PRODUCT INNOVATION, PRODUCT–MARKET COMPETITION AND PERSISTENT PROFITABILITY IN THE U.S. PHARMACEUTICAL INDUSTRY

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Increasingly, strategy scholars are exploring the relationships between innovation, competition, and the persistence of superior profits. Sustained high profitability may result when a firm repeatedly introduces valuable innovations that service previously unmet consumer demands. While the returns to the firm from each innovation may erode over time, innovation ensures that, overall, the firm maintains a high performance position. At the same time, sustained high profitability may also accrue to firms that innovate less often, but effectively avoid the competition that otherwise erodes high returns. This paper elaborates these relationships before presenting an empirical analysis of the effects of differential innovative propensities and differential rates of competition on pharmaceutical firms’ abilities to sustain profit outcomes that are above those earned by competing firms. The analysis, which is situated within the U.S. pharmaceutical industry, finds support for the expected relationship between high innovative propensity and sustained superior profitability, but no support for a link between persistence and the ability to avoid competition.
the competitive position of each innovation over time (Rumelt, 1987; Williams, 1992).

The next section describes how a coherent analysis of firm-level profit dynamics must recognize that firms represent evolving portfolios of products. The framework that is presented indicates how variability in the propensity to innovate, as well as the ability to avoid competition, combine to explain why firms experience persistent profitability to differing degrees. The ensuing sections present an empirical analysis of the relationship between innovative propensity, product–market competition, and firm-level persistent profitability in the U.S. pharmaceutical industry. More specifically, it demonstrates that profit persistence is evident in the U.S. pharmaceutical industry, but that it varies across firms. It also demonstrates that firms vary in the two key dimensions which are thought to affect the degree of persistence: innovative propensity and the ability to avoid competition. Finally, the analysis quantifies the impact of innovative propensity and the severity of competition on profit persistence. The findings provide support for a relationship between high innovative propensity and sustained superior profitability. However, no significant relationship is found between the ability to avoid competition and persistent profitability. The closing section summarizes the implications of the paper and points toward avenues for further research.

INNOVATION, COMPETITION AND PERSISTENT PROFITABILITY

An understanding of firm-level persistent profitability must address two questions: Where do relatively high profits come from? and What factors operate in favor of their persistence (Mueller, 1986)? Schumpeter (1934, 1950) provides answers to both questions (Nelson, 1986). An innovative new product tends to face low competition at the point of introduction and therefore earns relatively high profits. These high profits attract imitators, which increase the level of competition faced by the product as time passes. Finally, this increased competition translates into reduced profits for the firm producing the new product.

Whereas Schumpeter suggests that the returns to an innovative new product will be high initially and eventually fall off as competition intensifies, he does not suggest that the profit profile of a firm must necessarily follow the same course. The direct connection between product-level competitive dynamics and firm-level profit dynamics is severed if one allows for multiproduct firms. Schumpeter (1950) himself argues that large firms are responsible for a disproportionate share of innovative output. This conjecture has spawned a large volume of empirical research, the results of which are mixed (see Cohen and Levin, 1989; Kamien and Schwartz, 1982). What is important for current purposes is not whether larger or smaller firms are more innovative per se, but rather the recognition that multiple innovations may be embodied within a single firm. Extending this, one expects that firms may introduce innovations at different points in their respective histories and that their profitability at any point in time is related to each of the innovations that have been introduced. Those introduced recently may still be in relative monopoly positions while older products may be exposed to much greater levels of competition.

Therefore, researchers interested in firm-level persistent profitability need to go inside the firm and examine how the firms’ product portfolios change over time. The following paragraphs outline a dynamic framework which recognizes that firms may differ in their propensity to generate valuable innovations, as well as their ability to buffer those innovations from competition. In other words, it is assumed that firms are heterogeneous with respect to both of Schumpeter’s dynamics and that this explains the observed pattern of firm-level persistent profitability.

As suggested, relatively high profits flow from innovations (Geroski, Machin, and Van Reenen, 1993). Once attained, high profits may persist in one of two ways. According to an anti-competition explanation, a firm may introduce an innovative product (or group of products) that is buffered from the competition that otherwise erodes the high profits associated with its introduction. This argument is consistent with the position taken by industrial organization economists, whereby persistent profitability is thought to imply anti-competitive (or entry-deterring) behavior on the part of firms. It is also consistent with observations made by Williams (1992), who notes that some products depend on slow-cycle resources and are isolated from the effects of
imitation for longer periods of time, and by Rumelt (1987) in his discussion of isolating mechanisms.

On the other hand, an innovation explanation recognizes that relatively high profits may persist at the firm level even though competition is relatively intense. In such a case, the excess profits associated with any single innovation are transitory, but firms successfully introduce multiple innovations over time. Whereas in the former case, persistent profitability accrues to firms with unchanging product portfolios, these latter firms sustain above-normal profits with rapidly changing product portfolios. Note how this innovation explanation is consistent with the following description of Sony Corporation:

After it introduces each new product, Sony experiences a rapid increase in sales and profits associated with that product. However, this leads other firms to reverse engineer the Sony product and introduce their own version. Increased competition leads the sales and profits associated with the new product to be reduced. Thus, at the level of individual products introduced by Sony, Sony apparently enjoys only very short-lived competitive advantages. However, by looking at the total returns earned by Sony across all of its products over time, the source of Sony’s sustained competitive advantage becomes clear … Sony is able to constantly introduce new and exciting personal electronics products. No one of these products generate a sustained competitive advantage. However, over time, across several such product introductions, Sony’s capability advantages do lead to a sustained competitive advantage. (Barney, 1995: 55)

Development of an innovation explanation for profit persistence is also supported by Montgomery (1995: 263), who argues that strategy researchers have long overemphasized equilibrium rents, paying less attention to ‘Schumpeterian rents, and resources and advantages that erode through time.’

