The performance of initial public offerings in the biotechnology industry

Todd A Finkle, Gonzaga University
Dan French, University of Missouri

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THE PERFORMANCE OF INITIAL PUBLIC OFFERINGS IN THE BIOTECHNOLOGY INDUSTRY

TODD A. FINKLE
THE WILLIAM AND RITA FITZGERALD INSTITUTE FOR ENTREPRENEURIAL STUDIES
UNIVERSITY OF AKRON
COLLEGE OF BUSINESS
259 SOUTH BROADWAY
AKRON, OH 44325-4801
(330) 972-8479
Fax (330) 972-6588
finklet@uakron.edu

DAN FRENCH
UNIVERSITY OF MISSOURI
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ABSTRACT

This study examines the underpricing and aftermarket performance of the emerging
industry of biotechnology. Findings indicate that the average first day return for the biotech firms
was 1.8 and 1.6 percent. Furthermore, the biotech firms significantly underperformed the
NASDAQ (-30.7%) and NYSE (-16.5%) over a two-year period after going public.

Entrepreneurship, Finance, and Investments
Entrepreneurship scholars (see Marino, Castaldi, & Dollinger, 1989; MacMillan & Katz, 1992) have a call for more research to be performed on initial public offerings (IPOs). While previous research has primarily focused on the general population of IPOs, this study attempts to fill a gap in previous entrepreneurship research by focusing on the emerging industry of biotechnology. Specifically, this study examines the underpricing phenomenon two years after a firm’s IPO for the entire population of biotechnology from 1987 to 1994. The underpricing of IPOs in the aftermarket has been investigated by numerous researchers (see Aggarwal and Rivoli, 1990; Block & Stanley, 1980; Buser & Chan, 1987; Carter & Manaster, 1990; Ibbotson, 1975; Levis, 1993; Logue, 1973; McDonald & Fisher, 1972; Neuberger & LaChapelle, 1983; Reilly, 1973,1977; Reilly & Hatfield, 1969; Ritter, 1991; Smith 1986; Stoll & Curley, 1970).

Previous empirical research has indicated significant underpricing on the first day of trading after a firm’s IPO. Additionally, some studies have found some degree of underpricing in the immediate aftermarket of these newly issued IPOs.

A few researchers have investigated the average percentage increase at the end of the first day of trading. For example, Smith (1986) found the average return to investors after the first day of trading to be 15%. Tinic (1988) found the average return to be over 17% after the first day of trading. Ibbotson, Sindelar, and Ritter (1988) found the change from the initial offering price to the market price at the end of the first day to be 16.4%. Ritter’s (1991) study of IPOs from 1975-84 found the mean adjusted average initial return to be 14.06%. However, three years after going public Ritter’s firms significantly underperformed a set of comparable seasoned firms matched
by size and industry. Over a three-year period, the return for the sample of IPOs was 34.7% versus the control sample with a return of 61.86%.

Stoll and Curley (1970) found price appreciation in the short run, however, in the long run stocks did not perform very well. Ibbotson (1975) found positive performance in the first year and negative performance in the next three years. Aggarwal and Rivoli (1990) documented an abnormal return of -13.73% for investors purchasing all IPOs in the open market at the close of the first day of trading and holding for 250 days. Levis (1993) reports average first day returns of 14.3% and long-run underperformance of -30.59% for a sample of 712 IPOs. Other studies (see Aggarwal, Leal, & Hernandez, 1993; Loughran, 1993; Loughran & Ritter, 1995) have documented abnormal returns of IPOs in the aftermarket. Uhlir (1989) found German IPOs underperformed the market by 7.41% (excluding first day returns) in their first year of trading. For a review of the international studies examining the aftermarket performance of IPOs see Aggarwal et. al., (1993). Overall, there is a general consensus that there is short-term excess returns and long-term underperformance

This study will attempt to answer Ritter’s (1991) question: Is the documented underperformance a sample-specific phenomenon or does it apply to other offerings over different periods? Is the underpricing phenomenon industry specific? The study will also attempt to answer the question: Is there a relationship between first-day returns and the long-run performance of these IPOs? Finally, the study will attempt to answer the question: Is there a relationship between the underpricing phenomenon and whether a biotech firm goes public during a hot versus a cold market?

The significance of these findings is important to entrepreneurship scholars and practitioners for several reasons. First, it allows the entrepreneurs who are taking these firms
public to understand any patterns, which may occur in the aftermarket. For instance, Schiller (1990) hypothesized that equity markets in general and the IPO market are subject to fads that affect market prices. If these patterns exist, questions may arise about the efficiencies of the markets, which may increase the costs of going public. If the entrepreneurs understand the underpricing phenomenon in the aftermarket, they may be able to proactively respond by changing their capital structure.

