendel 1988, Fiegenbaum and Thomas 1988) was used to create up to 22 distributions

of returns for each firm for each of the two performance measures, which in effect created 44 subsamples in all 40 of the industry samples. Firms that did not have at least four out of five years of performance data in a period were excluded from the analysis for that period.

Sustained superior economic performance was operationalized as superior economic performance that lasted six or more consecutive windows (i.e., ten years), since that period contained two nonoverlapping five-year windows—thus eliminating any potential bias due to the effect of a single outstanding performance year. While this establishes an admittedly conservative test, any shorter period, e.g., nine years, would, given the methodology employed, permit a firm with a single year of extraordinary performance (e.g., due to the sale of a subsidiary) to be classified as a sustained superior performer. As it is, the ten-year period does permit a firm which obtains superior performance in each of two successive five-year periods (i.e., in two successive product cycles of five years or somewhat shorter) to be classified as a sustained superior performer—thus mitigating somewhat the conservativeness of the test.

Independent Variables

The independent variables used to test Hypotheses 2a and 2b are industry four-firm concentration ratio and market share. Industry four-firm concentration ratio was operationalized by dividing the combined total revenues of the four largest firms in each industry by the total revenues of all firms in the industry. As seen in Table 1, the industry four-firm concentration ratio ranged from 0.13 to 0.98, with a mean across all forty industries of 0.56. Market share was operationalized as the ratio of each firm's total revenues to the total revenues of all firms in the industry. Table 1 shows that market share ranged from 0 to 0.82 with a mean across all firms of 0.02.

Control Variables

Control variables include firm size, diversification, industry density, and dummy variables for each industry. Firm size was included as a control variable because of a substantial body of evidence that size has independent effects (e.g., Granovetter 1984) and was operationalized as the natural logarithm of total sales (Shalit and Sankar 1977). Diversification was controlled for because of a large body of literature that argues for its effects on performance (see Hoskisson and Hitt 1990 for a summary of these arguments) and is operationalized using the Jacquemin-Berry entropy measure of diversification (Jacquemin and Berry 1979, Palepu 1985), which is defined as

$$E = \sum_{i=1}^{n} P_i \ln(1/P_i)$$

where P_i is the share of the ith segment in the total sales of the firm, which operates in n segments, and can therefore range from zero for single-business-segment firms to much larger values for highly diversified firms (Table 1 shows that the most diversified firm in our sample had an entropy measure of 2.18, but the mean entropy across the sample was 0.195, representing a relatively low level of diversification). Density was included as a control variable because the event study methodology used here has primarily been used in ecological research, which has found a wide range of effects of density (Hannah and Freeman 1989) and is operationalized as the total number of firms in each industry in each period. Because the dependent variables represent five-year windows, the control variables were all calculated as five-year moving averages matched to the five-year windows of the dependent variables (for the size variable, it is the natural logarithm of the average sales, not the average of the natural logarithms). Because the data for the entropy measure only exist beginning in 1978, the first five-year window that could be used in the models is 1974–1978. The additional two years of data (1972–1973) were used to ameliorate the left-censoring problem by separating the firms that made the state transition described below prior to 1974 from those that actually made the transition in the first window. The industry dummy variables were coded using the deviation method, where the mean effect of each industry dummy variable is compared to the overall effect of all industries taken together (the grand mean). Table 1 shows the descriptive statistics and correlations of all study variables.

Industry Selection

Because some of the theories upon which this research is based focus on industry effects, selection of which and how many industries to study is problematic. There are two main problems, (1) the general selection problem and (2) the diversified firm problem. The general selection problem was solved by selecting 40 industries out of the 279 that were of adequate size (at least 20 firms in the industry). Ten industries were included because of their use in prior strategic management research: SIC 2834—Pharmaceuticals (Cool and Dierickx 1993, Cool and Schendel 1987, Hill and Hansen 1991, Hirsch 1975, Kerin et al. 1990, Pisano 1990, Sudharshan et al. 1991), SIC 2851—Paints and Allied Products (Dess 1987, Dess and Davis 1984, Fredrickson 1984), SIC 2911—Petroleum Refining (Murray 1989, Ollinger 1994, Pfeffer and Nowak 1976), SIC 357—Office Equipment and Computing Machinery (Baird et al. 1988, Brown and Eisenhardt 1997, Chakravarthy 1986, Eisenhardt and Bourgeois 1988, Eisenhardt and Tabrizi 1995, Westley and Mintzberg

Table 1 Means, Standard Deviations, Minimums, Maximums, and Bivariate Correlations for All Study Variables*

Variable	Mean	S.D.	Min.	Max.	1	2	3	4	5	6	7	
1	ROA PSP	0.0064	0.0796	0	1	1.000						
2	q PSP	0.0036	0.0595	0	1	0.082•••	1.000					
3	Density	101.1600	82.2800	4	391	−0.011••	−0.007	1.000				
4	Entropy	0.1954	0.3731	0	2.1818	0.002	−0.002	−0.225•••	1.000			
5	Market Share	0.0183	0.0539	0	0.8155	0.013••	0.006	−0.204•••	0.390•••	1.000		
6	Size	4.0968	2.9673	-10	11.5810	0.009	−0.025•••	−0.134•••	0.296•••	0.386•••	1.000	
7	4-Firm Conc. Ratio	0.5565	0.1904	0.1301	0.9751	0.011•	0.009	−0.353•••	0.156•••	0.145•••	−0.251•••	1.000
8	SIC1000	0.0102	0.1004	0	1	0.006	−0.001	−0.097•••	0.001	0.046•••	−0.154•••	0.157•••
9	SIC104X	0.0263	0.1600	0	1	0.009•	−0.004	−0.065•••	−0.050•••	−0.003	−0.185•••	−0.080•••
10	SIC1311	0.1096	0.3124	0	1	0.002	0.007	0.565•••	−0.015•••	−0.092•••	−0.287•••	0.125•••
11	SIC1531	0.0205	0.1418	0	1	−0.008	−0.009	−0.101•••	0.019•••	0.007	0.003	−0.067•••
12	SIC2621	0.0112	0.1054	0	1	−0.001	0.002	−0.101•••	0.127•••	0.046•••	0.088•••	−0.064•••
13	SIC267X	0.0130	0.1135	0	1	−0.009•	0.001	−0.103•••	0.069•••	0.038•••	0.001	0.151•••
14	SIC2711	0.0085	0.0921	0	1	−0.004	−0.001	−0.093•••	0.116•••	0.064•••	0.057•••	0.007
15	SIC2721	0.0056	0.0749	0	1	0.009	0.009	−0.082•••	0.058•••	0.088•••	−0.010•	0.099•••
16	SIC2731	0.0088	0.0932	0	1	−0.005	−0.001	−0.093•••	0.058•••	0.053•••	0.007	0.046•••
17	SIC2834	0.0383	0.1918	0	1	0.026•••	0.019•••	−0.010•	0.041•••	−0.022•••	−0.044•••	−0.206•••
18	SIC2835	0.0147	0.1204	0	1	0.016•••	−0.003	−0.085•••	−0.043•••	0.026•••	−0.114•••	0.081•••
19	SIC2851	0.0054	0.0736	0	1	0.002	0.002	−0.081•••	0.062•••	0.095•••	0.030•••	0.123•••
20	SIC2911	0.0208	0.1426	0	1	−0.010•	0.007	−0.102•••	0.135•••	0.011•	0.190•••	−0.111•••
21	SIC3089	0.0183	0.1339	0	1	0.002	0.013•	−0.105•••	0.069•••	0.018•••	−0.022•••	0.089•••
22	SIC331X	0.0239	0.1528	0	1	−0.007	0.009	−0.097•••	0.075•••	0.001	0.084•••	−0.064•••
23	SIC355X	0.0229	0.1497	0	1	−0.007	0.003	−0.097•••	0.021•••	0.003	−0.034•••	−0.053•••
24	SIC357X	0.0749	0.2632	0	1	−0.002	0.000	0.236•••	−0.066•••	−0.063•••	−0.039•••	0.135•••
25	SIC365X	0.0119	0.1083	0	1	0.001	0.007	−0.101•••	0.032•••	0.045•••	0.017•••	0.166•••
26	SIC3661	0.0227	0.1488	0	1	0.003	−0.009	−0.089•••	−0.013••	0.004	−0.026•••	0.255•••
27	SIC3674	0.0235	0.1514	0	1	0.000	−0.004	−0.089•••	−0.012••	0.003	−0.012•	0.158•••
28	SIC3714	0.0216	0.1454	0	1	−0.004	−0.006	−0.100•••	0.111•••	0.007	0.047•••	0.076•••
29	SIC3812	0.0150	0.1215	0	1	−0.003	−0.004	−0.103•••	0.088•••	0.030•••	0.009	0.121•••
30	SIC3841	0.0192	0.1370	0	1	0.005	0.003	−0.098•••	−0.027•••	0.016•••	−0.081•••	0.195•••
31	SIC3845	0.0229	0.1495	0	1	0.001	0.001	−0.062•••	−0.058•••	0.005	−0.106•••	0.010•
32	SIC3861	0.0115	0.1067	0	1	−0.003	0.000	−0.100•••	0.000	0.033•••	−0.020•••	0.194•••
33	SIC421X	0.0208	0.1427	0	1	0.000	−0.002	−0.101•••	−0.021•••	0.007	0.027•••	0.040•••
34	SIC4512	0.0162	0.1264	0	1	−0.002	−0.008	−0.105•••	−0.050•••	0.025•••	0.082•••	−0.095•••
35	SIC481X	0.0536	0.2253	0	1	0.012•	0.016••	0.044•••	−0.046•••	−0.045•••	0.098•••	−0.148•••
36	SIC4833	0.0096	0.0975	0	1	−0.005	−0.006	−0.095•••	0.081•••	0.056•••	0.010•	0.164•••
37	SIC4911	0.0378	0.1908	0	1	−0.009	−0.012•	−0.035•••	−0.078•••	−0.022•••	0.143•••	−0.380•••
38	SIC5311	0.0152	0.1224	0	1	0.001	0.001	−0.102•••	−0.005	0.031•••	0.100•••	0.058•••
39	SIC5411	0.0225	0.1484	0	1	0.001	0.010	−0.098•••	−0.017•••	0.006	0.132•••	−0.095•••
40	SIC5812	0.0437	0.2045	0	1	0.001	−0.003	−0.024•••	−0.023•••	−0.031•••	−0.006	−0.042•••
41	SIC602X	0.0959	0.2944	0	1	−0.019•••	−0.017••	0.463•••	−0.171•••	−0.081•••	0.170•••	−0.487•••
42	SIC6211	0.0177	0.1319	0	1	0.004	−0.005	−0.099•••	−0.018•••	0.020•••	0.028•••	0.148•••
43	SIC6311	0.0164	0.1271	0	1	0.001	0.002	−0.105•••	0.127•••	0.022•••	0.088•••	0.011•
44	SIC7011	0.0172	0.1300	0	1	0.002	0.001	−0.104•••	0.022•••	0.021•••	−0.034•••	0.191•••
45	SIC731X	0.0068	0.0824	0	1	−0.003	−0.005	−0.087•••	−0.015•••	0.075•••	−0.003	0.054•••
46	SIC7372	0.0336	0.1803	0	1	0.005	0.000	0.015•••	−0.076•••	−0.017•••	−0.062•••	−0.057•••
47	SIC7812	0.0116	0.1072	0	1	−0.006	−0.006	−0.098•••	0.038•••	0.044•••	−0.014••	0.113•••

**Note*. Bivariate correlations for industry dummy variables omitted. The ROA sample contained 42,201 total spells and the Tobin's *q* sample contained 32,822 total spells.

