First-mover: Are Technologically New Products a Competitive Advantage?

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Abstract. Do innovative products incorporated advanced technologies help firms improve operating performance? In this study researchers traced the operating performance of 168 publicly traded manufacturing firms that announced technologically innovative products in two major industries from the health care domain, namely pharmaceuticals and medical instruments. Researchers employed the event-study methodology and collected objective financial data from COMPUSTAT (Global). Researchers found that technologically innovative products had a statistically significant positive effect on operating performance. The median abnormal increase in return-on-assets ranged from 2.20% to 7.07% over a four-year period.

Introduction

Firms need to continuously renew themselves if they are to survive and prosper in the current business environment where customers, technologies and competition change rapidly. Developing technologically innovative products have been recognized as the primary means of firm renewal and as a "driver of renewal". Although research has theoretically explored the antecedents of product development success, virtually nothing is known about their performance and financial value. In addition, there remain suspicions that the rents to innovation may be scarce.

Despite the widespread assumption that technological innovations bring positive financial rewards to for-profit firms, studies have cast doubt on whether companies' efforts in developing breakthrough innovations are yielding positive economic returns [1] [2]. Previous research has suggested that firms actively pursuing breakthrough product development do not necessarily outperform other organizations. Breakthrough innovation requires substantial R&D budgets and introducing innovative new products is highly risky [3] [4]. Innovators must face the reality that other firms will imitate their actions, typically earning a share of the profits that is much greater than their initial investment [5] [6]. For example, Liu [7] examined stock market reactions to US biotechnology firms' innovation news announcements (e.g., FDA approval and patent grant).

There are some key differences between this study and previous studies. First, the stock market reactions results may be of more interest to investors, as well as managers of publicly traded firms. However, these results may have less valuable implications for privately held firms since stock prices are not the key concern of their owners. However, managers of all the firms are interested in the long-term profitability impact of technologically innovative products. Second, to our best knowledge, there is limited empirical evidence on the long-term financial impact of technologically innovative products based on objective data. Research done thus far has used one major method - survey, in order to assess the links between technologically innovative products and long-term firm performance indicators. Although this research method can help explore the construction that cannot be easily measured by objective data, it essentially ends with managers' words on whether the financial performance of the introduced innovative products is higher than the performance of incremental innovations (e.g., merely product updates or minor improvements). Therefore, this type of data potentially suffers from self-report bias. Third, the performance measures, methodology, data, and sample used in the present study were vastly different from those used by the above reviewed studies.

In this study the key research question is whether firms gain superior performance from products that involve a substantially new technology in two major industries, namely pharmaceuticals and medical instruments, from the health care domain. During the last 50 years, the health care domain has undergone a technological revolution and this transformation has been mirrored in the two primary industries of pharmaceuticals and medical instruments. Both pharmaceuticals and medical instruments are knowledge-intensive industries where new technology and innovation are the lifeblood [8] [9]. They produce a wealth of products used to treat and diagnose diseases, assist health care workers, and improve the quality of human health in all the fields. In these respects, both of these two industries are similar to other high-tech industries (e.g., electronics) that are commonly studied in innovation research [10]. Findings from pharmaceuticals and medical instruments research may have implications for other knowledge-intensive and innovation-based industries.

Theoretical Background and Hypothesis Development

Researchers organize the theoretical arguments around the knowledge-based view (KBV) of the firm as many of the skills that give rise to firms' competitive advantage are knowledge-based. The recent development of KBV provides a new lens through which researchers may view and understand the primary rationale for a firm's existence - the creation, transfer, and application of knowledge. KBV may be seen as an outgrowth of several steams of research, including the resource-based view of the firm, organizational learning, organizational capabilities, and innovation. Over the last decade, management research has increasingly emphasized the role of knowledge in developing a firm's resource base. Management theorists argue that the basis for sustained competitive advantage is a firm's ability to develop rare and valuable knowledge through learning, and to subsequently build upon and apply that rare knowledge to product, process or organizational development. It is commonly accepted that unique knowledge is linked with gaining and sustaining competitive advantage.

There are two quite different views about why technological innovation may be associated with superior performance. The first view asserts that it is the final innovative product that helps increase firm profitability. A technologically innovative product tends to face low competition at the point of its introduction and therefore earns relatively high profits to the introducing firm. Technological innovation symbolizes the creation of tacit, complex, and specific knowledge that is hard for competitors to replicate. The development and combinations of such unique knowledge are very ambiguous to outside observers or potential competitors. It is highly "sticky" to the innovating firm, protecting the knowledge-based advantage of the firm and conferring above-normal rents. The second view asserts that it is the process of developing technology innovation that affects firm performance because it transforms a firm's internal capabilities. KBV argues that the heterogeneous knowledge bases and capabilities among firms are the main determinants of performance differences and above-average performance is linked to significant development of new knowledge. Developing technologically innovative products in a firm represents the creation of radically new knowledge through a larger, complex capability. It will help the firm's internal capabilities, enhancing its ability to learn about new technologies, match technological possibilities with demand needs, and, as a consequence, sustain its market position in the face of changes in supply or demand conditions.

Based on the above reasoning, researchers expect the impacts of technologically innovative products on ROA, an overall profitability indicator commonly used to measure how effective management is in using a firm's assets to generate earnings.