Secondly, the cost of external equity capital for companies going public depends not only upon the transaction costs incurred in going public but also the returns that investors receive in the aftermarket (Ritter, 1991). In essence, the cost of external equity will be lower for firms with lower returns in the aftermarket. Thirdly, the results of the study may indicate trading opportunities for investors.

Finally, if the volume of biotech IPOs displays large variations over time, if the high volume periods are associated with poor long-run performance, this would indicate that issuers are successful at taking advantage of “windows of opportunity (Ritter, 1991).”

The first part of the paper describes the sample of IPOs used in the study and the methodology used to examine the short-and long-run performance. The second part of the paper presents cross-sectional and time-series evidence on initial and aftermarket performance. Finally, the conclusion summarizes the findings of the study.

DATA AND METHODOLOGY

Sample
The sample consists of all biotech firms that made IPOs from 1987 to 1994. The number of IPOs during this period was 144, however, the final sample size was 98 firms (68%). Forty-six firms were eliminated due to a lack of data. A database was developed through the following sources: Disclosure Inc., Securities and Exchange Commission, and an extensive literature search. The sample focused on an emerging industry of which most of the firms were considered young (under 15 years old) (Kazanjian & Drazin, 1990).

Table 1 depicts the distribution of the sample by year, number of IPOs, gross proceeds, and mean initial offering size. Results of the table indicate that the largest amount of capital raised and the largest number of firms that went public occurred in 1991 and 1992. This finding is consistent with previous research on hot versus cold markets (see Ritter, 1984). Ritter (1984) defined hot markets as a period when investors tend to be overoptimistic about the earnings of young growth companies. It is during these periods that firms are able to raise more capital. Deeds, DeCarolis, & Coombs (1997) tested this hypothesis with a sample of public biotech firms from 1983-1992. They found that firms which went public during hot markets were able to raise an extra $8.9 million during their IPO (the average IPO in their sample raised $20 million). This study is consistent with previous research by finding that firms which went public during the hot markets of 1991 and 1992 were also able to raise an additional $7 million during their IPO (the average IPO during this time period was raised $20.4 million).

To examine whether the phenomenon of underpricing exists in the aftermarket, this study calculates three returns: (1) initial period return (after the first day of trading), (2) the cumulative adjusted returns (CAR) calculated with quarterly portfolio rebalancing, where the adjusted returns are computed using two benchmarks, and (3) two-year buy and hold returns for the
biotech IPOs. Data for measures of aftermarket performance was hand collected from *Standard and Poor's Stock Reports*. Other data in this study (e.g., size of a firm’s IPO) was obtained from prospecti.

The first day adjusted return for stock $i$ is defined as the percentage change in price from the offering date to the close of at the first day of trading ($r_i$) subtracted by the change in the benchmark used ($r_m$).

$$ar_i = r_i - r_m$$  \hspace{1cm} (1)

The adjusted quarterly return for stock $i$ in quarter $t$ is defined as:

$$ar_{it} = r_{it} - r_{mt}.$$ \hspace{1cm} (2)

Each quarterly return was based on a continuous 90 day trading interval. With the first quarter calculated as the difference between the initial offering price and price of the stock at the end of the first quarter of trading. The second quarter would be the difference between the ending price in the first quarter and the next 90 day interval.

This study uses the same measures on long-run performance as Ritter (1991) and Levis (1993). The average benchmark-adjusted return on a portfolio of $n$ IPOs for quarter $t$ is the equally weighted arithmetic average of the benchmark-adjusted returns:

$$AR_t = \frac{1}{n} \sum_{e=1}^{n} ar_{it}$$ \hspace{1cm} (3)

The cumulative benchmark-adjusted aftermarket performance from the beginning of the first full calendar quarter of trading to event quarter $s$ is the summation of the average benchmark-adjusted returns:
Similar to Ritter (1991), if a firm is delisted from the sample, the portfolio return for the next quarter is an equally weighted average of the remaining firms in the portfolio. The cumulative market-adjusted return for quarters 1 to 8 involved rebalancing, with the proceeds of a delisted firm equally allocated among the surviving firms in each quarter. For the quarter in which the IPO is delisted, the return for both the IPO and the benchmark includes just the days from the start of the quarter until the delisting.

