**The Psychology Threshold of Market Capitalization for Biotechnology IPOs**

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**Abstract**

This paper analyzes stock return behavior following IPO events in the biotechnology sector and examines factors that could have an impact on this behavior.

The results of the research indicate a positive Cumulative Average Abnormal Return (CAAR) of 3.03% in the 20 days following the IPO until the end of the quiet period for all firms under examination, and a decline of tens of percent in the 18 months post-IPO. When the sample is divided into two subsamples according to firm size, a market value (MV) of $500 million can be identified as a threshold for positive or negative post-IPO yields. Companies with a MV below this threshold experience a positive but not significant CAAR in the first 20 days post-IPO and a significant negative CAAR from day 31 onwards. In contrast, companies above this $500 million threshold show a significant positive CAAR 20 days post-IPO, followed by a consistent increase in CAAR for the next few months. The results also indicate that MV, IPO proceeds, shareholder dilution, and clinical phases are critical factors determining post-IPO returns. In conclusion, we suggest that investors recognize a $500 million market value of a firm as a confidence threshold when investing in newly issued biotechnology firms. We postulate that firms valued above this amount attract more attention and gain greater investor confidence than do firms below this threshold. Lower-valued firms can be considered “lottery stocks,” as their IPO ignites a period of enthusiasm until the quiet period ends, whereafter investors’ attention to such firms gradually diminishes, and their focus moves on to their next potential lottery-like opportunity.

**Keywords:** IPO, pharma companies; financial markets; behavioral finance; market value

**JEL Classifications**: D8 (Information, Knowledge, and Uncertainty); G11 (Portfolio Choice; Investment Decisions); G14 (Information and Market Efficiency; Event Studies);

**1. Introduction**

The pharmaceutical industry develops, produces, and markets drugs to be used as medications. According to its revenues and capitalization, it is one of the world’s top five industries, with total annual revenues of over US $700 billion, most of which are generated by multinational pharmaceutical giants that have been dominating the industry for decades. A new drug can take on average 12 to 14 years to develop, at a cost of between 1.3 to 1.6 billion dollars. Out of more than 10,000 drug discovery trials, only one will eventually lead to a new drug coming to the market. With the rapid development of biotechnology over the last decade, the industry has been changing and creating space for smaller pharmaceutical firms. The Jumpstart Our Business Startups (JOBS) Act (detailed below) has facilitated access to the capital market for small firms. As a result, a growing number of biotechnology companies are seeking to raise public capital through IPOs.

**1.1 Focus of the Study**

This paper focuses on biotechnology firms that issued IPOs in the United States between January 2013 and December 2018. Its purpose is to clarify if and how the new JOBS Act, enacted in the United States in April 2012, had an effect on firms’ stock returns during the eighteen months post-IPO. The first part of the paper analyzes the Cumulative Average Abnormal Return (CAAR) on stocks and the second part examines factors that may affect stock returns. Some of these factors are well documented, such as company market value or IPO proceeds, while others are specific to biopharmaceutical companies, such as drug regulatory status, firms’ therapeutic area, and more.

* 1. **The JOBS Act and IPO Regulatory Periods in the United States**

The Jumpstart Our Business Startups (JOBS) Act, enacted in the United States in April 2012, was designed to help revitalize the IPO market by providing a series of regulatory, accounting, and disclosure easements for Emerging Growth Companies (EGC). EGCs are characterized by annual gross revenues of less than US $1 billion over the year prior the IPO. Dambra et al. (2015) documented a 25% increase in new IPOs (for a total of 21 IPOs) annually in the two years following enactment of the law compared to the two years preceding the law’s enactment. In addition, offerings of EGC and non-ECG firms increased by 53% (10%) following enactment of the law. Of these, pharmaceutical or biopharmaceutical companies had the greatest increase in activity, as they were more likely to take advantage of the act’s risk reduction provisions which permit firms to file their IPO confidentially while making overtures to qualified institutional buyers.

The IPO regulatory process is divided into a number of specified periods. The first, the pre-filing period, begins when a firm chooses an underwriter and ends when the firm files a registration statement with the SEC. The second, the waiting/pre-effective period or the quiet period, begins when the company files a registration statement with the SEC and ends when the registration statement is declared effective. During this waiting period, the laws limit the information a firm and related parties can release to the public. In addition, investment bankers and underwriters are not permitted to release any analyst coverage, including buy or sell recommendations, during this period. Once the quiet period expires, analyst coverage is released to the public. This quiet period can last as few as 10 days, but in many cases, investment bankers will require a quiet period of 25 days to fulfill their legal requirement to deliver a prospectus to the SEC. The third period, the post-effective period, begins when the registration statement is declared effective by the SEC. In the fourth, or lock-up period, major shareholders are prohibited from selling their shares. Lock-up periods usually last between 90 to 180 days following the IPO. Once the lock-up period ends, most trading restrictions are removed.