•••is significant at the 0.001 level.

••is significant at the 0.01 level.

•is significant at the 0.05 level.

1989), SIC 4512—Airlines (Hambrick et al. 1996, Ramaswamy et al. 1994, Schefczyk 1993, Tushman and Anderson 1986), SIC 481—Telephone Communications (Barnett 1997, Kashlak and Joshi 1994), SIC 5311—Department Stores (Harrigan 1985), SIC 602—Commercial Banks (Amel and Rhoades 1988, Cool et al. 1989, Fox-Wolfgramm et al. 1998, Pennings and Harianto 1992, Reger et al. 1992), SIC 6311—Life Insurance (Fiegenbaum and Thomas 1990, Ranger-Moore et al. 1991), and SIC 7812—Motion Picture Production (Miller and Shamsie 1996, Robins 1993). The other 30 industries were chosen at random, although weighted by size of industry (while the overall sample represents 9% of the industries available, and 14% of the industries with 20 firms or more, it also includes 64% of the 25 largest industries and 38% of the 100 largest; as a consequence of this weighting the sample includes 6,772 firms, or 33% of the firms in the COMPUSTAT database). Ten of the selected industries were consolidated to the three-digit SIC level because some firms were only classified at the three-digit level (xxx0; six of 10), and/or the adjacent four-digit SIC industries were close competitors in the same product-markets (seven of 10), and/or the industries had been studied at the three-digit SIC level in prior research (two of 10). These 10 three-digit industries are Gold and Silver Mining (SIC 104x), Converted Paper (SIC 267x), Steel Works (SIC 331x), Special Industry Machinery (SIC 355x), Office Equipment and Computing Machinery (SIC 357x), Household Audio and Video Equipment (SIC 365x), Trucking (SIC 421x), Telephone Communications (SIC 481x), Commercial Banks (SIC 602x), and Advertising Agencies (SIC 731x). Thus the final sample includes 30 four-digit SIC-level industries and 10 three-digit SIC-level industries. The industries in the sample represent seven out of 10 one-digit SIC-level categories, including (1) Mining and Construction, (2) Natural Resource Products, (3) Manufacturing, (4) Transportation and Public Utilities, (5) Wholesale and Retail Trade, (6) Finance, Insurance, and Real Estate, and (7) Services. Only (0) Agriculture, Forestry, and Fishing, (8) Health, Legal, and Social Services, and (9) Public Administration are not represented. The complete sample, with some descriptive statistics, is presented in Table 2.

The second-mentioned industry selection problem is that the presence of diversified firms in an industry could potentially have an effect on the results. Because the primary statistical method to be employed focuses on mean and variances of returns, the diversification literature was searched to estimate the nature of the expected effects. With respect to the effect of diversified firms on the performance means, Hoskisson and Hitt (1990), summarizing some of both the theoretical and empirical literature, concluded that "a notable body of the research generally concluded that no relationship existed between firm diversification and performance" (Hoskisson and Hitt 1990, p. 469), and our independent review of the literature reached the same conclusion. Thus, mean returns should not be significantly biased in either direction by the inclusion of diversified firms. In terms of the variances of returns, Milgrom and Roberts (1992), following a long tradition, noted that firm diversification is designed to reduce risk, and defined risk as variance. In an empirical examination of diversification and risk (defined as variance) Amit and Livnat (1988) found, indeed, that diversification led to lower variances of returns. Thus the variances of returns should be biased toward stability (lower variances) by the inclusion of diversified firms. However, to ensure that diversification was not an issue in the stratification process, an additional empirical test (described below) was conducted to test the effect of the inclusion of diversified firms and, as reported in the next section, no effect was found. Also, as described previously, level of diversification (the entropy measure) was included as a control variable in all models.

Outlier Identification

This research focuses on what is essentially an outlier or frontier phenomenon (Starbuck 1993), superior economic performance. The fundamental problem faced in this research is the identification of the firms that exhibit this superior performance. All of the hypotheses developed depend on this identification. However, most statistical techniques are based on measures of central tendency, and focus instead on means and averages. Waring (1996), in his previously referenced study, even went so far as to *remove* outliers to improve his autoregressive models of decay, whereas our argument is that it is these very outliers that are of interest, which is why we are avoiding the use of autoregressive models. In order to identify superior performers over time, a new methodology, based on an iterative application of the Kolmogorov-Smirnov two-sample test, will be used (Ruefli and Wiggins 1994, 2000; Wiggins 1995).

To initialize the Iterative Kolmogorov-Smirnov stratification (IKS) technique, Hypothesis 1 will initially be assumed to be true, i.e., it will be assumed that there is a single distribution of performance for the entire industry or reference set and that no firm has statistically significant superior performance. Each firm's distribution of performance levels for a period will then be iteratively tested against the group distribution of performance levels for that period using the nonparametric Kolmogorov-Smirnov two-sample test.

Firms which are found to have performance distributions that are different in a statistically significant ($\alpha =$

Table 2 Descriptive Statistics for All Industries Including Modal Statistics for Both Dependent Variables (ROA and Tobin's *q*) 1974–1997

SIC	Industry Name	1 N	2 avg n (ROA)	3 Modal Mean ROA	4 Modal Stdev ROA	5 Total Spells ROA	6 SP Spells ROA	7 % SP Spells ROA	8 PSP Spells ROA	9 % PSP Spells ROA	10 # PSP Firms ROA	11 PSP Ratio ROA	12 Avg N (Q)	13 Modal Mean Q	14 Modal Stdev	15 Total Spells Q	16 SP Spells Q	17 % SP Spells Q	18 PSP Spells Q	19 % PSP Spells Q	20 # PSP Firms Q	21 PSP Ratio Q
1000	Metal mining	66	21.45	−12.87	73.71	429	73	17.02%	37	8.62%	5	7.58%	14.70	2.10	8.44	294	38	12.93%	7	2.38%	1	1.52%
104X	Gold and silver ores	180	57.35	−32.08	705.76	1147	241	21.01%	106	9.24%	14	7.78%	45.70	−5.02	243.21	914	128	14.00%	23	2.52%	3	1.67%
1311	Crude petroleum and natural gas	739	234.25	−9.07	257.15	4685	723	15.43%	327	6.98%	39	5.28%	171.30	1.84	101.26	3426	392	11.44%	157	4.58%	18	2.44%
1531	Operative builders	107	43.60	0.54	16.08	872	99	11.35%	25	2.87%	3	2.80%	33.55	0.93	4.01	671	37	5.51%	0	0.00%	0	0.00%
2621	Paper mills	39	23.15	4.23	7.27	463	77	16.63%	55	11.88%	5	12.82%	19.95	1.22	0.57	399	55	13.78%	27	6.77%	3	7.69%
267X	Paper and paperboard	70	27.10	3.79	10.90	542	98	18.08%	39	7.20%	2	4.29%	22.40	1.55	3.89	448	77	17.19%	41	9.15%	3	4.29%
2711	Newspaper publishing and printing	44	17.90	8.25	5.30	358	44	12.29%	17	4.75%	2	4.55%	14.75	2.38	4.74	295	39	14.58%	19	6.44%	2	4.55%
2721	Periodical publishing	38	11.55	−1.72	23.02	231	58	25.11%	45	19.48%	4	10.53%	8.20	2.21	8.06	164	45	27.44%	36	21.95%	3	7.89%
2731	Book publishing	47	18.10	4.09	8.12	362	79	21.82%	42	11.60%	5	10.64%	13.65	1.56	1.01	273	16	5.86%	7	2.56%	1	2.13%
2834	Pharmaceuticals	258	82.60	−16.61	45.89	1652	541	32.75%	319	19.31%	32	12.40%	69.45	4.13	11.76	1389	228	16.41%	104	7.49%	13	5.04%
2835	In vitro in vivo diagnostics	112	32.80	−59.54	481.25	656	196	29.88%	101	15.40%	11	9.82%	24.70	3.49	24.56	494	61	12.35%	7	1.42%	1	0.89%
2851	Paints and allied products	22	11.10	5.59	10.52	222	37	16.67%	27	12.16%	2	9.09%	8.85	1.64	0.88	177	16	9.04%	8	4.52%	1	4.55%
2911	Petroleum refining	85	43.35	4.32	4.84	867	66	7.61%	8	0.92%	1	1.18%	35.85	1.11	12.45	717	74	10.32%	37	5.16%	5	5.88%
3089	Misc. plastic products	107	37.75	2.36	7.33	755	147	19.47%	77	10.20%	7	6.54%	30.00	1.33	1.99	600	94	15.67%	49	8.17%	6	5.61%
331X	Steel works and blast furnaces	118	49.30	1.74	10.14	986	141	14.30%	41	4.16%	4	3.39%	39.60	0.76	5.20	792	110	13.89%	68	8.59%	6	5.08%
355X	Special industrial machinery	160	48.15	0.39	15.79	963	95	9.87%	26	2.70%	4	2.50%	39.60	1.16	12.95	792	95	11.99%	28	3.54%	4	2.50%
357X	Office equipment and elec. computing	557	161.30	−3.96	43.78	3226	491	15.22%	183	5.67%	22	3.95%	131.30	1.38	49.62	2626	380	14.47%	96	3.66%	12	2.15%
365X	Household audio and video equipment	87	23.95	0.61	11.27	479	65	13.57%	29	6.05%	4	4.60%	18.85	1.55	3.41	377	40	10.61%	19	5.04%	3	3.45%
3661	Telephone and telegraph equipment	164	48.95	−2.65	20.75	979	143	14.61%	62	6.33%	8	4.88%	39.30	0.41	47.46	786	41	5.22%	0	0.00%	0	0.00%
3674	Semiconductors and related devices	159	50.25	1.53	17.03	1005	115	11.44%	44	4.38%	7	4.40%	42.50	2.24	4.31	850	98	11.53%	16	1.88%	2	1.26%
3714	Auto parts and accessories	133	44.40	2.55	20.65	888	166	18.69%	89	10.02%	7	5.26%	35.95	1.43	3.38	719	54	7.51%	23	3.20%	3	2.26%
3812	Navigation and guidance systems	69	30.45	3.69	10.71	609	78	12.81%	36	5.91%	4	5.80%	25.80	2.05	5.03	516	29	5.62%	12	2.33%	2	2.90%