**PERSISTENT PROFITABILITY RESEARCH**

The impetus for this research stems from a desire to understand the dynamics of firm-level profitability. It is therefore necessary to move away from cross-sectional analysis and towards a method that captures the intertemporal behavior of firm profits. Such a movement has already occurred within the industrial organization economics literature, spurred by scholars interested in the persistent profitability question. Mueller (1986) suggests that the dynamic behavior of firm profits may be examined by estimating the autoregressive properties of the profit time series (see also Geroski, 1990):

\[
\pi_t = \alpha + \beta \times \pi_{t-1} + \epsilon_t
\]

where \(\pi_t\) is the relative profitability of firm \(i\) in year \(t\): \(\pi_{it} = (\Pi_{it} - \Pi_{avg,t})/\Pi_{avg,t}\) (\(\Pi_{it}\) is the profit rate of firm \(i\) in year \(t\), and \(\Pi_{avg,t}\) is the average profit rate earned across all firms). As Geroski (1990) explains, this autoregressive profit model is a reduced-form representation of a more complex dynamic model wherein high profits attract entry, which subsequently lowers profitability. Therefore, empirical findings which indicate a high degree of persistence are interpreted as evidence of impediments to competitive entry.

In Equation (1), \(\alpha\) and \(\beta\) jointly describe the dynamics of firm profits. The \(\beta\) estimate (the persistence parameter) indicates the rate at which abnormal profits converge upon long-run levels. As shown in Figure 1, the path of profit convergence depends critically on the range into which the estimated value of \(\beta\) falls. Eventual convergence is assured only when \(\beta\) falls within the \(-1\) to +1 range. Parameter estimates outside of this range imply increasingly divergent profit outcomes over time, an outcome that economic theorists find problematic. Fortunately, in the vast majority of previous studies, \(\beta\) estimates fall within the 0 to +1 range. A \(\beta\) estimate that is not significantly different from 1 indicates a forestalling of the convergence process. In such cases, abnormal profits persist indefinitely. More generally, the higher is \(\beta\), the more persistent are the abnormal profit outcomes.

The \(\alpha\) and \(\beta\) also combine to indicate the level upon which firm profits converge in the long run. If the long run is the point at which period-to-period changes in profitability cease, then an indicator of the long-run rate of return \((\pi_{lr})\) may be obtained by setting \(\pi_{t-1}\) equal to \(\pi_{lr}\) (Schohl, 1990: 391): \(\pi_{lr} = \alpha/(1-\beta)\). When \(\pi_{lr}\) is not significantly different from zero, high and low profits converge upon normal levels in the long run. Conversely, an estimate that is significantly greater than zero indicates that
firms earn relatively high profits, even into the long run.

Equation (1) is the modal approach taken by persistent profitability researchers (e.g., Geroski and Jacquemin, 1988; Mueller, 1986; Schohl, 1990; Waring, 1996). In this analysis, industry-wide and firm-specific regressions are estimated. In the industry-wide regression, the $\alpha$ and $\beta$ coefficients are forced to be the same across all firms. Estimation uses the information contained in all the firms’ profit time-series to characterize overall industry profit dynamics. These results are complemented by examining profit dynamics in regressions wherein the $\alpha$ and $\beta$ estimates are allowed to vary across firms. These regressions identify those firms for which persistence and long-run profit levels are different from overall average. Finally, note that Equation (1) examines the path of convergence followed by all abnormal profit outcomes, including those that are below normal. However, the discussion in the preceding section refers to the persistence of above-normal profit outcomes. It says nothing about expectations vis-a-vis the dynamic path taken by abnormally low profits (this is not to say that the persistence of below-normal returns is not an interesting topic of study). As such, a variant of Equation (1) is estimated using only those observations for which $\pi_{t-1}$ is greater than zero.

**Modeling the effects of innovation and competition**

Persistent high profitability may be linked to a firm’s ability to innovate. In such a case, one expects abnormally high profits to demonstrate greater persistence and converge upon higher long-run levels if the extent of innovation is higher over the sample period. More formally, we hypothesize that:

**Hypothesis 1a:** Profit persistence ($\beta$) is positively related to firm innovative propensity.

**Hypothesis 1b:** Long-run profit rates ($\alpha/(1-\beta)$) are positively related to firm innovative propensity.

The above framework also leads us to expect that differences in the extent to which innovative new products are buffered against competition explain some of the variance in firm-level profit persistence. More specifically, more intense competition faced by innovative products over time should lead to less profit persistence and lower long-run profit levels:

**Hypothesis 2a:** Profit persistence ($\beta$) is negatively related to competition intensity at the product level.
Hypothesis 2b: Long-run profit rates \((\alpha/1-\beta)\) are negatively related to competition intensity at the product level.

These four hypotheses refer to the effects of innovative propensity and competition intensity on the persistence of abnormal firm-level profits. We test for such effects by estimating an elaborated version of Equation (1):

\[
\pi_t = \alpha + \alpha_1 \times \text{IN}_i + \alpha_2 \times \text{LC}_i + \beta \times \pi_{t-1} + \epsilon_t
\]

where \(\text{IN}_i\) reflects a firm’s innovative propensity, and \(\text{LC}_i\) captures a firm’s ability to avoid competition (the operationalization of these variables is discussed in the next section). Equation (2) allows for tests of whether these variables have a significant impact on the \(\alpha\) and \(\beta\) estimates from Equation (1). More specifically, Hypothesis 1a (2a) suggests that \(\beta_1\) (\(\beta_2\)) should be positive, while Hypothesis 1b (2b) implies positive estimates for \(\alpha_1\) (\(\alpha_2\)).