**1.3 The Clinical Journey from the Lab to the Shelf**

Product development is a critical element in the work and potential success of biotechnology firms. In general, the stages of product development research are the research project stage, the pre-clinical stage and clinical Phases I, II and III.

The research project stageis the stage of choosing a molecule, such as a gene or protein, that has pharmacological or biological activity likely to be therapeutically useful.The pre-clinical stage is aimed at determining the dosage that can be safely administered to people during the clinical phases. The clinical stages,lasting an average of six to seven years, involve testing with humans to ensure that the drug is effective and safe to use. years. A drug must meet success criteria at each of the three clinical phases before moving on to the next one.

During Phase I, the main goals are to assess safety and tolerability, and to explore how the drug interacts in the body. The main goals of Phase IIare to evaluate a drug’s effectiveness in patients, to further explore its safety, and to determine the optimal dose. Studies during this phase are usually carried out in hospitals and involve a small number of patients who are already suffering from a serious illness or who have exhausted all other existing treatments. Phase III is the final step before regulatory approval by the FDA and is the most expensive. During this phase, large studies are conducted involving 500 to 5,000 or more patients to determine a drug’s added value, effectiveness, and safety. If candidates administered the drug in Phase III testing clearly benefit from it and the drug’s risk level is acceptable, the company can file a New Drug Application (NDA) with the FDA requesting regulatory approval to market the drug. After receiving approval, the company can move to the market stage in which it manufactures and markets the drug.

 **1.4 Common Causes of Mortality in the United States**

Clearly, biotechnology firms have a strong incentive to find solutions for serious medical issues plaguing the population. The major causes of death in the United States have remained fairly consistent over the past five years, and ten factors are responsible for about 74% of all deaths.

According to the Center for Disease Control and Prevention (CDC), in 2017, heart disease was the leading cause of death for both men and women, accounting for 23.5% of all deaths. The second leading cause of death was cancer, accounting for about 21.3% of all deaths in 2017.

**1.5 Biotechnology Firms’ Shares: Lottery Type Stocks?**

Lottery stocks have been characterized in the literature as stocks with features similar to those of a lottery ticket: their purchase offers a high chance of a small loss but a small chance of a big profit (Markowitz 1952). These shares were quantitatively characterized in a study by Kumar (2009) as having low prices, high idiosyncratic bias, and high idiosyncratic volatility.

Thus, buying a share in a pharmaceutical firm during its initial stages can be likened to buying a lottery ticket, where there is a small chance of great success (as previously noted, fewer than one out of 10,000 drug discovery trials result in a new drug coming to the market) and a large chance of losing all or part of the investment, which will be reflected in the fall in the share price. Kumar (2009) finds that lottery type stocks underperform and that stock price is “one of the defining characteristics of lottery-type stocks because, like lotteries, if investors are searching for cheap bets, they should naturally gravitate toward low-priced stocks. Thus, stock price is likely to be an important characteristic of stocks that might be perceived as lotteries.” (p. 1899)

**1.6 Stocks Returns Post-IPO and Factors Affecting These Returns**

Studies involving IPOs have covered a wide range of issues and those most relevant to this paper address share performance up to three years following firms’ IPOs. Jain and Kini (1994) showed low performance of firms for up to three years following the IPOs and Loughran and Ritter (1995) reported that IPO stocks yielded an average of 5% over a one-year post-IPO period, compared to 12% for a comparably-sized non-IPO benchmark stock. In a seminal paper, Ritter and Welch (2002) investigated the long-term performance of IPOs and found that the three-year average market-adjusted return on IPOs was a negative 23.4%. In contrast, a study conducted by Goergen et al. (2009) on IPOs in France and Germany issued during the period 1996–2000 found no significant abnormal returns. Chang et al. (2017) found that applying a simple buy and hold strategy for three years after the purchase of one share of every company issuing an IPO between 1980 and 2015 would yield an 18.7% decline in value, with shares of technology firms exhibiting even greater declines.

Researchers have also been puzzled about declines in returns close to the expiration of IPO lock-up periods, and some studies have concluded that the market reacts negatively to lock-up period expirations. The research of Ofek (2000), conducted in the United States from 1996 through 1998, found an abnormal negative return during the lock-up expiration period, as well as a 1% to 3% drop in the stock price and a 40% increase in volume of trading 180 days after the IPO. Examining IPOs in the United States from 1988 through 1997, Bradley et al. (2001) (see also, Brav and Gompers [2003]; and Field and Hanka [2001]) observed negative abnormal returns of approximately 2% near the time of the lock-up period’s expiration. Komenkul and Kiranand (2017) found positive and significant CAARs of 5.57% 36 months post-IPO in ASEAN (Association of Southeast Asian Nations) countries between 1986 and 2014. Malaysia and Singapore present the highest and lowest CAARs of 57.25% and -39.4%, respectively, three years post-IPO.