Table 2 (cont'd.) **Descriptive Statistics for All Industries Including Modal Statistics for Both Dependent Variables (ROA and Tobin's *q*) 1974–1997**

SIC	Industry Name	1 N	2 avg n (ROA)	3 Modal Mean ROA	4 Modal Stdev ROA	5 Total Spells ROA	6 SP Spells ROA	7 % SP Spells ROA	8 PSP Spells ROA	9 % PSP Spells ROA	10 # PSP Firms ROA	11 PSP Ratio ROA	12 Avg N (Q)	13 Modal Mean Q	14 Modal Stdev	15 Total Spells Q	16 SP Spells Q	17 % SP Spells Q	18 PSP Spells Q	19 % PSP Spells Q	20 # PSP Firms Q	21 PSP Ratio Q
3841	Surgical and medical equipment	159	40.85	−3.19	45.85	817	172	21.05%	74	9.06%	8	5.03%	30.30	4.48	33.04	606	74	12.21%	22	3.63%	3	1.89%
3845	Electromedical apparatus	185	50.75	−8.20	30.12	1015	149	14.68%	71	7.00%	7	3.78%	39.30	6.62	91.74	786	116	14.76%	24	3.05%	3	1.62%
3861	Photographic equipment and supplies	66	24.40	−0.37	29.36	488	58	11.89%	27	5.53%	3	4.55%	18.05	2.23	7.02	361	35	9.70%	6	1.66%	1	1.52%
421X	Trucking (except local)	148	42.15	1.62	12.50	843	173	20.52%	91	10.79%	9	6.08%	30.05	1.50	12.60	601	66	10.98%	23	3.83%	3	2.03%
4512	Airlines	110	33.80	−1.56	20.00	676	86	12.72%	28	4.14%	4	3.64%	25.20	1.60	6.41	504	19	3.77%	0	0.00%	0	0.00%
481X	Telephone communications	305	117.00	5.05	6.56	2340	346	14.79%	240	10.26%	27	8.85%	45.60	2.13	23.21	912	147	16.12%	75	8.22%	9	2.95%
4833	Television broadcast stations	75	20.15	2.97	15.09	403	73	18.11%	23	5.71%	3	4.00%	15.55	2.31	8.38	311	42	13.50%	0	0.00%	0	0.00%
4911	Electrical services	168	71.55	4.18	1.41	1431	110	7.69%	48	3.35%	5	2.98%	63.55	1.14	0.95	1271	26	2.05%	8	0.63%	1	0.60%
5311	Department stores	78	29.75	2.86	7.05	595	119	20.00%	71	11.93%	7	8.97%	22.45	0.92	8.65	449	54	12.03%	19	4.23%	2	2.56%
5411	Grocery stores	133	45.05	3.26	4.49	901	224	24.86%	178	19.76%	14	10.53%	35.70	2.35	38.93	714	156	21.85%	98	13.73%	10	7.52%
5812	Eating places	316	91.75	0.23	13.82	1835	372	20.27%	227	12.37%	20	6.33%	68.80	2.11	4.71	1376	156	11.34%	28	2.98%	5	1.58%
602X	Commercial banks	678	203.35	0.73	1.37	4067	267	6.57%	120	2.95%	13	1.92%	190.35	1.12	0.65	3807	165	4.33%	45	1.18%	6	0.88%
6211	Securities brokers and dealers	107	37.95	−0.68	34.88	759	174	22.92%	68	8.96%	7	6.54%	30.95	1.20	1.15	619	40	6.46%	14	2.26%	1	0.93%
6311	Life insurance	103	33.40	1.68	2.51	668	107	16.02%	48	7.19%	5	4.85%	31.35	1.00	0.60	627	42	6.70%	20	3.19%	3	2.91%
7011	Hotels and motels	102	35.20	−1.07	30.81	704	178	25.28%	117	16.62%	10	9.80%	21.55	1.40	3.01	431	56	12.99%	22	5.10%	2	1.96%
731X	Advertising agencies	64	14.25	1.11	15.33	285	36	12.63%	7	2.46%	1	1.56%	11.50	1.97	9.26	230	28	12.17%	0	0.00%	0	0.00%
7372	Prepackaged software	512	75.00	−4.89	43.10	1500	200	13.33%	99	6.60%	13	2.54%	54.90	4.83	32.67	1098	129	11.75%	31	2.82%	4	0.78%
7812	Motion picture production	102	24.90	−15.27	394.81	498	55	11.04%	10	2.01%	1	0.98%	20.00	2.53	13.85	400	48	12.00%	7	1.75%	1	0.98%
	Totals/averages	**6772**				**42201**	**6672**	**15.81%**	**3282**	**7.78%**	**350**	**5.17%**				**32822**	**3551**	**10.82%**	**1239**	**3.77%**	**139**	**2.16%**

0.05) fashion from the group distribution will be set aside, and the process will be repeated until the stratum of firms sharing the main distribution stabilizes. The firms excluded from the main performance stratum will then be used as the basis for forming a second stratum, and the process will be repeated. This iterative process will continue until no further inclusions or exclusions can be made.

Note that, unlike cluster analysis, the IKS method does not predetermine the number of strata of performance distributions for an industry; strata emerge based on the characteristics of the data and the significance level established to discriminate between distributions. Further, the IKS methodology is, in Ketchen and Shook's (1996) terms, a polythetic divisive multiple-pass technique and, as such, mitigates against both the subjective involvement of the researcher and incompleteness of single-pass algorithms characteristic of traditional clustering techniques.

While the performance strata developed by the Iterative Kolmogorov-Smirnov analysis form naturally ordered categories (Argresti 1984) from high performance to poor performance that are statistically significantly different from each other, the possibility of varying numbers of performance strata over time exists, making longitudinal comparisons difficult. Because we are only interested in the firms whose performance is above the industry or reference set modal stratum, as a form of *a fortiori* analysis (since it is conservative with respect to the hypotheses being tested), in each time period the number of performance strata will be compressed to three by creating two supersets of strata: those above the modal stratum and those below the modal stratum. These two supersets, along with the modal stratum, will form the basis for the analysis.

Examining the membership of the above-modal performance stratum over time to determine if any firms remain in this stratum for multiple overlapping time periods will complete the test of Hypothesis 1, that no firms will exhibit persistent superior economic performance.

Hypothesis Testing with Event History Analysis

To test the second set of hypotheses, models of the rates at which firms enter the superior performance stratum will be estimated using discrete-time event history analysis techniques (Allison 1984, Tuma and Hannan 1984). Event history methods are preferred over linear regression models in the study of discrete-state change processes. In this context, the major problem with linear regression models is that they fail to take into account the timing of state changes, which may (or may not be) relevant.

The main function of event history analysis is to estimate a hazard function so that the instantaneous rate of change for a firm can be calculated at time t. In the case of persistent superior economic performance (PSP), the hazard function is defined as follows:

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr[PSPt,\ t + \Delta t | \sim PSP\ at\ t]}{\delta t}$$

where $\Pr[PSPt, t + \Delta t | \sim PSP\ at\ t]$ is the probability of a firm entering the superior-performance stratum between time t and time $t + \Delta t$, conditional on *not* being in the superior-performance stratum at time t.

Discrete-time maximum-likelihood models (Allison 1984, 1995) will be used to estimate firm transition rates. These models apply logistic regression to the analysis of pooled cross-sectional and time-series data. A separate observational record will be created for each time period in which a firm is not in (or enters) the PSP stratum, then for each firm period the dependent variable is coded 1 if the firm entered the PSP stratum in that period and 0 otherwise. Logistic regression models of the dichotomous dependent variable will then be estimated for the pooled sample (Allison 1984, 1995). Hypothesis 2a will be tested by entering the four-firm concentration ratio into the model, and Hypothesis 2b by entering firm market share.

Hypothesis Testing with Ordinal Time Series Analysis

To test Hypothesis 3, that the stratum of firms exhibiting superior economic performance will remain stable over time, ordinal time series analysis (OTSA) will be employed. OTSA is a technique, based on state-determined systems instead of measures of central tendency, which is able to deal with the problem of missing observations such as firms coming into and going out of business (Collins and Ruefli 1992, Ruefli and Wilson 1990). In particular, computed OTSA transition matrices (Collins and Ruefli 1992) reporting the frequency of transition shifts among the ordered strata of the superior-performance stratum, the modal-performance stratum, and the inferior-performance stratum will be compared to stable transition matrices in which the superior-performance stratum transition is unitary (i.e., there are no transitions out of the superior-performance stratum) via the G^2 statistic (Hays 1988, Wickens 1989) used to compare observed and expected values.

Results

As the first step toward testing the hypotheses developed previously, the two sets of 40 industry samples were individually stratified with the Iterative Kolmogorov-Smirnov method. For each sample this method formed

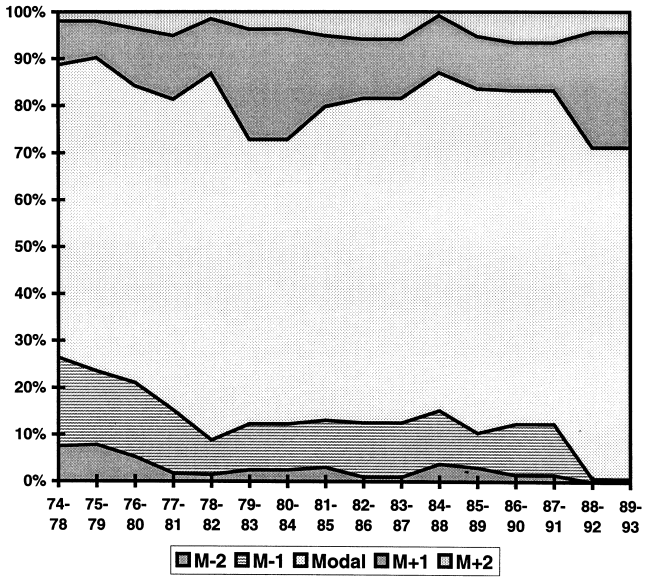
strata of statistically significantly different performance levels. The strata for the computer industry (SIC 357) Tobin's q statistics that were derived are shown graphically across time in Figure 1, labeled as Modal, M + n (above modal), and M-n (below modal). As can be seen from the figure, the number of strata varied across time. But for both measures, for all samples, this variance remained small. For each of the samples examined, by each measure, in each period a significant fraction of the firms (roughly 70% in the ROA samples and 84% in the Tobin's q samples) were categorized by the Iterative Kolmogorov-Smirnov technique in the modal stratum. Table 2 shows the modal strata means and standard deviations for both samples for all 40 industries in Columns 3 and 4 (ROA) and Columns 13 and 14 (Tobin's q).