DATA AND ANALYSIS

The pharmaceutical industry is an ideal site for this research. Questions about the sources of persistent above-normal pharmaceutical firm profitability have dominated academic debates (Comanor, 1986). Moreover, discussion about pharmaceutical industry competition inevitably points to the inadequacy of static models of price competition and to the need for analysis to be grounded in dynamic notions of product competition (Cocks, 1975; Comanor, 1986). Finally, Henderson (1994) argues that, given the role that innovation has always played in the pharmaceutical industry, such firms should serve as models for firms in other industries who must compete in increasingly dynamic competitive environments.

Before proceeding, it is necessary to address the issues of measuring firm profitability and normal profitability. Debates about performance measurement are found in the strategy literature (Venkatraman and Ramanujam, 1986), the economics literature (Scherer and Ross, 1990), and the pharmaceutical economics literature (Schwartzman, 1976). While recognizing the importance of such debates, the primary aim of the following comments is to provide support for after-tax return on assets (ROA) as a measure of firm-level profitability. According to Scherer and Ross (1990: 416), ‘profit is the surplus of revenue over cost, including the cost of attracting capital from other uses.’ Although ideal measures are difficult to attain, they suggest three ‘second-best’ profitability measures: accounting rates of return (e.g., ROA), Tobin’s \(q\) ratio, and the price–cost margin. The correlations between accounting rates of return and Tobin’s \(q\) are typically quite high and ‘neither measure is innately superior to the other in detecting supra-competitive profits’ (Scherer and Ross, 1990: 417). Mueller (1990) agrees, suggesting that the primary difference between the two is that Tobin’s \(q\) tends to capture future economic returns, while ROA measures only current returns. The goal of this research is to analyze the period-to-period dynamics of current profitability that are attributable to innovative propensity and product–market competition. As such, it is not desirable to have current and future returns confounded in the same profit measure. As such, ROA (defined as the ratio of net income to total assets) is preferred as the measure of firm profitability. In support of this decision, note that accounting rates of return are used extensively by scholars examining the dynamics of firm profitability.1

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1 Much of the concern about using accounting rates of returns to indicate economic profitability relates to accountants’ decisions to expense, rather than capitalize R&D and advertising expenditures (Brownlee, 1979; Scherer and Ross, 1990). Because these expenditures contribute to the development of a firm’s intangible asset base, the argument is that they should be capitalized and subsequently expensed according to an appropriate depreciation schedule. This issue is critical to the measurement of pharmaceutical firm profitability because R&D and advertising outlays represent a very large component of overall expenditures. Those attempting to revise reported rates of return in accordance with this concern explain away a great portion of the pharmaceutical industry’s abnormally high profits (e.g., Schwartzman, 1976). There are several responses to this concern. First, the ability to explain away interindustry profit differentials is not universal. Menga and Mueller (1991), for example, find that considerable differences remain even after accounting for differential R&D and advertising propensities. Second, the assumptions made about the economic lives of R&D and advertising investments and about their depreciation profiles are, to a large degree, arbitrary (Clarkson, 1979: 119). This suggests that although revised rates of return may be different than those reported in firms’ financial statements, they are not necessarily more accurate in any absolute sense. Third, most of the discussion on this issue has been in the context of interindustry profitability comparisons. The current interest, however, is in intratrade propensity comparisons. To the extent that the firm-to-firm variance in R&D and advertising propensities is likely lower within, as opposed to across, industries, the above concern is not as significant.
Equations (1) and (2) model the autoregressive properties of *normalized* profit series. Mueller (1986) argues for the necessity to control for overall economic trends in order to capture the extent to which firms earn persistent abnormal returns. That is, abnormal should be specified in relation to some indicator of normal profits. In all preceding persistent profitability research, samples were comprised of firms from a number of different industries. As such, each researcher used some measure of economy-wide average profitability as the indicator of normal profits. However, the same group of researchers also distinguish between economy-wide average, industry average, and firm-specific returns (Cubbin and Geroski, 1987; Mueller, 1986; Rumelt, 1991; Waring, 1996). While certain elements of industry structure (Porter, 1985) are hypothesized to cause industry returns to deviate from the economy-wide average, these effects are distinguishable from those factors that cause firm-level returns to deviate from their respective industry averages (Grant, 1991). This research is interested in the extent to which pharmaceutical firms earn profits that are persistently higher than those earned by *competing pharmaceutical firms*. As such, the measure of normal profitability (asset-weighted average ROA across the sampled firms) used is an intraindustry measure (see Waring, 1996).

**Data**

The analysis combines data collected at the firm level with that collected at the product level. The product-level data are supplied by Intercontinental Medical Statistics America (IMS), who have collected pharmaceutical product data for at least the last 30 years (data from 1977 through 1993 are used in this analysis). These IMS data include the year of product introduction, annual product sales, therapeutic market (and submarket) membership, and total therapeutic market (and submarket) sales.\(^2\) In any year, a pharmaceutical firm may sell in excess of 100 different drug products. Moreover, a firm’s portfolios of products change from one year to the next. In order to keep the project manageable, only those products that achieved at least $1 million in sales in some year during the sample period (i.e., all significant product offerings) are considered. A total of 4914 drug products meet this sampling criterion. Although a large number of products are not included, the sampled products account for more than 95 percent of total U.S. pharmaceutical sales in any one year.

At the firm level, annual accounting data (net income and total assets) describing publicly-traded pharmaceutical firms are available from the Compustat (for U.S.-listed companies) and GlobalScope (for non-U.S.-listed companies) data bases. Uninterrupted time series of data (ranging from 5 to 17 years) were available for 42 firms that were in the top 40 (according to U.S. pharmaceutical sales) in any one of the sampled years. These firms were responsible for 1070 new product introductions over the 1977–93 period. The remaining products in the above data file were either introduced by nonsampled firms, introduced prior to 1977, or did not report introduction dates.