Thakor et al. (2017) distinguish between pharma and biopharmaceutical companies. Their findings indicate that, for the period 2015–1980, the pharma and biotechnology sectors produced the lowest and highest average annual returns of 6% and 14%, respectively, per year. The biotechnology sector was also characterized by the highest volatility and the lowest Sharpe index during this period. Thakor et al. (2017) confirm that almost all biotechnology companies are loss-making enterprises.

Previous research has analyzed a wide range of factors that have an impact on IPOs’ long-term performance: initial return, underwriter reputation, the existence of venture capital (VC) backing, financial ratios, size, and many more. Other studies focusing the biopharma sector have also analyzed factors like R&D expenses and the number of patents. This paper refers to studies analyzing factors relevant to its research focus, including: firm size, IPO proceeds, dilution percentage, and the number of products clinically tested by the firm that resulted in mixed findings. A study conducted by Durukan (2002) analyzed stocks’ performance for three years post-IPOs on the Istanbul Stock Exchange between 1990 and 1997. Privatization, firm size, and gross proceeds were found to have positive effects on returns, while shareholder dilution was found to have a negative effect. Gao et al. (2006) suggested that a greater divergence of opinion among investors and investor sentiment were sources of long-term performance.” Firm size and IPO proceeds were found to be irrelevant variables **i**n explaining long-term excess returns. In contrast, a study conducted by Goergen et al. (2007), using a United Kingdom dataset of IPOs issued between 1991 to 1995, found firms’ size and multi-nationality at the time of the IPO to have a positive impact on long-term performance. Higher issuing costs, firms’ profitability prior to the IPO, and higher shareholder dilution were found to have negative effects on returns. The age of the firm and the reputation of the underwriter were found to be irrelevant with respect to returns. Chan and Lo (2011) suggest that firms with credit ratings present significantly less initial underpricing in comparison to firms without credit ratings and that credit-rated firms do not exhibit abnormal long-term performance. These results indicate that increased disclosure contributes to price corrections in the short term. Thomadakis et al. (2012) explored Greek IPOs between 1994 to 2002 and found that the factors affecting long-run performance were ownership concentration, board classification, and issuance during a pronounced “hot period” IPO wave. Firm market size was found to be an irrelevant factor in terms of long-term performance**.**

Regarding biopharma firms’ IPOs, Higgins et al. (2011) explored the factors affecting the IPO proceeds during the two time periods of 1989–1992 and 1996–2000, and found that “firms with an affiliated Nobel prize winner succeeded in raising the value of their firms by more than $30 million compared to firms without a Nobel laureate during the first period.” The affiliation with a Nobel Prize laureate lost its significance as a signal of value in the second period. The effect of dilution was negative in both time periods, but nevertheless dropped by about half between the two periods. The number of products a firm was testing in clinical phases had a positive significant effect in the first period only. More recent studies, such as that of Gorry and Useche (2017) suggest that a firm working on a drug with an orphan drug designation could be expected to experience higher proceeds at the IPO date. In addition, the effect of an orphan drug designation is stronger than patent applications or later-stage drugs compounds. Higher valuations were also related to the VC role, underwriters’ reputations, and R&D expenses. The number of drugs undergoing at least Phase II of clinical testing and the number of patents applied for in a four-year window prior to the IPO were not statistically significant.

**2. Data and Analysis**

Average firm market value in our database (Table 2) is US $537 million. We chose a rounded market value of $500 million as a separator threshold. Companies above this threshold value will be referred below as large companies and those valued below the threshold will be referred to as small companies.

**2.1**. **Research Goals and Hypotheses**

As described above, the quiet period of an IPO process expires 10 to 25 days after an IPO is priced and opens for trading. The launching of coverage by the underwriters on that day can have a significant impact on the stock price. The goal of this research was to investigate CAAR behavior from the IPO date to the end of the quiet period and thereafter.