To generate the superset strata, all strata above the modal stratum were combined into the superior-performance stratum, while all strata below the modal stratum were combined to form the inferior-performance stratum. The strata sizes are consistent between the two measures of performance. To validate the stratification supersets, DFA was employed in a confirmatory mode on a random sample of the industries studied. For these industries, all of the discriminant functions were significant ($p < 0.05$) for both variables, demonstrating the validity of the superset performance strata.

The Effects of Diversification

Because the industry samples were based upon primary SIC code, some diversified firms that also conducted business in other SIC codes were included in these samples.

Figure 1 **Percentage of Firms in Tobin's q Strata Across Time in Computer Industry (SIC 357)**



To determine if the inclusion of the diversified firms materially affected the results for the nondiversified firms, the latter[1] were subsampled from the computing industry (SIC 357) ROA sample and the entire analysis described above was repeated on just those firms. Once again, all of the discriminant functions were statistically significant at least at the $p < 0.05$ level, and the average classification rate of over 60% was over two and one-half times that expected by chance. To compare the classifications of the nondiversified subsample with those from the complete sample, each set of the observations was pooled and Cohen's kappa for interrater agreement was calculated. The two sets of analyses agreed on over 88% of the classifications with a value of kappa of 0.756 (with a standard error of 0.023 for an approximate z-score of 31.972, significant at the $p < 0.001$ level). Cohen's kappa was also computed for each five-year window. In one period, the number of groups was unbalanced and kappa could not be computed, but in all the other periods kappa was significant at the $p < 0.001$ level, and in two periods the two analyses agreed on 100% of the classifications. With such high levels of agreement between the two sets of analyses, the inclusion of the diversified firms does not appear to materially affect the outcomes of the analyses, which is consistent with the conclusions of Hoskisson and Hitt (1990).

Hypothesis One: Persistent Superior Economic Performance

To test Hypothesis 1, the superset strata described above were examined to determine if any firms remained in the superior-performance stratum for six consecutive five-year windows or longer. In four of the Tobin's q samples, at least one firm remained in the above-average stratum for at least 16 (representing 20 years) of the 20 windows covering the 24 years of data. These firms are shown in Table 3. In 18 of the 40 ROA samples, at least one firm remained in the above-average stratum for at least 16 of the 20 windows generated. These firms are shown in Table 4. Note that three of the four Tobin's q firms, Tambrands, Inc. (Paper), Worthington Industries (Steel), and Food Lion, Inc. (Grocery Stores), also appear on the ROA list.

Overall, we find 146 firms in the Tobin's q sample and 350 in the ROA sample that achieve persistence of superior performance. In percentages, 5.17% of the ROA firms and 2.16% of the Tobin's q firms achieved at least 10 years of persistent superior economic performance. In all 40 of the industries in the ROA sample at least one firm achieved at least 10 years of persistent superior economic performance.

Only in five out of the 40 industries in the Tobin's q

Table 3 Firms Achieving 20 or More Years of Persistent Superior Performance (Tobin's *q*), 1974–1997

SIC	Industry	Firm	Years of PSP
267x	Paper and Paperboard	Tambrands, Inc.*	1974–1997*
2721	Periodical Publishing	CCH Inc.*	1974–1994*
331x	Steel Works and Blast Furnaces	Worthington Industries*	1974–1997*
5411	Grocery Stores	Food Lion Inc.*	1974–1997*

**Note.* Left-censored firm that entered PSP strata prior to 1974 and is not in hazard model in Table 5.

sample (1531—Operative Builders, 3661—Telephone and Telegraph Equipment, 4512—Airlines, 4833—Television Broadcasting, and 731x—Advertising Agencies) did *no* firm achieve even 10 years of persistent superior economic performance. So in both samples, Hypothesis 1 is overwhelmingly rejected. These results differ from the regression-based findings of Jacobsen (1988), who found, using ROI, that *all* abnormal profits decay over time, but extend Mueller's (1986) results, which were that some firms sustained profitability over the earlier period 1950–1972. It is of special interest to note that American Home Products and Eli Lilly & Co. (Pharmaceuticals) and Minnesota Mining and Manufacturing Company (Paper) were persistent superior performers in Mueller's 1950–1972 sample (1986) as well as in ours, indicating

Table 4 Firms Achieving 20 or More Years of Persistent Superior Performance (ROA), 1974–1997

SIC	Industry	Firm	Years of PSP
2621	Paper Mills	P.H. Glatfelter Co.	1974–1993
267x	Paper and Paperboard	Minnesota Mining & Mfg Co.*	1974–1996*
		Tambrands, Inc.*	1974–1997*
2721	Periodical Publishing	Plenum Publishing Corp.	1976–1997
2834	Pharmaceuticals	American Home Products Corp.*	1974–1997*
		Lilly (Eli) & Co.*	1974–1997*
2851	Paints and Allied Products	Moore (Benjamin) & Co	1977–1996
3089	Plastic Products	Liqui-Box Corp.	1976–1997
		Rubbermaid Inc.	1975–1995
331x	Steel Works and Blast Furnaces	Worthington Industries*	1974–1996*
357x	Computing Machinery and Office Equipment	Hewlett-Packard Co.*	1974–1997*
3714	Automotive Parts	Clarcor Inc.*	1974–1997*
		Universal Manufacturing Co.*	1974–1997*
3841	Surgical and Medical Instruments	Stryker Corp.	1977–1997
3845	Electromedical Apparatus	Medtronic Inc.	1977–1997
421x	Trucking	United Parcel Service AM Inc.*	1974–1997*
		Arnold Industries Inc.	1976–1997
481x	Telephone Communications	Hickory Tech Corp.	1977–1997
5311	Department Stores	Mercantile Stores Co. Inc.*	1974–1996*
5411	Grocery Stores	Albertsons Inc.*	1974–1997*
		Brunos Inc.	1975–1994
		Food Lion Inc.*	1974–1995*
		Publix Super Markets Inc.*	1974–1997*
		Weis Markets Inc.*	1974–1997*
		Winn-Dixie Stores Inc.*	1974–1997*
5812	Eating Places	Bob Evans Farms*	1974–1996*
		Luby's Cafeterias Inc.*	1974–1997*
		McDonalds Corp.	1974–1997
		Ruby Tuesday Inc.*	1974–1994*
6211	Securities Brokers and Dealers	Edwards (A G) Inc.	1974–1997
7011	Hotels and Motels	Hilton Hotels Corp.*	1974–1996*
		Marcus Corp.*	1974–1997*

**Note.* Left-censored firm that entered PSP strata prior to 1974 and is not in hazard model in Table 6.

that *very* long-term persistence of superior performance appears to be possible.

Hypothesis Two: Concentration, Market Share, and Persistence

Hypothesis 2 posits that small numbers of firms will achieve persistent superior economic performance. Figure 2 shows the percentages of firms, by industry, achieving superior economic performance for multiple time periods in the Tobin's *q* samples. As can be seen in Figure 2 (and also in Table 2, Column 21, PSP Ratio *q*), fewer than 8% of the firms in the 40 industry samples achieve statistically significant superior economic performance in at least six overlapping five-year windows (i.e., 10 years) sometime between 1974 and 1997 (8% is the maximum, observed in three industries; 0% is the minimum, observed in four industries; the mean and median percentage across industries is 2% of firms). As mentioned previously, this is substantially below the 14.88% of firms identified as superior performers by Mueller (1986). As the number of periods increases the proportion of firms who maintain such performance decreases very rapidly. For the ROA industry samples (Table 2, Column 11, PSP Ratio ROA) the numbers were slightly higher, but at most 13% of firms in a particular industry achieved 10 years of persistent superior economic performance (this was in the paper mills industry, SIC 2621; the other four industries that had more than 10% of the firms in the industry achieving persistence were periodical publishing—SIC 2721, book publishing—SIC 2731, pharmaceuticals—SIC 2834, and grocery stores—SIC 5411), and on average only 5% did so (with a minimum of 1%, and a median of 5%; 10 of the 40 industries exceeded the 8% maximum found in the Tobin's *q* samples).

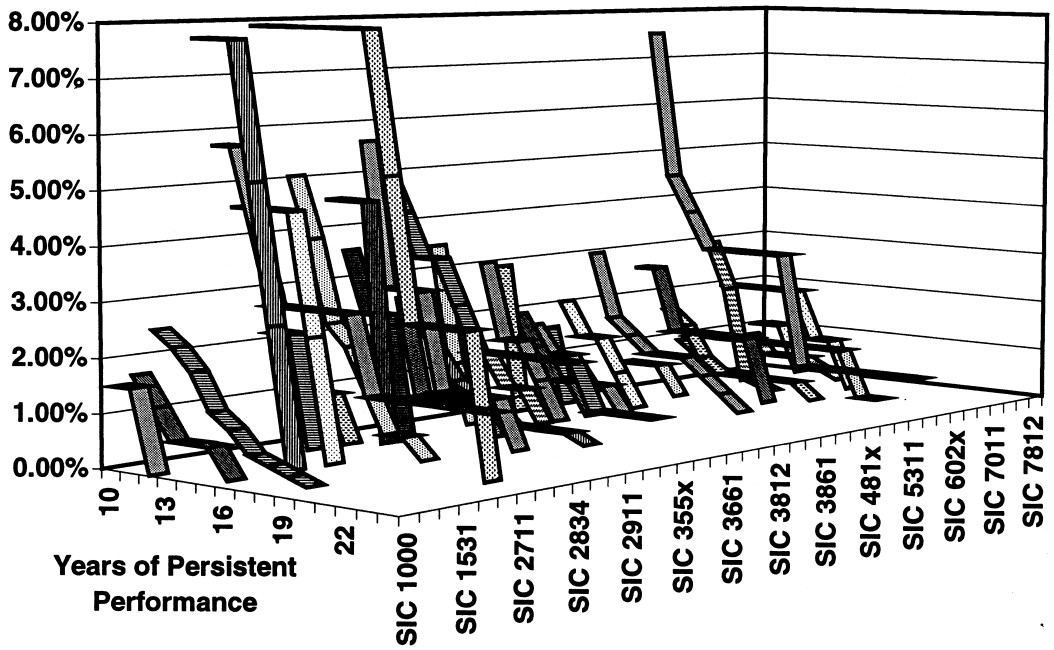
Two of the theories, SCP industrial organization and evolutionary economics, that predict the observed small numbers of firms exhibiting persistent superior economic performance in the industry samples do so on the basis of industry concentration (Hypothesis 2a) and/or market share (Hypothesis 2b). To examine whether this is in fact the mechanism that leads to the small numbers observed, the four-firm concentration ratio was used to test Hypothesis 2a. As can be seen from Tables 5 and 6, which show the results of the event history analysis, the four-firm concentration ratio coefficient is not significant for any model for either measure of performance.[2] Models were also estimated using the two-firm concentration ratio and the results were similar, with no significant effect of concentration. Note also that of the 40 industry dummy variables only the five listed by industry in Table 5 (Tobin's *q*) and the 14 listed in Table 6 (ROA) were significant—indicating that, in general, industry membership was not a significant factor in persistent superior economic performance. Given these results, there is no support for the Industry Concentration Hypothesis 2a. These results are consonant with the regression-based work of Jacobsen (1988), who found no effect of concentration on the persistence of abnormal profits measured using ROI, as well as with the regression-based work of Mueller (1986), who found the effect of concentration in only a few industries, and also with the seminal work of Lindenberg and Ross (1981), who found that concentration was not correlated with Tobin's *q*.