The formula used to calculate the statistical significance of CARs is:

\[
CAR = \frac{\sum_{1, s}^{t} AR}{\sqrt{n}}
\]

(4)

where

\[
t(CAR) = \frac{CAR \cdot \sqrt{n}}{t}
\]

(5)

\[
\sqrt{t \cdot var + 2 \cdot (t - 1) \cdot cov}
\]

where \(t\) is the event quarter, \(var\) is the average (over two-years) cross-sectional variance, and \(cov\) is the first-order autocovariance of the \(AR_t\) series.

I also use a two-year holding period as an alternative to the cumulative average benchmark adjusted return. This assumes quarterly rebalancing. The two-year holding period is computed as follows:

\[
R_i = \prod_{t = 1}^{8} (1 + r_{it})
\]

(6)

where \(r_i\) is the raw return on firm \(i\) in event quarter \(t\). This measures the total return from a buy and hold strategy where an IPO purchased at the end of the first day of trading of the first calendar month and held until earlier of its second year anniversary or its delisting. To interpret this two-year return, I compute wealth relatives as a performance measure as defined as:
\[ WR = \frac{1 + \text{average 2 year total return on IPOs}}{1 + \text{average 2 year total return on market benchmark}} \]  

(7)

A wealth relative fraction greater than 1.00 indicates that the biotech IPOs outperformed the market-benchmark, while a value below 1.00 indicates IPO underperformance.

The measures of quarterly abnormal returns used in this study do not adjust for systematic risk. The assumption of a beta of 1.00 is unlikely. A number of studies (see Ibbotson, 1975, Affleck-Graves, Hege, & Miller, 1991, Sudarsanam, 1992) have documented that the average beta of newly issued firms is higher than 1.00. Ritter (1991) and Levis (1993) show that the measurement of the long-run performance of IPOs is sensitive to the benchmark employed. Most of the studies on aftermarket performance have focused on the general population of the IPOs. These studies tend to use benchmarks like the NYSE, NASDAQ, or AMEX indexes. Similar to previous studies, I use the NASDAQ and NYSE indexes as benchmarks. The NYSE comprises the largest public corporations in the U.S. The NASDAQ is the home of most of the small, high technology companies, including biotech IPOs. In addition to these benchmarks, This study will examine the non adjusted raw returns for the sample of public biotech firms. Therefore, three measures will be examined in the study: 1) non adjusted raw returns, 2) NASDAQ adjusted, and 3) NYSE adjusted returns.

**EMPIRICAL FINDINGS**

**First Day Returns**

Table 2 reports the average first day return for the entire sample of 98 IPOs. The average first day return is 1.8 percent for the IPOs and 1.6 percent for both the NASDAQ and NYSE adjusted returns. The results of a t-test indicate a significant difference between the three returns. This finding is in contrast to previous research (see Levis, 1993; Ritter, 1991) that found the
mean adjusted first day return to be around 14 percent.

-----Insert Table 2 about here-----

Table 3 examines the pattern of first day returns over time. The average first day returns for 1989, 1991, and 1992 (18%, 7.7%, and 9.7%) were markedly higher than the other years. While there appears to be some relationship between going public during a hot market and larger first day returns, the results do not indicate certainty due to the high return in 1989.

-----Insert Table 3 about here-----

**Aftermarket Performance**

Table 4 reports the raw and cumulative adjusted returns (CARs), excluding the first day returns, for the two-year period after the initial offering. Results indicate that the raw return of the biotech IPOs is 3.4% at the end of two years. The adjusted CARs for the NASDAQ and NYSE indices were -30.7% and -16.5%. The findings are consistent with previous studies, which found the level of IPO underperformance to be economically and statistically significant. The findings also indicate that the type of benchmark utilized will have an effect on the results. The NASDAQ adjusted index was significantly lower than the NYSE index.

-----Insert Table 4 about here-----

**Cross-Sectional and Time-Series Patterns in the Aftermarket Performance of IPOs**

Table 5 investigates the results of the study by examining the relationships between the size of a firm’s initial public offering. The results indicate that firms which raise a larger amount of money during their IPO (greater than $25 million) tend to have larger first day returns, 15.4% versus the overall average of 1.8%. In contrast to Ritter (1991), the results were inconclusive as to the relationship between a firm’s initial offering size and their two-year aftermarket performance. The wealth relatives for the NASDAQ and the NYSE were 1.012 and 1.023
respectively. This indicates that the raw return of the IPOs barely outperformed both indices over the two-year period, excluding initial returns.

-----Insert Table 5 about here-----

Table 6 provides further insight into the long-run underperformance of the IPOs. The table reports the distribution of the two-year holding returns for the IPOs, and the NASDAQ and NYSE adjusted returns. The results indicate that the IPOs underperformed the NASDAQ and NYSE index by 30.7% and 16.5%.