**Innovative propensity**

Hypotheses 1a and 1b posit a relationship between innovative propensity and profit persistence. This section describes an approach that generates the innovative propensity variable (IN\(_i\)). As suggested above, the firms in this study brought a total of 1070 new drug products to market during the sample period. However, not all of these drugs should be considered innovative; new pharmaceutical products range from being highly innovative at one extreme to highly imitative at the other (Kemp, 1975). Following this observation, an approach is required that identifies a subset of more innovative new drug

\(^2\) The following table illustrates the market structure used by IMS to organize their pharmaceutical products data. As the table shows, products are organized into a hierarchical structure that is similar to the Standard Industrial Classification system that is used to organize firms into industries:

```
30000 Cancer/Transplant Therapy
  30100 ...
  30200 ...
  30300 ...

31000 Cardiovascular Therapy
  31100 Antihypertensive Drugs
    31110 ...
    31120 ...
    31130 ...
    31140 Ace Inhibitors
      31141 Ace Inhibitors, Alone (Submarket)
      31142 Ace Inhibitors with Diuretic (Submarket)
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introductions. The one taken herein involves examining the products’ initial market shares:

\[ MS_{j0} = \left( \frac{SAL_{j0}}{MKTSAL_{j0}} \right) \times 100 \]

where \( SAL_{j0} \) is the sales of product \( j \) in its first full year on the market, and \( MKTSAL_{j0} \) is the sales of all products within the same therapeutic submarket in that same year (see footnote 2).³ Products introduced with relatively high initial market shares are considered more innovative.

Initial market shares range from 100 when a product is introduced into a true monopoly position (i.e., no other products possess sufficiently similar attributes to be considered competitors) to zero when the sales of all competitors dwarf its own sales. In this respect, the two extremes of the initial market share continuum correspond precisely to the above notions of extremely low and extremely intense competition. Moreover, there is a broader correspondence between the initial market share of a new product and its impact on market-level competition measures. Previous attempts to operationalize competition levels have looked at indicators of market concentration, such as three-, four-, or eight-firm concentration ratios, Herfindahl indices, or entropy measures of concentration (Jacquemin, 1987). Linking with this research, an innovative new product may be considered one that reduces the overall level of competition experienced within a market, and thereby increases reported concentration levels. Because each of these concentration measures is calculated based on the market shares of incumbent products, it follows that a new product with a higher initial market share will exert a more positive impact on observed concentration levels. On the other hand, a new product with a very low initial market share may not figure into three-, four-, or eight-firm concentration ratios, and will have a smaller impact on Herfindahl and entropy measures (which assign lower weightings to lower-share incumbents).

There may, however, be some concern that initial market share is not a clean indicator of the innovativeness of a new product. In their study of the factors that influence new product success in the pharmaceutical industry, Gatignon, Weitz, and Bansal (1990) found that the initial market share of a new drug is affected by, among other things, the detailing efforts of the introducing firm. Because we take market-based (and not a technology-based) approach to innovation, it is not inconsistent that an innovator may undertake activities such as product detailing or advertising to enhance the perceived attractiveness of the differentiated new offering (Kirzner, 1973; Penrose, 1959: 80). Moreover, Gatignon et al. (1990) stress that demand conditions within the pharmaceutical industry are such that, all else equal, relative price has little impact on the initial market share of a new drug product (see also Gorecki, 1986). This suggests that pharmaceutical firms have little scope to gain significant initial market shares without some degree of actual product differentiation, or product innovativeness (Robinson, 1990). However, in light of the findings of Gatignon et al. (1990), we bias our categorization of innovative towards the extremely high end of the initial market share distribution.

The next task is to set the cut-off \( MS_{j0} \) level that distinguishes the innovative products in our sample. According to an oft-cited Booz, Allen and Hamilton survey of new product introductions, roughly 10 percent of all products introduced to the market may be considered ‘new-to-the-world’ products (cf. Ali, 1994). The 90th percentile of the initial market share (\( MS_{j0} \)) distribution for all products in the product-level data file is 15.6 percent. As such, innovative products are those introduced with market shares in excess of 15.6 percent. Using this approach, 145 of the 1070 products introduced by the sampled firms are innovative.

Returning to the above comment on the market share ranking of these products (with higher-ranked products having a greater impact on measures of market concentration), each of the 145 innovative products is introduced into one of the top three rankings in its submarket, with the median product occupying the top position. On

³ According to Schumpeter, innovative new products are introduced to relatively low levels of competition. One way to assess the initial level of competition is to take a highly restricted view of what constitutes a product’s competitors. Within the pharmaceutical industry, patents are available and are generally found to be effective (Levin et al., 1987). Under such a regime, one may consider only those products that are generic versions of the focal product to be its competitors. However, such an approach may not adequately capture the nature of product competition. As Weston (1979: 93) suggests, ‘the appearance of similar drugs introduces competition before the expiry of the seventeen-year patent period.’ To the extent that such claims are valid, assuming that the only competition for products comes from direct copies is erroneous.
the other hand, only 12.8 percent of the remaining products occupy one of the top three rankings, with the median product occupying the ninth position in its first full year on the market. This suggests that every one of the innovative new products would exert some positive influence on the three-, four-, and eight-product concentration ratios, while the median imitator product would not figure in any of these measures of market concentration. Linking with Dranove and Meltzer's (1994) market importance indicator, we find (not surprisingly) that the innovative products have average annual sales of $71.7 million, roughly six times greater than the $12.1 million average for the remaining products. Finally, in response to concerns that this list of innovative products may contain (successful) generic copies of existing therapies, we obtained a copy of an FOI Services, Inc. publication entitled The NDA Book (FOI Services, 1996). This source provides information on roughly 28,000 drugs that have been approved by the U.S. Food and Drug Administration since 1938. More specifically, it indexes each drug according to its trade name, as well as its generic name. We located 80 of the innovative products