The results of the tests of Hypothesis 2b, on the relationship between market share and performance, are more intriguing. As shown in Table 6, in the ROA samples the coefficients for market share are not significant, but as shown in Table 5, market share significantly positively improves the log-odds of entering the PSP stratum for the Tobin's *q* sample. So while market share does not have a relationship with accounting performance, it does have a relationship with stock market performance, which implies that investors value market share. Note also that the coefficient for size, which is positive and significant in the ROA models, significantly *negatively* affects the log-odds of entering the PSP stratum in the Tobin's *q* sample. Taken together, these two results imply that smaller firms with large market shares—hence, in relatively smaller (and possibly younger) industries—are more likely to achieve persistent superior market performance, which is logical when you consider cases such as Microsoft and Novell in the computer software industry (SIC 7372). Both of these firms entered the PSP stratum as soon as they went public, and thereby entered the Tobin's *q* sample at a time when they both had relatively large market shares but were still of comparatively small size since the industry was in its infancy. Since that time, of course, their large market shares have led to considerably larger sizes, but this effect is not captured in these models.

In the ROA sample, as shown in Table 6, the coefficient for size is positive and significant, as previously stated, and the coefficient for the entropy measure of diversification is negative and significant. Taken together, these results imply that larger firms with lower levels of diversification are more likely to achieve persistent superior economic performance. Looking to Table 4, we find 23 of the 32 very long-term superior performers are single-business firms (note that most of these firms are left censored and therefore are not in the hazard model, so this is additional evidence that persistent superior economic performance is associated with lower levels of diversification).

The effects of industry are also of interest in these models. In the Tobin's *q* samples (Table 5), being in the pharmaceuticals, petroleum refining, steel works, telephone

Figure 2 **Percentage of Firms Exhibiting Superior Economic Performance Over Multiple Time Periods (Tobin's *q* Sample)**



communications, or grocery store industries had a significant positive effect on the log-odds of achieving persistent superior economic performance, although these effects went away when concentration ratios (an industry-level variable) were included. All five of these industries had average concentration ratios below 50% (only six other industries had similarly low ratios) and include three of the six lowest, which would indicate that not only does concentration not enhance the ability to achieve persistent market performance, it could actually detract. In the ROA samples (Table 6), 10 industries had significant coefficients in all models (seven positive and three negative), and another four had significant coefficients in at least one model (three positive and one negative), but there was no similar relationship between industry and concentration ratios. Only one industry, pharmaceuticals (SIC 2834), had significant positive coefficients in both sets of samples, which again points to the significant gap between market and accounting performance measures. This gap is even more apparent when noting that two commodity industries, petroleum refining (SIC 2911) and steel works (SIC 331X), had positive significant coefficients in the Tobin's *q* models, but had negative significant coefficients in the ROA hazard models.

Hypothesis Three: Stability and Persistence

Hypothesis 3 was tested using ordinal time series analysis transition tables. Table 7 reports the transition matrix for the entire sample for ROA, in which the rows represent the prior period states (in this case, strata ordered by performance), and the columns represent the subsequent period states (or strata). The matrix elements therefore give the frequency of a firm moving from the row stratum in the prior period to the column stratum in the subsequent period. For example, in Table 7, the frequency of a firm in the modal stratum (State or Row 0) making the transition to the superior-performance stratum (State or Column $+1$) is 0.038, as shown in the cell at Row 0, Column $+1$.

Hypothesis 3 argued for stability in the membership of the superior-performance strata over time. For the ROA sample, the only stratum that is close to stable is the modal stratum, as shown in Table 7, with a probability of 0.919 that firms will remain in that stratum from period to period. Results for the entire sample in terms of Tobin's *q*, shown in Table 8, are similar. If the numbers in the transition matrices are regarded as probabilities for a 10-year period, the probability that a firm will remain in the above-average stratum over this period, representing persistence of performance, is only 0.088 in the ROA sample and 0.033 in the Tobin's *q* sample. Testing Hypothesis 3 by comparing the observed transition incidence matrices to expected-value matrices in which the above-average stratum is completely stable yields G^2 (Hays 1988, Wickens 1989) values of 1,633.4 for the Tobin's *q* sample and 2,471 for the ROA sample, both of which are significant at the $p < 0.001$ level with two degrees of

Table 5 Maximum Likelihood Estimates of Persistent Superior Performance (Tobin's *q*) for 40 Industries, 1974–1997*

	Model			
Variable	1	2	3	4
Density	−0.0040	−0.0043	−0.0040	−0.0048
	(0.0039)	(0.0041)	(0.0040)	(0.0042)
Size	−0.1607•••	−0.1604•••	−0.1986•••	−0.1986•••
	(0.0390)	(0.0390)	(0.0383)	(0.0381)
Entropy	−0.3197	−0.3216	−0.5390	−0.5558
	(0.2872)	(0.2872)	(0.2954)	(0.2972)
Pharmaceuticals	2.0233•	1.8904	2.0895•	1.7265
	(0.9623)	(1.1184)	(0.9629)	(1.1150)
Petroleum Refining	2.0845•	1.9698	2.3288•	2.0191
	(1.0272)	(1.1385)	(1.0282)	(1.1338)
Steel Works and Blast Furnaces	1.8355	1.7615	2.0050•	1.8053
	(1.0040)	(1.0529)	(1.0050)	(1.0509)
Telephone Communications	2.0868•	1.9905	2.1953•	1.9303
	(0.9765)	(1.1603)	(0.9768)	(1.0623)
Grocery Stores	2.1541•	2.0603	2.2955•	2.0396
	(0.9967)	(1.0745)	(0.9973)	(1.0724)
4-Firm Conc. Ratio		1.2403		0.3818
		(2.4196)		(2.4183)
Market Share			0.0528•••	5.2706•••
			(0.0130)	(1.3606)
Log-likelihood	−715.41	−715.37	−709.82	−709.61

**Note.* The Tobin's *q* model contained 22,151 spells. Only the five industries whose dummy variables had statistically significant coefficients are displayed; the thirty-five non-significant industry dummy variables are omitted.

••• is significant at the 0.001 level.

•• is significant at the 0.01 level.

• is significant at the 0.05 level.

freedom. Thus, in both of the samples, membership in the above-average performing strata is not stable over time, with multiple firms entering and leaving the strata, so Hypothesis 3 is not supported.

Discussion and Implications

We tested three hypotheses derived from several strategic management and economic theories about the persistence of superior economic performance of firms over time. In contrast to Hypothesis 1, which argues the neoclassical economic view that no firm will achieve persistent superior economic performance in an industry, we found firms in almost every industry sample that achieved at least 10 years of persistent superior economic performance, and we even identified three firms that have maintained persistent superior economic performance for almost 50 years. Similar nonconfirming results were found for Hypothesis 3, which predicted that groups of firms exhibiting persistent superior economic performance will have stable membership over time. We found instead that the composition of these groups of firms changed, sometimes greatly, over time. Finally, somewhat mixed results were obtained in the tests of Hypotheses 2, 2a, and 2b. Hypothesis 2, that small numbers of firms would obtain persistent superior economic performance, was supported. Hypothesis 2a, that industry concentration would be associated with persistent economic performance, was not supported. Hypothesis 2b, that market share would be associated with persistent superior economic performance was supported when performance was measured with a market measure, but not supported when performance was measured with an accounting measure.

These results have interesting implications for both economics and strategic management perspectives on sustained competitive advantage, as summarized in Table 9. The reader should note, however, that we directly tested only the SCP paradigm of industrial organization and its strategic management counterpart. Inferences

Table 6 Maximum Likelihood Estimates of Persistent Superior Performance (ROA) for 40 Industries, 1974–1997*

	Model			
Variable	1	2	3	4
Density	0.0017	−0.0010	0.0016	−0.0010
	(0.0028)	(0.0032)	(0.0028)	(0.0032)
Size	0.2174•••	0.2148•••	0.2184•••	0.2121•••
	(0.0293)	(0.0293)	(0.0324)	(0.0324)
Entropy	−0.5634••	−0.5622••	−0.5605••	−0.5700••
	(0.1890)	(0.1892)	(0.1931)	(0.1934)
Metal Mining	1.3523••	1.7210•••	1.3565••	1.7157•••
	(0.4791)	(0.5220)	(0.4824)	(0.5227)
Gold & Silver Ores	1.3214•••	1.0678••	1.3231•••	1.0593••
	(0.3210)	(0.3558)	(0.3218)	(0.3585)
Periodical Publishing	1.7254••	2.0159•••	1.7275••	2.0145•••
	(0.5346)	(0.5592)	(0.5353)	(0.5592)
Pharmaceuticals	1.6576•••	1.1067••	1.6559•••	1.1027••
	(0.2481)	(0.3938)	(0.2491)	(0.3942)
In Vitro In Vivo	2.0055•••	2.0148•••	2.0095•••	2.0050•••
Diagnostics	(0.3538)	(0.3536)	(0.3578)	(0.3571)
Petroleum Refining	−2.3283•	−2.8197••	−2.3336•	−2.8136••
	(0.9937)	(1.0301)	(0.9962)	(1.0305)
Steel Works and Blast	−0.8927	−1.2168•	−0.8953	−1.2149•
Furnaces	(0.5863)	(0.6131)	(0.5874)	(0.6132)
Telephone & Telegraph	0.6759	1.1638•	0.6474	1.1680•
Equipment	(0.3821)	(0.4797)	(0.3826)	(0.4803)
Surgical & Medical	1.0501••	1.5117••	1.0530••	1.5112••
Equipment	(0.3868)	(0.4665)	(0.3887)	(0.4665)
Electromedical	0.8753•	0.8033	0.8777•	0.7962
Apparatus	(0.4082)	(0.4105)	(0.4094)	(0.4120)
Electrical Services	−0.9521•	−2.0583••	−1.1972•	−2.0648••
	(0.4756)	(0.6765)	(0.4770)	(0.6773)
Commercial Banks	−1.7030••	−2.1093••	−1.7048••	−2.1109•••
	(0.5319)	(0.5791)	(0.5324)	(0.5791)
Hotels and Motels	0.7647	1.1728•	0.7655	1.1771•
	(0.4341)	(0.4918)	(0.4342)	(0.4923)
Prepackaged Software	0.9656••	0.9042••	0.9674••	0.8989••
	(0.3224)	(0.3260)	(0.3233)	(0.3271)
4-Firm Conc. Ratio		−1.9715		−2.2338
		(1.2836)		(1.2390)
Market Share			−0.0008	0.0021
			(0.0103)	(0.0105)
Log-likelihood	−1512.77	−1511.11	−1512.77	−1511.08

**Note.* The ROA model contained 27,048 spells. Only the fourteen industries whose dummy variables had statistically significant coefficients are displayed; the twenty-six non-significant industry dummy variables are omitted.