-----Insert Table 6 about here-----

Table 7 investigates the relationship between the long-run performance of the IPOs and the two indices by year of issuance. The results indicate that during the hot markets of 1991 and 1992 the IPOs underperformed the NASDAQ (-57.3% & -56%) and NYSE (-34.7% & -43.4%) indices. The wealth relatives also confirm the results.

-----Insert Table 7 about here-----

CONCLUSIONS
REFERENCES


UNDERPRICING IN THE AFTERMARKET

The mystery of underpricing of IPOs has undermined researchers for several decades. Several attempts have been made to understand the phenomenon. Three streams of research have focused on the understanding of the underpricing phenomenon: investment bankers (Ritter, 1984; Beatty & Ritter, 1986; Johnson & Miller, 1988; Carter & Manster, 1990; Barry, Muscarella, & Vetsuypens, 1991; Carter & Dark, 1993), insurance against legal liability (Ibbotson, 1975; Tinic, 1988), and asymmetric information (Baron, 1982; Rock, 1986; Allen & Faulhaber, 1989; Grinblatt & Hwang, 1989; Welch, 1989; Benveniste & Spindt, 1989).

Four hypotheses have been tested to determine the underpricing phenomenon. The monopsony power of hypothesis (Ritter, 1984) suggests that underwriters intentionally underprice issues. Large and reputable investment banking firms usually underwrite more established firms rather than small, startup companies. Therefore, smaller firms have to use investment-banking companies who for some reason have the ability to exercise greater bargaining power over them. Thus, these smaller firms tend to be underpriced more than the established firms. Chalk and Peavey (1987) state that these underpriced issues are allocated to regular and favored clients who pay commissions and fees far in excess of competitive rates. Therefore, the underwriters deliberately underprice the securities to capture excess profits. Tinic (1988) tested this hypothesis and found no evidence of this phenomenon in his research.

The speculative bubble hypothesis insinuates that the pricing of the IPO was appropriate. The high initial returns were due to the popularity of the IPO. However, at some period after IPO, the positive abnormal returns will turn negative. Ritter (1984) found no evidence of the speculative bubble hypothesis.

The legal-liability hypothesis states that underpricing could provide insurance against
legal liability and associated damages to investment bankers’ reputations. Underwriters
underprice new issues as a cheap way of lowering the probability that the price will fall after the
issue, which in turn reduces the likelihood of legal action by disgruntled buyers (Loderer,
Sheehan, & Kadlec, 1991).

The information asymmetry hypothesis has been applied to several models of IPO underpricing.
Rock (1986) argues that IPOs are underpriced because there are informed and uninformed
investors. If new shares were priced at their expected value, Rock states that the informed
investors would try to purchase the good issues. When bad issues arose, they would not purchase
them, leaving the poor issues to the uninformed investors who would face losses and pull out of
the market. To avoid this, investment bankers underprice IPOs so that uninformed investors earn
a normal expected return and stay in the market. Carter and Manaster (1990) found a relationship
between more prestigious underwriters and lower risk IPOs. They state that prestigious
underwriters have more information about the firm, therefore there is less incentive to acquire
information and fewer informed investors. Therefore, IPOs backed by more prestigious
underwriters will have lower returns.
The first few studies (Reilly & Hatfield; 1969; Stoll & Curley 1970; Reilly, 1973; McDonald & Fisher, 1972; and Logue, 1973) did not control for risk in their studies. However, more recent studies (see Ibbotson, 1975; Ritter, 1991; Aggarwal, Leal, & Hernandez, 1993; Levis, 1993) had more powerful results by controlling for the volatility of the markets. Ibbotson (1975) was the first to study IPO returns of common stock on a risk adjusted basis. He developed a method for computing betas of IPO common stocks called RATS (Returns Across Time and Securities).

**UNDERPRICING AND HOT MARKETS**

Several researchers have investigated the underpricing of IPOs in hot versus cold markets (see Ibbotson & Jaffe, 1975; Ritter, 1984; Ibbotson et. al., 1988). Hot markets are periods where the extent of underpricing is highly cyclical, with some periods lasting months at a time. During these periods, the initial return is much higher for IPOs. In turn, cold markets are characterized by poor initial returns and relatively light IPO activity. In their study of IPOs from 1960-1970, Ibbotson and Jaffe (1975) concluded that issuers may obtain a higher offering price relative to the efficient price when they go public in cold markets.

Ritter (1984) studied the hot market of 1980 and found the mean return on IPOs after the first day of trading to be 48.4%. His findings indicate that the best time to go public is during high-volume periods following hot market issues. Research has shown that during hot markets, on average, IPOs are underpriced significantly more than cold markets.