in the trade name index. Of these, 79 were either the only product having its specific generic name, or the first product introduced to the market with that specific generic name. This suggests that roughly 98 percent of the innovative product introductions are not generic copies of products already sold on the market (in the only other case, the preceding product with the same generic name was introduced by the same firm). These data do not necessarily indicate that all of these innovative products were radically different from existing offerings at the time that they were introduced. They do, however, suggest that the initial market-share approach to identifying innovative new drugs does not arbitrarily pick up undifferentiated generic competitors. As a comparison, we also located 103 of the 145 new products that were introduced with the lowest initial market shares. Only 28 percent of these products were either the only product having its specific generic name, or the first product introduced to the market with that specific generic name. This comparison suggests that the large majority of products with very low initial market shares are generic copies of products already on the market.

The final task is to turn this categorization of innovative products into an indicator of innovative propensity (see Table 1). Firms with relatively high innovative propensities should derive a greater proportion of their sales from innovative products. In each year, we compute the ratio of innovative product sales to total pharmaceutical sales for each firm before subtracting the corresponding industry average. The innovative propensity of each firm is then indicated by its average of this ratio calculated across the years for which the firm is in the sample (a value of zero suggests that the firm in question demonstrates average innovative propensity). Using this approach, Amgen, Glaxo, Pfizer, Merck, and Marion Merrell Dow are the most innovative firms, while Forest, Boots, Genentech, Boehringer Mannheim, and Allergan are the least innovative.

### Avoiding competition

Hypotheses 2a and 2b relate the intensity of competition faced by a firm’s innovative new

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<tr>
<th>Firms with above-average innovative propensity</th>
<th>Average</th>
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<tbody>
<tr>
<td>Amgen, Glaxo, Pfizer, Merck, Marion Merrell Dow, Miles, ICI, Squibb, SmithKline Beecham, Hoescht, Johnson &amp; Johnson, Wellcome, Cooper, Schering-Plough, Ciba-Geigy</td>
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<tr>
<td>0.70 (Amgen)</td>
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<td>0.66</td>
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<table>
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<tr>
<th>Firms with below-average innovative propensity</th>
<th>Average</th>
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<tr>
<td>Sterling Drug, Searle, Lyphomed, Warner-Lambert, Key, Lilly, American Cyanamid, Abbott, Robins, Bristol Myers Squibb, Syntex, Pennwalt, Thompson, Procter &amp; Gamble, American Home Products, Upjohn, Rhone-Poulec Rorer, Carter-Wallace, Sandoz, Block, Fisons, Roche, Forest, Boots, Genentech, Boehringer Mannheim, Allergan</td>
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<td>-0.29 (Allergan)</td>
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**Table 1. Innovative propensity**

*Average across years in sample of the share of total sales coming from innovative products relative to corresponding industry average.*

Source: IMS America

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*P. W. Roberts*
products over time to profit persistence. This section describes the market share approach that is used to generate the low-competition (LC) variable. Just as innovative was operationalized with reference to the initial market share of a new product, the intensity of competition faced by a new product over time is operationalized with reference to the average market share change over its term on the market. More specifically, we calculate the slope of the regression line relating market share to elapsed time (\( \lambda_1 \)) for each new product:

\[
MS_{jt} = \lambda_0 + \lambda_1 \times ELAPSE_{jt} + \epsilon_{it}
\]  

(3)

where \( MS_{jt} \) is defined as above and \( ELAPSE_{jt} \) is the number of years between year \( t \) and the product’s first full year on the market. One expects qualitatively different relationships between the intensity of competition faced by a product (as indicated by its market share change) and elapsed time for the different types of product introductions. Assuming that Schumpeter’s conjecture about innovative products holds, imitating products serve to increase the level of competition faced by innovative new products. That is, successful imitators move from having no market presence at all to establishing (often small) footholds for themselves as time passes.

Across all products, the average slope of the regression line relating market share to elapsed time is not significantly different from zero. However, a t-test confirms that the average slope estimates differ significantly across the two types of products. Innovative products tend to experience erosion in their market shares as time elapses, while imitative products tend to make slight gains. Before examining how the erosion rates for innovative products vary across firms, we first note the correspondence between this approach to operationalizing changes in competition and research examining first-mover advantage. Researchers have devoted considerable attention to issues surrounding the order-of-entry question (e.g., Lieberman and Montgomery, 1988; Robinson, Kalyanaram and Urban, 1994). This research tends to focus on the costs and benefits of market pioneering versus those associated with later entry. At a conceptual level, Lieberman and Montgomery (1988) note that first movers may be advantaged over later entrants because of their technological leadership position, their ability to preempt valuable assets, and/or their ability to establish consumer switching costs. Empirically, there is considerable evidence—including some from the pharmaceutical industry (Gorecki, 1986; Grabowski and Vernon, 1992)—that ‘market pioneers tend to maintain market share advantages over later entrants’ (Robinson et al., 1994: 2).

Order-of-entry researchers are concerned with the extent to which advantageous market positions are sustained over time, but have tended to look exclusively at market share dynamics. Our analysis goes one step further by relating a firm’s ability to sustain advantageous product–market positions with its firm-level profit dynamics. Tying these two approaches together, Lieberman and Montgomery (1988) remind scholars that order-of-entry research is ultimately concerned with the profit implications of moving first into markets and sustaining the associated benefits. Data limitations have tended to preclude the use of profitability as a dependent variable and researchers tend to employ market share and/or firm survival. Similarly, Robinson et al. (1994) note that the combination of the entry order–market share results and the market share–profitability results attest to a positive relationship between market pioneering and firm profitability.5

By construction, the innovative products in this study are introduced with relatively high market shares. The question now is to determine whether the sampled firms are differentially able to sustain