••• is significant at the 0.001 level.

•• is significant at the 0.01 level.

• is significant at the 0.05 level.

about many of the other theoretical perspectives are primarily based on ruling out alternative explanations from the SCP IO/Porter perspective.

The sustained competitive advantage notion of the SCP paradigm of industrial organization, which is also the foundation for much research in strategy (such as the

Table 7 ROA State Transition Rates for the Entire Sample

TO → / FROM	+1	0	−1
+1	0.784	0.195	0.021
0	0.038	0.919	0.042
−1	0.030	0.208	0.762

Table 8 Tobin's *q* State Transition Rates for the Entire Sample

TO → / FROM	+1	0	−1
+1	0.711	0.244	0.045
0	0.025	0.957	0.018
−1	0.121	0.260	0.618

work of Porter) receives mixed support from the results of this research. While the existence of persistent superior economic performance (H1) and the small number of firms achieving it (H2) is in accord with SCP industrial organization and Porter's sustained competitive advantage, one of the mechanisms by which SCP IO and Porter argue that this will occur, industry concentration (H2a), is not supported in either of the industry samples. The other mechanism, large market share (H2b), is only supported in the Tobin's *q* sample. Porter's theory of strategic groups (H3) with mobility barriers and predictive validity is also not supported in either of these samples (see also Wiggins and Ruefli (1995).

The prediction of neoclassical economics, the baseline model for many of the economic theories, is also not supported. The existence, however rare, of very long-term (20 or more years) persistent superior economic performance (H1) in 22 out of the 80 industry samples and long-term (10 or more years) persistent superior economic performance in 75 out of the 80 industry samples is an indication that an equilibrium condition is rarely, if ever, achieved.

Evolutionary economics and the Austrian school of economics fare somewhat better. The existence of very long-term (20 or more years) persistent superior economic performance (H1) contradicts their long-term predictions, although the changing membership of the top performance stratum (H3) is consistent with their predictions of cycles of innovation leading to periods of persistent superior economic performance. However, because we do not measure predictors of the changing membership, we do not know the reasons for the changes, only that such changes would be consistent with the theory. The small numbers of firms achieving persistent superior economic performance (H2), while consistent with evolutionary economics, does not directly support the theory because it is not associated with the predicted industry concentration (H2a).

The most favorable outcome for any of the theoretical perspectives is for the strategic management resource-based view of the firm, which receives some support from the results of two of the hypothesis tests and is consonant

Table 9 Implications of Results for Theoretical Perspectives

Theoretical Perspective Economics	H1 No Firms	H2 Small Numbers	H2A Concentration	H2B Market Share	H3 Stability
1. Neoclassical economics	−				
2A. SCP paradigm IO	+	+	−	$+_{q-ROA}$	−
2B. Price theory IO	+				
3. Evolutionary economics	−	1	−		1
4. Austrian economics	−	1			1
Strategic management					
5A. Porter	+	+	−	$+_{q-ROA}$	−
5B. Resource-based view	+	+	1	1	1

$^{+}$Hypothesis test result offers some support for theory
$^{-}$Hypothesis test result does not support theory
1: Hypothesis test result consonant with theory
0: Hypothesis test result not consonant with theory
blank—Hypothesis test not directly relevant to theory

with the others. Persistent superior economic performance, which is held to be the fundamental objective of the firm in the resource-based view (e.g., Conner), is found to exist (H1) but is also found to be rare (H2), which is consistent with the concept of rare and valuable resources which lead to sustained competitive advantages. None of the supported hypotheses contradict the resource-based view of the firm. However, we did not measure firm resources in this research, and so we cannot claim that firm resources directly impact performance or its persistence, although we did rule out some of the alternative explanations offered by the other theoretical perspectives.

Very modest support is offered for price theory industrial organization economics. This perspective is also supported by the existence of persistent superior economic performance (H1), but because none of our variables directly relate to this perspective, we cannot speculate further.

The key finding of this research for management practice is that the demonstrated rarity of achieving sustained superior economic performance implies that it is extremely difficult to achieve. That in turn implies that it can only be achieved by strategies that are very skillfully implemented and adapted over long periods of time (and may have to be very innovative). It is thus unlikely that imitation or adoption of knowledge available in the market will serve as a path to sustained superior performance. The results also indicate that there may even be a question as to whether sustained superior performance is even a reasonable goal to set for a firm. Stedry's (1960) budgeting studies showed that goals, to be effective motivators, should be perceived as reachable—albeit with additional effort. The findings here indicate that for some industries sustained superior performance may not be achievable, and for many other industries may be so rare as to be practicably unachievable. An associated finding for management practice is that even if superior performance is achieved and sustained for a period of time, the probability of slipping from that lofty perch is relatively high. Thus managers, while working against it, should be prepared for that eventuality and should be ready to formulate revised strategies for once again moving into the superior-performance stratum. In that regard, it is worth noting in Table 8 that the path from the modal-performance stratum to the superior-performance stratum might better lead through the inferior-performance stratum—at least in terms of Tobin's q as a performance measure. Note that, on average, firms went from the -1 stratum to the $+1$ stratum almost five times more frequently than they went from the 0 stratum to the $+1$ stratum (0.121 vs. 0.025). This implies that for a firm in the modal stratum it may be that performance should first be sacrificed to gain a better chance at ensuing superior performance, although this may also (or instead) imply that when performance declines to a certain point, the top management team is motivated to make substantial changes to enhance the performance of the firm.[3]

The findings of this research also have implications for strategic management research. The fact that persistent superior economic performance is indeed rare, and that therefore the search for a single structural advantage such as proposed by Porter is unlikely to be successful, implies that the search for multiple small incremental advantages may be a fruitful alternative for managers to pursue and for strategic management researchers to investigate. For example, Hewlett-Packard, the firm that achieved 24 years of persistent superior economic performance in the computer industry, and 3M, which achieved 23 years in the paper and paperboard industry, are both recognized for their multiple successive successful product innovations. It may be that the strategy *process* at Hewlett-Packard and 3M which has led to such a series of successes is, in fact, their sustained competitive advantage (Adler et al. 1989, Bowen et al. 1994, Brown and Eisenhardt 1997).

An aspect of this research which does not directly address any of the hypotheses, but which points the way for some future examination, is the large preponderance of firms in all time periods and in all samples that fell into the average or modal-performance stratum. A minimum of 47% and as many as 90% of firms in some industries were statistically indistinguishable from the average. This large number of average firms, coupled with the relative symmetry of the sizes of the above-average and below-average strata, may offer an explanation for why previous research in economics using measures of central tendency (primarily regression analysis) found support for so many of the theories for which the present research failed to find support.

The temporal dynamics observed in this research also suggest that revisions to extant theories may be able to explain the observed behavior. As noted, well over half of all firms on average fall into the modal stratum. The behavior of these firms is consistent with the neoclassical equilibrium model, although instead of converging on a point of zero profits (where price equals marginal cost), they converge on a distribution around a point, and as seen in Table 2, that point is often near zero or even below zero. The variations around the mean of the modal stratum, rather than representing simple random variation, could be explained by the more relaxed assumptions of organizational economics (Chandler 1990, Cyert and March 1963, Teece 1983), with bounded rationality

(Simon 1976) and complex preference functions (Cyert and March 1963) accounting for the fluctuations. As has been mentioned, the fact that few firms that achieve persistent superior economic performance is consistent with the predictions of the resource-based view of the firm. Thus, the entire system could be viewed as a homeostasis, with the modal stratum representing the base state.

In such a homeostatic model, a few firms achieve superior economic performance, but the regulating mechanisms of Austrian and evolutionary economics, imitation and competition, constantly put pressure on these firms to return to the main group. A few firms also fail to achieve the performance levels of the homeostatic group, and end up in the below-modal stratum, where most (if not all) firms are losing money. These firms must either return to the main group by becoming more efficient, or they continue the downward spiral and fail, becoming data points in ecological studies of organizational mortality. Some of the inferior performers are those firms investing heavily in attempting to achieve a competitive advantage (such as computer industry firms seeking technological advances or pharmaceutical firms working on patentable medicines), and if it is achieved they can make the transition directly from the below-average to the above-average stratum, a behavior of which this research found some evidence in the Tobin's *q* sample, as previously mentioned. The behaviors observed in this research are all consistent with such a complex homeostatic model of performance.

Limitations of the Research

One limitation of this research is its reliance on the corporate-level data available in the COMPUSTAT data base, which is further exacerbated by potential industry identification problems caused by using SIC codes. On the other hand, the problem of diversified firms has been shown empirically to be not significant.

The primary limitation of this research is related to the prior limitation, and that is that due to data availability constraints (as well as complexity), the models are not fully specified enough to test all of the theoretical perspectives. We have previously noted that many of the inferences we draw about some of the theoretical perspectives are only the result of ruling out alternative explanations. Of particular interest would be future research that examined the effects of resources and innovation on persistent superior economic performance.