Sample and Data Collection

Researchers collected announcements of technologically new product introduction mainly from Lexis Nexis (Academic), which is a well-known full-text information searching database. It provides a

searchable access to a comprehensive spectrum of full-text business news, legal information, and others from over 5,600 sources, including the Business Wire, and PR Newswire. It has been widely used to collect relevant event news by other researchers. Before conducting a large-scale search of the database, researchers studied a few pieces of announcements of technologically innovative product introduction to identify the keywords that are commonly used to describe new products. After the initial search and identification processes, researchers used keywords such as "revolutionary/breakthrough/innovative" and "product/technology", in conjunction with words such as "introduce, unveil and launch," company names retrieved from CompuStat (Global), and other relevant phrases, to search Lexis Nexis (Academic) from 1986 to 2004. Any records in the database containing the keywords were regarded as "candidate announcements".

Research Methodology-Event Study

Researchers used the event study methodology to evaluate the long-term operating performance effects of technologically innovative products. The usefulness of such a methodology comes from the fact that, assuming rationality in the market place, the effect of an event will be reflected in the performance indicators of a firm. This method can help to isolate the component of performance change owing to unexpected firm-specific events.

1) Event definition. The initial task of conducting an event study is to define the event of interest and identify the period over which the performance measures of the firms involved in this event will be examined - the event window. In this study the event of interest was the announcement of a technologically innovative product by a sample firm. Researchers defined the event period as the year in which an innovative product was announced (year t). Researchers investigated the abnormal financial impact of a technological innovative product over a four-year period after its introduction announcement (i.e., the event window is from year t+1 to year t+4), which is a rough estimate of the product life cycle.

2) Selection criteria. After identifying the event of interest, it is necessary to determine the selection criteria for the inclusion of sample and/or control firms in the study. The criteria in our study for the sample firm were that it should have announced a technologically innovative product and have sufficient related financial data in the Compustat (Global) database. Researchers selected a control firm that had similar total assets, ROA and was of the same 2-digit SIC code, subject to the constraint that the control firm's ROA lay between 90% and 110% of the sample firm's ROA and its total assets lay between 33% and 300% of the sample firm's assets in the base year (year t-1).

3) Normal and abnormal performance. The abnormal return is the actual post-event financial performance of a sample firm over the event window minus its estimated normal performance over the same time period. The estimated normal performance is defined as the return that would be expected if the event did not take place. In our study this was generally represented by the average post-event performance of a control group of a sample firm.

The statistical tests commonly used in event studies are the paired-sample t-test, which is parametric, the Wilcoxon sign ranks (WSR) test, and the Binomial sign test, which are non-parametric. Generally, if the abnormal performance follows a normal distribution, the parametric test is more valid. However, for event studies based on accounting data, non-parametric tests are uniformly more powerful than parametric t-statistics. Therefore, in this study, researchers used the Wilcoxon sign ranks test to assess whether the median was significantly different from zero, and the Binomial sign test to measure whether the percentage of sample firms generating positive performance was significantly different from 50%. For report completeness, researchers also used the t-statistics to test whether the mean was significantly different from zero. Researchers measured the significance of the results based on the more conservative two-tailed test results.

Empirical Results and Discussions

Since there is no consistent agreement in the literature on how long it will take to develop and commercialize a technologically innovative product in the medical instrument and pharmaceutical industries, it is necessary to test whether the sample firms had already performed better than their control groups. Firms with better financial performance may be in a better position to develop technological innovations than firms with poorer financial performance. This pre-event bias would undermine our analysis and findings. The abnormal performance results from year t-2 to year t-1 were obtained by comparing the ROA during the base year against the ROA during one year before the base year so as to detect the possible existence of pre-event performance bias. From Table 1, researchers see that the abnormal performance change in ROA during year t-2 to year t-1 was positive but not significant. Therefore, researchers have good reason to believe that the sample firms and the selected control firms had similar pre-event performance before the announcement of technologically innovative products. In other words, they all had equal chances to develop and commercialize technology innovations.

Table 1 shows the statistical results of abnormal changes in ROA over the four-year period (from year t to year t+4). The results are strongly positive and statistically significant. The row "t-1 to t" measures the ROA accumulation in case the technologically innovative product was introduced to the market that might bring revenues to the introducing firms before the end of fiscal year t. The rows "t-1 to t+1", "t-1 to t+2", "t-1 to t+3", and "t-1 to t+4" measure the ROA accumulation when the product had been introduced to the market for about one year, two years, three years, and four years, respectively. There were significant increases in ROA for period "t-1 to t+1" to "t-1 to t+4", with an increase from 2.20% ($p < 0.05$) to 7.07% ($p < 0.001$). Researchers found that technologically innovative products can help the introducing firms gain higher ROA when compared with their control firms.

Table 1 Abnormal Performance in ROA

Time Periods	N[a]	AP Mean[b]	AP Median[b]	p-value (t-test) [c]	p-value (WSR) [c]	p-value (Sign Test) [c]
t-2 to t-1	144	0.4738	0.5190	0.702	0.840	0.803
t-1 to t	146	-1.2014	-0.3137	0.496	0.562	0.804
t-1 to t+1	130	3.7424	2.1990	0.062*	0.017**	0.028**
t-1 to t+2	109	6.3081	2.4787	0.002***	0.004***	0.022**
t-1 to t+3	89	7.1762	3.9032	0.002***	0.008***	0.056*
t-1 to t+4	76	9.8523	7.0699	0.002***	0.001***	0.029**

Conclusions

This paper provides empirical evidence on the effect of technologically innovative products on accounting-based measures of operating performance. Based on a sample of 168 firms that introduced technologically innovative products in the pharmaceuticals and medical instruments industries, researchers found that these products have a statistically significant positive effect on operating performance.

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