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4 Note that it was not feasible to use a count of subsequent product introductions as an indicator of the extent of competition as we do not have data for all products introduced during the sample time period (i.e., those that failed to reach the $1 million annual sales threshold are excluded). Including all of these products would have dramatically increased the resources required for data entry. However, IMS does provide data on total therapeutic market sales, which ensures that these products, although not represented individually, are represented in the denominator of the market share figure.

5 This study stops short of fully addressing the entry timing issue as the products have not been explicitly identified as pioneers, early followers or late followers. Rather, it may be assumed that pioneering products are those with high initial market shares, while followers are the lower share entrants. This empirical strategy is necessary because IMS’s therapeutic markets have, in most cases, longer lives than each generation of pharmaceutical products that they subsume. Future research may examine the evolution of specific therapeutic markets in order to determine the dynamic relationship between the innovative products that have been identified and the various classes of follower products (including imitators). With more precise timing data in hand, one would be in a better position to examine the order-of-entry questions.
the market share advantages associated with product innovation. Relatively speaking, firms with greater average $\lambda_i$ estimates (for their innovative products) are better at avoiding competition. Although the market shares accruing to innovative products tend to decrease as time elapses, Table 2 demonstrates that firms are differentially able to preserve the benefits associated with product innovation. ICI, Sandoz, Glaxo, Searle, and Syntex experience relatively large gains in the market shares of their innovative products as time elapses and are considered relatively good at avoiding competition. At the other extreme, market share erosion is most rapid for Lilly, Squibb, Roche, Wellcome, and Rhone-Poulenc Rorer. This completes the discussion of the dependent and independent variables used in this study (Table 3 provides a brief summary).

Table 2. Average relationship between market share and elapsed time (innovative product-specific regressions)$^a$

<table>
<thead>
<tr>
<th></th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms with above-</td>
<td>4.52 (ICI)</td>
<td>-15.74 (Rhone Poulenc Rorer)</td>
</tr>
<tr>
<td>average ability to avoid competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-2.16</td>
<td></td>
</tr>
<tr>
<td>Firms with below-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>average ability to avoid competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firms with no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>innovative products</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$Coefficients not available for products with less than 2 years of data.

RESULTS

Across the 515 observations, the mean value of $\pi_{it}$ is 0.20, while the minimum and maximum values are -2.74 and 2.24, respectively. This suggests that the observed profit outcomes range from roughly 275 percent below the weighted industry average to roughly 225 percent above. For the 308 high profit observations (those for which lagged normalized profit is positive), the mean, minimum, and maximum values are 0.54, -2.74, and 2.24, respectively. Table 4 presents the results from regressions run on Equation (1). The first column is based on all observations. The persistence parameter ($\beta$) is significantly less than 1, indicating that relatively high and low profit outcomes do eventually dissipate. At the same time, the long-run profit estimate is significantly greater than zero, suggesting that abnormal firm-level ROA tends toward a long-run rate that is greater than the weighted industry average. The results change somewhat when focus is placed exclusively on the relatively high profit outcomes. The second column of Table 4 shows that the

Table 3. Summary of variables and coefficients

<table>
<thead>
<tr>
<th>Variables and coefficients</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalized profit rate</td>
<td>$\pi_{it}$</td>
<td>Firm ROA less weighted industry average ROA divided by weighted industry average ROA</td>
</tr>
<tr>
<td>Lag of normalized profit rate</td>
<td>$\pi_{it-1}$</td>
<td></td>
</tr>
<tr>
<td>Innovative propensity</td>
<td>$IN_i$</td>
<td>Relative proportion of firm pharmaceutical sales derived from innovative new products (see discussion surrounding Table 1)</td>
</tr>
<tr>
<td>Low competition</td>
<td>$LC_i$</td>
<td>Extent to which innovative products avoid market share erosion over time (see discussion surrounding Table 2)</td>
</tr>
<tr>
<td>Persistence parameter</td>
<td>$\beta_1$</td>
<td>Higher persistence as $\beta_1$ approaches 1</td>
</tr>
<tr>
<td>Long-run profit rate</td>
<td>$\pi_{it} = \alpha_i / (1 - \beta_1)$</td>
<td></td>
</tr>
</tbody>
</table>
Innovation and Persistent Profitability

Table 4. Results from autoregressive profits models (standard errors in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>All observations</th>
<th>High profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.04</td>
</tr>
<tr>
<td>Lagged profits ((\pi_{it-1}))</td>
<td>0.70</td>
<td>0.87</td>
</tr>
<tr>
<td>N</td>
<td>515</td>
<td>308</td>
</tr>
<tr>
<td>Adjusted R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.54</td>
<td>0.51</td>
</tr>
<tr>
<td>Long-run profits ((\pi_{it}))</td>
<td>0.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.31&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>\(p<0.01\); \(b\)\(p<0.10\)

A higher degree of persistence of relatively high profits is greater than that for relatively low profits. In addition, the level upon which profits converge in the long run is significantly greater than zero for high profit outcomes. Comparing across columns, high profits tend to converge at a slower rate (the persistence parameter equals 0.87 vs. 0.70) toward slightly higher long-run levels (the long-run profit rate equals 0.31 vs. 0.23) than do all profits taken together.

Next, the model’s parameter estimates are allowed to vary across firms, and the firm-specific \(\alpha\) and \(\beta\) estimates are combined to calculate estimates of each firm’s long-run profit rate (\(\alpha/1-\beta\)). Separate \(F\)-tests reject the equality of the \(\alpha\) and \(\beta\) estimates across firms, confirming that there is significant variance across firms in the extent to which abnormal profit outcomes persist over time. More specifically, 10 firms return long-run profit estimates that are significantly greater than zero (\(p<0.10\)), while eight firms return estimates that are significantly less than zero. Similar results were obtained from the regression which isolates the high profit observations. Once again, separate \(F\)-tests reject the equality of the \(\alpha\) and \(\beta\) estimates across firms. This time, all but one of the firms report long-run profit estimates that are greater than zero. In 12 cases, these positive estimates are significant.