Another limitation of this research is in the minimum time frame, 10 years, selected to represent persistent superior economic performance. While we feel that this made for a conservative test, particularly of Hypothesis 1, and that it eliminated any spurious effects from a single outstanding performance year, it may very well be that the appropriate time frames are shorter, varying by industry or by competitive arena. An associated limitation is that the data employed are both right- and left-censored. However, they do cover almost three decades, and precisely the three decades in which the concept of sustained competitive advantage rose to prominence in strategic management research. The use of additional data (1972–1973) to ameliorate the left-censoring problem was also of benefit, as 20 persistent superior performance transitions otherwise would have been lost to left-censoring.

Directions for Future Research

Although research by the authors has examined a number of other industries with results very similar to those reported here, the most obvious direction for future research is to extend the methods used in this research to other industries, more samples, and other time periods. A more in-depth examination of regulated industries would also be of interest. For example, a more comprehensive longitudinal study of the airline industry or the trucking industry (both of which are included in this research) that spanned the periods before and after deregulation might be revealing. Also, replication over a longer time frame such as 40 or 50 years would be of great interest, particularly because this time frame would encompass the periods most heavily studied by the early empirical work in strategic management research and would enhance the comparability of this research with prior investigations. Additionally, a replication of this study, but employing smaller windows (i.e., four or even three years in length) would provide a less conservative level of qualification for sustained superior performance.

This research looked only at the rates of *entry* into the superior performance stratum; it would also be of great interest to look at the rates of *exit* from this stratum and the effects of many of the same variables. This would further extend the work of Mueller (1986, 1990), Jacobsen (1988), and the many others who examined the *decay* of persistence by applying this new methodology to a question that has only been addressed with autoregressive models.

In addition, the path firms take in reaching superior performance, whether by monotonic improvements or by incurring a performance debt, deserves further study. It would be informative to know whether firms that moved from the submodal stratum to the superior stratum stayed in that stratum for longer or shorter periods of time than firms that moved from the modal stratum to the superior stratum did.

Because the achievement of the outcomes associated

with sustained competitive advantage was found to be limited to a handful of firms, and even for most of those firms further limited in temporal extent, future theoretical development will be required to adapt theories of the firm to reflect this reality. Of all the theoretical perspectives examined in this research, only the resource-based view of the firm is consistent with all of the findings of this research. It may be possible to construct a theoretical economic model, such as the homeostatic model proposed in the discussion section above, based on the richer and more relaxed assumptions of organizational and evolutionary economics, that can account for the behaviors observed in the current research. Such a model might be able to integrate many of the theoretical perspectives that this research draws upon to develop a more complex model of firm behavior that could predict the kinds of results found in this research.

In conclusion, by examining the topography of economic performance via a new data-driven technique that identifies statistically significant superior economic performance, this research offers some important insights into the temporal dynamics of sustained competitive advantage. The avoidance of measures of central tendency allowed relationships that might have been obscured by averages to be highlighted, and the stratification technique employed resolved the problem of distinguishing superior economic performance. Implications for theories of strategic management and economics are significant in that the revealed topography reveals an environment quite different in some aspects than that envisioned in several extant theories.

Acknowledgments

The authors wish to thank Jay Barney, Jan Beyer, Allen Bluedorn, W. W. Cooper, Allison Davis-Blake, Kathleen Conner, Janet Dukerich, Kathleen Eisenhardt, Rob Folger, Dick Foster, Brian Golden, Jovan Grahovac, Ira Harris, Michael Hitt, David Jemison, Preston McAfee, Reuben McDaniel, Hao Ma, Richard Makadok, Paul Mang, Robert Nixon, Dan Schendel, David Schkade, Herb Simon, Jack Walters, seminar participants at the University of South Carolina, SUNY Buffalo, the University of Texas at Austin, ITESM Mexico City, Universidad de Los Andes, Tulane University, and McKinsey & Co.; and ten anonymous referees for comments and suggestions on earlier versions of this research. Special thanks to Andy Henderson for methodological assistance, to Hemang Desai for data collection assistance, to Frances Hauge Fabian for multiple readings and many comments, and to Claudia Bird Schoonhoven for excellent editorial guidance.

Endnotes

[1]To remain consistent with prior diversification research, the coding was done strictly on SIC code classifications, even though this meant that many firms that would not be considered diversified by industry experts were in fact coded as diversified. For example, PC clone computer manufacturers such as Dell, Gateway 2000, Zeos, and others all report SIC codes for software, communications devices, and other add-ons that are ancillary to their main business.

[2]The event history models were initially estimated including both linear and nonlinear time-covariate terms to determine if the hazard rate changed over time, but the coefficients for the time covariates were not only not statistically significant, indicating that the hazard rate did not change over time, but also had a mild suppression effect on some of the other time-varying covariates, such as size, so these variables were removed and the models reestimated.

[3]We are indebted to an anonymous referee for this insight.

References

Adler, P. S., H. E. Riggs, S. C. Wheelwright. 1989. Product development know-how: Trading tactics for strategy. *Sloan Management Rev.* **31** 7–17.

Allison, P. D. 1984. *Event History Analysis: Regression for Longitudinal Event Data*. Sage, Beverly Hills, CA.

——. 1995. *Survival Analysis Using the SAS System: A Practical Guide*. SAS Institute, Inc., Cary, NC.

Amel, D. F., S. A. Rhoades. 1988. Strategic groups in banking. *Rev. Econom. Statist.* **70** 685–690.

Amit, R., J. Livnat. 1988. Diversification and the risk-return trade-off. *Acad. Management J.* **31** 154–166.

——, P. J. H. Schoemaker. 1993. Strategic assets and organizational rent. *Strategic Management J.* **14** 33–46.

Ansoff, H. I. 1965. *Corporate Strategy*. McGraw-Hill, New York.

Argresti, A. 1984. *Analysis of Ordinal Categorical Data*. John Wiley & Sons, New York.

Arrow, K., F. Hahn. 1971. *General Competitive Analysis*. Holden Day, San Francisco, CA.

Bain, J. S. 1959. *Industrial Organization*. Wiley, New York.

Baird, I. S., D. Sudharshan, H. Thomas. 1988. Addressing temporal change in strategic groups analysis: A three-mode factor analysis approach. *J. Management* **14** 425–440.

Barnett, W. P. 1997. The dynamics of competitive intensity. *Admin. Sci. Quart.* **42** 128–160.

Barney, J. B. 1991. Firm resources and sustained competitive advantage. *J. Management* **17** 99–120.

——, R. E. Hoskisson. 1990. Strategic groups: Untested assertions and research proposals. *Managerial and Decision Econom.* **11** 187–198.

Baumol, W. J. 1982. Contestable markets: An uprising in the theory of industry structure. *Amer. Econom. Rev.* **72** 1–15.

Becker, G. S. 1964. *Human Capital*. Columbia, New York.

Besanko, D., D. Dranove, M. Shanley. 1996. *The Economics of Strategy*. John Wiley & Sons, Inc., New York.

Bowen, H. K., K. B. Clark, C. A. Holloway, S. C. Wheelwright. 1994. Development projects: The engine of renewal. *Harvard Bus. Rev.* **72** 110–120.

Brown, S. L., K. M. Eisenhardt. 1997. The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Admin. Sci. Quart.* **42** 1–34.

——, ——. 1998. *Competing on the Edge: Strategy as Structured Chaos*. Harvard Business School Press, Boston, MA.

Caves, R. E., M. E. Porter. 1977. From entry barriers to mobility barriers: Conjectural decisions and contrived deterrence to new competition. *Quart. J. Econom.* **91** 421–441.

Chakravarthy, B. S. 1986. Measuring strategic performance. *Strategic Management J.* **7** 437–458.

Chandler, A. D., Jr. 1990. *Scale and Scope: The Dynamics of Industrial Capitalism*. Harvard University Press, Cambridge, MA.

Collins, J. M., T. W. Ruefli. 1992. Strategic risk: An ordinal approach. *Management Sci.* **38** 1707–1731.

Conner, K. R. 1991. A historical comparison of resource-based theory and five schools of thought within industrial organization economics: Do we have a new theory of the firm? *J. Management* **17** 121–154.

Cool, K., I. Dierickx. 1993. Rivalry, strategic groups and firm profitability. *Strategic Management J.* **14** 47–59.

——, D. E. Schendel. 1987. Strategic group formation and performance. *Management Sci.* **33** 1102–1124.

——, ——. 1988. Performance differences among strategic group members. *Strategic Management J.* **9** 207–223.

——, I. Dierickx, D. B. Jemison. 1989. Business strategy, market structure and risk-return relationships: A structural approach. *Strategic Management J.* **10** 507–522.

Cyert, R. M., and J. G. March. 1963. *A Behavioral Theory of the Firm*. Prentice-Hall, Englewood Cliffs, NJ.

D'Aveni, R. A. 1994. *Hypercompetition: Managing the Dynamics of Strategic Maneuvering*. The Free Press, New York.

Debreu, G. 1959. *The Theory of Value*. Wiley, New York.

Dess, G. G. 1987. Consensus on strategy formulation and organizational performance: Competitors in a fragmented industry. *Strategic Management J.* **8** 259–277.

——, P. S. Davis. 1984. Porter's (1980) generic strategies as determinants of strategic group membership and organizational performance. *Acad. Management J.* **27** 467–488.

Droucopoulos, V., T. P. Lianos. 1993. The persistence of profits in the Greek manufacturing industry. *Internat. Rev. Appl. Econom.* **7** 163–176.

Eisenhardt, K. M., L. J. Bourgeois, III. 1988. Politics of strategic decision making in high-velocity environments: Toward a midrange theory. *Acad. Management J.* **31** 737–770.

——, B. N. Tabrizi. 1995. Accelerating adaptive processes: Product innovation in the global computer industry. *Admin. Sci. Quart.* **40** 84–110.

Fiegenbaum, A., H. Thomas. 1988. Attitudes toward risk and the risk-return paradox: Prospect theory explanations. *Acad. Management J.* **31** 85–106.

——. 1990. Strategic groups and performance: The U.S. insurance industry, 1970–84. *Strategic Management J.* **11** 197–216.

Foster, R., S. Kaplan. 2001. *Creative Destruction: Why Companies That Are Built to Last Underperform the Market—And How to Successfully Transform Them*. Doubleday, New York.

Fox-Wolfgramm, S. J., K. B. Boal, J. G. Hunt. 1998. Organizational adaptation to institutional change: A comparative study of first-order change in prospector and defender banks. *Admin. Sci. Quart.* **43** 87–126.

Fredrickson, J. W. 1984. The Comprehensiveness of Strategic Decision Processes: Extension, Observations, Future Directions. *Acad. Management J.* **27** 445–466.

Geroski, P. A., A. Jacquemin. 1988. The persistence of profits: A European comparison. *The Econom. J.: The J. Royal Econom. Society* **98** 375–389.

Ghemawat, P. 1986. Sustainable advantage. C. A. Montgomery, M. E. Porter, eds. *Strategy: Seeking and Securing Competitive Advantage.* Harvard Business Review, Cambridge, MA. 27–38.

Goddard, J. A., J. O. S. Wilson. 1996. Persistence of profits for UK manufacturing and service sector firms. *Service Industries J.* **16** 105.

Granovetter, M. 1984. Small is beautiful: Labor markets and establishment size. *Amer. Soc. Rev.* **49** 323–334.

Hambrick, D. C., T. S. Cho, M.-J. Chen. 1996. The influence of top management team heterogeneity on firms' competitive moves. *Admin. Sci. Quart.* **41** 659–684.

Hannah, M. T., J. Freeman. 1989. *Organizational Ecology*. Harvard University Press, Cambridge, MA.

Harrigan, K. R. 1985. An application of clustering for strategic group analysis. *Strategic Management J.* **6** 55–73.

Hays, W. L. 1988. *Statistics*. Holt, Rinehart & Winston, Inc., Fort Worth, TX.

Hill, C. W. L., G. S. Hansen. 1991. A longitudinal study of the cause and consequences of changes in diversification in the U. S. pharmaceutical industry 1977–86. *Strategic Management J.* **12** 187–199.

Hirsch, P. M. 1975. Organizational effectiveness and the institutional environment. *Admin. Sci. Quart.* **20** 327–338.

Hoskisson, R. E., M. A. Hitt. 1990. Antecedents and performance outcomes of diversification: A review and critique of theoretical perspectives. *J. Management* **16** 461–509.

——, ——, R. A. Johnson, D. D. Moesel. 1993. Construct validity of an objective (entropy) categorical measure of diversification strategy. *Strategic Management J.* **14** 215–235.

Hunt, M. S. 1972. Competition in the major home appliance industry 1960–1970. Unpublished doctoral dissertation, Harvard University, Cambridge, MA.

Jacobsen, R. 1988. The persistence of abnormal returns. *Strategic Management J.* **9** 415–430.

Jacobson, R. 1992. The 'Austrian' school of strategy. *Acad. Management Rev.* **17** 782–807.

Jacquemin, A. P., C. H. Berry. 1979. Entropy measure of diversification and corporate growth. *J. Indust. Econom.* **27** 359–369.

Kashlak, R. J., M. P. Joshi. 1994. Core business regulation and dual diversification patterns in the telecommunications industry. *Strategic Management J.* **15** 603–611.

Kerin, R. A., V. Mahajan, P. R. Varadarajan. 1990. *Contemporary Perspectives on Strategic Market Planning*. Allyn and Bacon, Boston, MA.

Ketchen, D. J., Jr., C. L. Shook. 1996. The application of cluster analysis in strategic management research: An analysis and critique. *Strategic Management J.* **17** 441–458.

Klein, B. H., R. G. Crawford, A. A. Alchian. 1978. Vertical integration, appropriable rents and the competitive contracting process. *J. Law and Econom.* **21** 297–326.

Lindenberg, E., S. Ross. 1981. Tobin's q ratio and industrial organization. *J. Bus.* **54** 1–32.

Mason, E. S. 1939. Price and production policies of large-scale enterprise. *Amer. Econom. Rev.* **29** 61–74.

——. 1949. The current state of the monopoly problem in the United States. *Harvard Law Rev.* **62** 1265–1285.

Milgrom, P., J. Roberts. 1992. *Economics, Organization and Management*. Prentice Hall, Englewood Cliffs, NJ.

Miller, D., J. Shamsie. 1996. The resource-based view of the firm in two environments: The Hollywood film studios from 1936 to 1965. *Acad. Management J.* **39** 519–542.

Mueller, D. C. 1986. *Profits in the Long Run*. Cambridge University Press, Cambridge, U.K.

——, ed. 1990. *The Dynamics of Company Profits*. Cambridge University Press, Cambridge, U.K.

Murray, A. I. 1989. Top management group heterogeneity and firm performance. *Strategic Management J.* **10** 125–141.

Nayyar, P. R. 1993. Performance effects of information asymmetry and economies of scope in diversified service firms. *Acad. Management J.* **36** 28–57.

Nelson, R. R., S. G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Belknap Press, Cambridge, MA.

Newman, H. H. 1973. Strategic groups and the structure/performance relationship: A study with respect to the chemical process industries, Unpublished doctoral dissertation, Harvard University, Cambridge, MA.

Oliver, C. 1997. Sustainable competitive advantage: Combining institutional and resource-based views. *Strategic Management J.* **18** 697–713.

Ollinger, M. 1994. The limits of growth in the multidivisional firm: A case study of the U.S. oil industry from 1930–90. *Strategic Management J.* **15** 503–520.

Palepu, K. 1985. Diversification strategy, profit performance and the entropy measure. *Strategic Management J.* **6** 239–255.

Pennings, J. M., F. Harianto. 1992. The diffusion of technological innovation in the commercial banking industry. *Strategic Management J.* **13** 29–46.

Perfect, S. B., K. W. Wiles. 1992. Alternative constructions of Tobin's q: An empirical comparison, Unpublished working paper, Florida State University, Tallahassee, FL.

Pfeffer, J., P. Nowak. 1976. Joint ventures and interorganizational interdependence. *Admin. Sci. Quart.* **21** 398–412.

Pisano, G. P. 1990. The R&D boundaries of the firm: An empirical analysis. *Admin. Sci. Quart.* **35** 153–176.

Porter, M. E. 1973. *Consumer Behavior, Retailer Power, and Manufacturer Strategy in Consumer Goods Industries*, Unpublished doctoral dissertation, Harvard University, Cambridge, MA.

——. 1979. The structure within industries and companies' performance. *Rev. Econom. Statist.* **61** 214–227.

——. 1980. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. The Free Press, New York.

——. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. The Free Press, New York.

——. 1996. What is strategy? *Harvard Bus. Rev.* **74** 61–78.

Ramaswamy, K., A. S. Thomas, R. J. Litschert. 1994. Organizational performance in a regulated environment: The role of strategic orientation. *Strategic Management J.* **15** 63–74.

Ranger-Moore, J., J. Banaszak-Holl, M. T. Hannan. 1991. Density-dependent dynamics in regulated industries: Founding rates of banks and life insurance companies. *Admin. Sci. Quart.* **36** 36–65.

Reger, R. K., I. M. Duhaime, J. L. Simpert. 1992. Deregulation, strategic choice, risk and financial performance. *Strategic Management J.* **13** 189–204.

Ricardo, D. 1817. *Principles of Political Economy and Taxation*. J. Murray, London, U.K.

Robins, J. A. 1993. Organization as strategy: Restructuring production in the film industry. *Strategic Management J.* **14** 103–118.

Ruefli, T. W., R. R. Wiggins. 1994. When mean square error becomes variance: A comment on 'Business risk and return: A test of simultaneous relationships'. *Management Sci.* **40** 750–759.

——, ——. 2000. Longitudinal performance stratification: An iterative Kolmogorov-Smirnov approach. *Management Sci.* **46** 685–692.

——, C. L. Wilson. 1990. Data considerations and rank statistics, T. W. Ruefli, ed. *Ordinal Time Series Analysis.* Quorum Books, New York. 13–32.

Schefczyk, M. 1993. Operational performance of airlines: An extension of traditional measurement paradigms. *Strategic Management J.* **14** 301–317.

Schendel, D. E. 1994. Introduction to the summer 1994 special issue—'Strategy: Search for New Paradigms'. *Strategic Management J.* **15** 1–4.

Schmalensee, R. 1985. Do markets differ much? *Amer. Econom. Rev.* **75** 341–351.

Schohl, F. 1990. Persistence of profits in the long run: A critical extension of some recent findings. *Internat. J. Indust. Organ.* **8** 385–404.

Schumpeter, J. A. 1934. *The Theory of Economic Development*. Oxford University Press, New York.

Shalit, S. S., U. Sankar. 1977. The measurement of firm size. *Rev. Econom. Statistics* **59** 290–298.

Simon, H. A. 1976. *Administrative Behavior*. (3rd ed.). The Free Press, New York.

South, S. E. 1981. Competitive advantage: The cornerstone of strategic thinking. *J. Bus. Strategy* **12** 15–25.

Starbuck, W. H. 1993. Strategizing in the real world. *Internat. J. Tech. Management* **8** 77–86.

Stedry, A. C. 1960. *Budget Control and Cost Behavior*. Prentice-Hall, Englewood Cliffs, NJ.

Stigler, G. J. 1968. *The Organization of Industry*. Richard D. Irwin, Homewood, IL.

Sudharshan, D., H. Thomas, A. Fiegenbaum. 1991. Assessing mobility barriers in dynamic strategic groups analysis. *J. Management Stud.* **28** 429–439.

Teece, D. J. 1980. Economics of scope and the scope of an enterprise. *J. Econom. Behavior and Organ.* **1** 223–247.

——. 1983. Toward an economic theory of the multiproduct firm. *J. Econom. Behavior and Organ.* **3** 38–63.

——. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing, and public policy. *Res. Policy* **15** 285–305.

Tomer, J. F. 1987. *Organizational Capital: The Path to Higher Productivity and Well-being*. Praeger, New York.

Tuma, N. B., M. T. Hannan. 1984. *Social Dynamics: Models and Methods*. Academic Press, New York.

Tushman, M. L., P. Anderson. 1986. Technological discontinuities and organizational environments. *Admin. Sci. Quart.* **31** 439–465.

Varaiya, N., R. A. Kerin, D. Weeks. 1987. The relationship between

growth, profitability, and firm value. *Strategic Management J.* **8** 487–497.

Waring, G. F. 1996. Industry difference in the persistence of firm-specific returns. *Amer. Econom. Rev.* **86** 1253–1265.

Westley, F., H. Mintzberg. 1989. Visionary leadership and strategic management. *Strategic Management J.* **10** 17–32.

Wickens, T. D. 1989. *Multiway Contingency Tables Analysis for the Social Sciences*. Lawrence Erlbaum Associates, Inc., Hillsdale, NJ.

Wiggins, R. R. 1995. Sustained Competitive Advantage: Temporal Dynamics and the Myth of Superior Economic Performance. Unpublished doctoral dissertation, University of Texas, Austin, TX.

——, T. W. Ruefli. 1995. Necessary conditions for the predictive validity of strategic groups: Analysis without reliance on clustering techniques. *Acad. Management J.* **38** 1635–1656.

Williamson, O. E. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*. The Free Press, New York.

Woo, C. Y., G. E. Willard, U. S. Daellenback. 1992. Spin-off performance: A case of overstated expectations. *Strategic Management J.* **13** 433–477.

Accepted by Claudia Bird Schoonhoven.