Results from models testing for the effects of innovative propensity and competition intensity are found in Table 5. The results in the first column treat all profit observations symmetrically. Relatively high innovative propensity increases the constant term, but the increase is not statistically significant. However, the increase in the persistence parameter is significant. At the same time, the low competition variable exerts no significant effect on either the constant term or the persistence parameter. The results in the second column are from the model which isolates the relatively high lagged profit outcomes. This time, the model’s intercept term is positively and significantly affected by innovative propensity. However, the persistence parameter decreases (albeit not significantly) if a firm is highly innovative. Once again, no significant effects are found for the low competition variable.

Table 6 gauges the overall effects of innovative propensity on the long-run profit rate estimate (which is a function of both the intercept term and the persistence parameter). The upper row represents the long-run profit rate of a

Table 5. Effects of innovative propensity and competition on profit dynamics (standard errors in parentheses)

<table>
<thead>
<tr>
<th></th>
<th>All observations</th>
<th>High profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.09&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>High innovation (IN&lt;sub&gt;i&lt;/sub&gt;)</td>
<td>0.17</td>
<td>0.68&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Low competition (LC&lt;sub&gt;i&lt;/sub&gt;)</td>
<td>0.00</td>
<td>-0.00</td>
</tr>
<tr>
<td>Lagged profits ((\pi_{it-1}))</td>
<td>0.73&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.84&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IN&lt;sub&gt;i&lt;/sub&gt; (\times) (\pi_{it-1})</td>
<td>0.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.32</td>
</tr>
<tr>
<td>LC&lt;sub&gt;i&lt;/sub&gt; (\times) (\pi_{it-1})</td>
<td>0.01</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<sup>a</sup>\(p<0.01\); \(b\)\(p<0.10\)

Table 6. The effects of innovative propensity on long-run profits

<table>
<thead>
<tr>
<th></th>
<th>All observations</th>
<th>High profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High innovation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.40</td>
<td>0.73</td>
</tr>
<tr>
<td>Low innovation&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.08</td>
<td>-0.22</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.32</td>
<td>-0.96</td>
</tr>
</tbody>
</table>

<sup>a</sup>One standard deviation above the mean of the innovative propensity variable evaluated at the mean of the low competition variable.

<sup>b</sup>One standard deviation below the mean of the innovative propensity variable evaluated at the mean of the low competition variable.
(hypothetical) firm that is one standard deviation above the mean of the innovative propensity variable, evaluated at the mean of the low competition variable. The lower row repeats this calculation, this time for a firm that is one standard deviation below the mean of the innovative propensity variable (again, evaluated at the mean of the low competition variable). Using the results based on all observations, we see that the long-run profit rate falls from 0.40 to roughly 0.08 as the firm moves from the upper to the lower end of the innovative propensity variable. Considering only the high-profit observations, the long-run profit rate falls from 0.73 to −0.22. These results provide support for the hypotheses relating innovative propensity to firm-level profit persistence. Long-run profit levels and the rates at which abnormally high profits converge on those levels are both influenced by innovative propensity. However, there is little empirical support for the avoiding competition hypotheses.

The practical significance of the innovation findings is demonstrated in Figure 2, which illustrates the (hypothetical) paths of convergence for the above-average and below-average innovative firms from Table 6. Using the parameter estimates based on all observations, an ROA outcome that is 224 percent above average in year 1 (i.e., the highest in our sample of profit observations) erodes rather quickly if the firm in question is not highly innovative. However, if the firm demonstrates above-average innovative propensity, abnormal profits demonstrate a much higher degree of persistence. That firm is still earning returns that are 110 percent above average in year 5, and 60 percent above average in year 10. The lower panel of Figure 2 demonstrates that similar time path differences are observed if we use parameter estimates that are based on the high profit observations only.

Table 7 shifts to the firm level to demonstrate how persistently profitable firms are distinguished from their less successful counterparts by their innovative propensities and their ability to avoid competition. There are positive and significant correlations between long-run profit rates and firm innovative propensity scores (based on all observations, as well as high profit-only observations). These findings corroborate the overall regression results in Tables 5 and 6 and provide further support that persistent profitability in the pharmaceutical industry is driven by the differential innovative propensities across competing firms. There are also positive correlations between long-run profit rates and the firms’ ability to avoid competition; the correlation in the high profits case being significant at a 0.10 level of significance.

**DISCUSSION AND CONCLUSION**

This analysis clearly demonstrates that innovative propensity influences the extent to which abnormal profit outcomes persist over time. This is consistent with a theoretical framework within which high innovative propensity yields a series of temporary monopoly positions at the product level which, when aggregated to the firm level, translate into persistent profitability (see also D’Aveni, 1994). On the other hand, the ability to avoid competition implies a stronger correspondence between product-level competitive dynamics and firm-level profit dynamics, yielding an explanation for firm-level persistent profitability that mirrors the monopoly-based arguments popular within industrial organization economics. However, the analysis provides very weak support for the anti-competition thesis as the coefficients on the low-competition variables were insignificant in both regression models. The only significant supporting finding is a positive correlation between a firm’s ability to avoid competition and the persistence of its above-normal profit outcomes (see Table 7).

This research complements the resource-based perspective that is gaining prominence within the strategy literature. Although we present conceptual arguments and empirical evidence relating a firm’s innovative propensity and (to a much lesser extent) its ability to avoid competition to the evolution of its financial performance over time, we say very little about the precise nature of the underlying firm capabilities that support innovation and/or slow competition. In this sense, the framework deals with only part of the overall

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6 In respect of the surprising null result for the competition hypotheses, we reran the analysis using several different specifications of the low competition variable (including one based on market share changes experienced by all new products, and one that controlled for the initial market share level of each innovative new product). We also tried a specification based on product market concentration ratios (a more traditional measure of market-level competition intensity). However, the null result for the competition hypothesis was replicated across each of these specifications.
problem of understanding firm-level persistent profitability. In addition to calling for an extension of this research project, it is useful to refer to other research that illuminates the missing pieces of the framework. Henderson and Cockburn (1994, 1996) present the results of research which tries to understand the causes of relatively high innovative propensity among U.S. pharmaceutical firms. The factors that these authors look to include firm size, scope of operations, component competence (i.e., unique disciplinary expertise), and architectural competence (the ability to access and integrate various types of expertise). In addition, Gatignon et al. (1990) suggest that the impact of a relatively innovative new drug may be enhanced by the detailing efforts of the introducing firm. If these insights are combined with the current findings, one may begin to trace the path from a firm’s innovative capabilities through its innovative
outputs to the persistence of its above-normal profit outcomes.

Having said this, one should be cautious not to expect the innovative capability–innovation–persistent profitability path to be followed in all cases. Superior financial performance results from the more-or-less temporary monopoly positions that correspond with the introduction of valuable innovations to the market. It is sustained at the firm level only when innovation is repeated or when competition is weak. However, a valuable product innovation may arise as the result of an underlying innovative capability, or it may be the result of a chance event. Similarly, competition may be avoided because a firm systematically applies an isolating capability, or because it was fortunate enough to stumble upon an innovation that resists competitor imitation. A firm might therefore be persistently profitable although it lacks any underlying, valuable capabilities, its performance being due to the interaction of two chance events.

This research also makes contributions to the pharmaceutical economics literature. Treating pharmaceutical firms as evolving portfolios of products generates a framework that jointly embraces the innovation and monopoly arguments that have been put forth as explanations of the persistently high profits earned in the pharmaceutical industry (Comanor, 1986). Moreover, we provide empirical evidence that contributes to the ongoing debates about persistently high pharmaceutical profits. As many commentators note, the profits earned within the pharmaceutical industry are consistently well above those earned in the next highest earning industry (Office of Technology Assessment, 1993). Commentators tend to argue that such interindustry profit differentials either suggest the presence of relatively strong monopoly positions or are due to the relatively high innovation rates of incumbent pharmaceutical firms. The findings of this research, which come from a firm-level (not an industry-level) analysis of profit persistence, suggest that such a bifurcated debate may miss the true nature of the phenomenon. Because pharmaceutical firms differ in the extent to which they develop valuable product innovations and resist competition, one should be wary of simplistic either/or explanations of pharmaceutical firm profitability (having said this, there is much stronger empirical support for the innovation argument).

As it stands, this project only makes limited and indirect inferences about interindustry profit differentials, as it looks at the extent to which interindustry differences in profit persistence are attributable to differential innovation and competition rates across firms. Therefore, the analysis itself cannot explain the observed differences between pharmaceutical and non-pharmaceutical industry profit dynamics. However, the logic that is used to understand interindustry profit differentials may be extended to understand interindustry differentials. In several places, it has been suggested that pharmaceutical firm innovation rates tend to be higher than corresponding rates for nonpharmaceutical firms (e.g., Henderson, 1994). It has also been argued that—because of demand characteristics and/or a more effective patent regime (Caves, Whinston, and Hurwitz, 1991; Mansfield, Schwartz, and Wagner, 1981)—competitor imitation may be less intense within the pharmaceutical industry than without. If either (or both) of these conjectures stand up to empirical scrutiny, one may generate a Schumpeterian explanation of interindustry differences in profit persistence. Profit persistence may be greater within the pharmaceutical industry because pharmaceutical firms tend to be more innovative and/or better able to resist competition than their nonpharmaceutical counterparts. This suggests a valuable line of further inquiry.

In closing, we offer several extensions to this research. First, the discussion surrounding the creation of the innovation and competition variables suggests that future research might wish to juxtapose the current market-share approach against other possible approaches. Potential candidates would include Dranove and Meltzer's (1994) various indicators of therapeutic (as opposed to market) importance—including FDA indicators of therapeutic novelty and subsequent

Table 7. Innovation, competition and long-run profitability by firm (correlations)

<table>
<thead>
<tr>
<th></th>
<th>N observations</th>
<th>All High profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovative propensity</td>
<td>42</td>
<td>0.45&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Avoiding competition</td>
<td>26</td>
<td>0.13</td>
</tr>
</tbody>
</table>

<sup>a</sup>p<0.01; <sup>b</sup>p<0.10
citations in medical journals. In such efforts, researchers should follow Schumpeter and keep the distinction between technological novelty and importance and successful innovation firmly in mind (the latter being a market-based activity). While Trajtenberg (1990) does demonstrate a significant correspondence between citation-weighted patent counts and the social value of CT scanner innovations, Dranove and Meltzer’s (1994) research in the pharmaceutical industry shows that the correlations between indicators of therapeutic and market importance are far from perfect. Another approach might involve surveying doctors or pharmacists, asking them to identify products as innovative (see Banbury and Mitchell, 1995: 162). Relatedly, researchers might wish to scrutinize the level at which inter-product competition is modeled in this paper. While we explicitly adopt an approach that is broader than the patented product vs. generic competitor approach taken by, among others, Bond and Lean (1977), Caves et al. (1991), and Gorecki (1986), future research might wish to revisit this decision. If the current findings hold across these different operationalizations of the innovative product construct, we will have increased confidence in the robustness of the findings.

Finally, this research focuses explicitly on one type of innovation—product innovation. While the pharmaceutical industry emphasis on new drug products allows us to credibly overlook other types of innovations in this empirical setting, the same may not hold for other industries. Future research should try to move the analysis beyond the study of products only in order to embrace the several types of innovation to which Schumpeter alludes (e.g., process innovations, organizational innovations, new sources of input supply, and the introduction of existing products to new markets).

REFERENCES


Grabowski, H. and J. Vernon (1992). ‘Brand loyalty, entry, and price competition in pharmaceuticals after
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