We hypothesize that an upward trend can be expected in CAAR during the quiet period and a downward trend when the quiet period expires. The expected increase in CAAR during the quiet period can be attributed to the natural excitement generated by promotion immediately following the IPO. The later downward trend can be explained, in part, by the publication of reports about the company or its sector and future forecasts by affiliated analysts. Dividing the sample into two subsamples according to firm size, it is anticipated that large-sized firms will enjoy better performance because they are likely to have more experience, more available resources, and a more extensive product portfolio. The presence of these factors is likely to enhance a large firm’s potential for future success as well as attract greater attention from investors. The following hypotheses were formulated to reflect these expectations:

***H1:* Quiet Period and Stock’s Return***:* The natural excitement generated from promotion about the new IPO should result in a positive CAAR from the IPO date until the end of the quiet period. At the end of this period, when coverage by underwriters and their affiliated analysts begins, this initial excitement diminishes. As a result, the stock will then experience a negative CAAR.

***H2:* Stock Returns and Market Capitalization:**

Large-sized firms’ shares should show higher yields than do shares of small-sized firms, due to higher investor attention to large-sized firms and greater certainty about such firms’ future success.

There are multiple factors that are known to have an effect on returns, and abnormal returns (AR), mRisk, firm size and Book-to-Market Ratio are all recognized as factors affecting returns (Fama and French 1992). In the context of IPOs, other possible factors could prove relevant, some of which will be examined in this paper. Due to the long period of time required to develop a drug, financial resources are critical. Naturally, the larger the firm, the more resources it has and the greater likelihood it has of reaching the market with a product. Accordingly, we assume first, that market value will have a positive impact on returns, with a greater impact for large companies. Second, we posit that the variable of t could have two contrasting effects. On the one hand, the greater the proceeds, the more diluted the existing shareholders become, which would lead to a negative impact on returns. However, when the proceeds are greater in proportion to a firm’s value after the offering, the firm’s ability to continue its operations improves, thus positively affecting its returns Accordingly, the following additional hypotheses were formulated:

***H3:* Market Value**: Market value should have a positive impact on returns. The impact will be higher for large companies.

***H4:* IPO Proceeds**: The proceeds from the IPO proceeds should have two opposing effects. The sheer amount of the proceeds will have a negative impact on returns per shareholder. However, as a percentage of the firm’s market value, the impact of the proceeds will be positive.

Drug development is a long and expensive process (see paragraph 1.3). We hypothesize that advanced regulatory stages, such as Phase III and the market stage, will have a positive impact on returns as the company moves closer to sales or is already selling. In contrast, the earlier development stages are expected to have a negative impact on returns due to the large sums of money required until a product reaches the market, if at all. It should be noted that these stages are not mutually exclusive, as a company can be working on several products in different therapeutic areas and at different regulatory stages. We also have hypothesized that the total number of products and the number of products at each regulatory stage would have a positive impact on the returns due to higher future sales potential. As described above in paragraph 1.4, ​​cardiovascular disease and cancer are responsible for approximately 45% of deaths in the United States in recent years. We assume that engaging in research and producing as many products as possible in these areas will result in a positive impact on returns. Based on these assumption, the following hypotheses were formulated:

***H5*: Regulatory phase**: Advanced drug development stages such as Phase III and the market stage should have a positive impact on returns. The earlier stages should have a negative effect.

***H6*: Number of products**: A larger total number of products and number of products at each regulatory stage should have a positive impact on return.

***H7*: Therapeutic area**: Developing drugs in the areas of cardiology and oncology as well as the number of products in these areas should have a positive impact on returns.

Most of the firms in our database are in the early stages of drug development, and are therefore characterized by significant uncertainty. Investors will tend to treat such stocks as lottery stocks (see section 1.5), in which there is a small probability of huge rewards in the event that the firm is able to move to the next stage and a large probability of small losses if the firm fails to continue on to the next stage. If the profit potential is not realized after a short holding period, the investor will dispose of this share. It can be assumed that small firms’ shares are more likely to be perceived as lottery shares, and this is reflected in lower trading volume and lower share price.[[1]](#footnote-1) Accordingly, the following research hypothesis was formulated:

***H8*: Lottery type stocks**: Small firms’ shares are perceived as lottery stocks and therefore will underperform and experience lower trading volume and lower stock prices.

**2.2 Data and Method**

Our initial database consisted of all biotech companies that issued IPOs in the United States from January 2013 to December 2018, 96% of which were issued on the NASDAQ and the rest on the NYSE. We excluded firms that became private or were merged into or acquired by others from the time of the IPO until eighteen months following the IPO. Our final database consisted of 310 firms.

The Evaluate Pharma[[2]](#footnote-2) database was used to extract the issue date products count according to therapeutic area and regulatory stage. We extracted the issue date, price and amount of money raised from the Nasdaq site.[[3]](#footnote-3) Trading data of closing price and volume were retrieved from Yahoo Finance.[[4]](#footnote-4) Market capitalization was calculated for December of the IPO year by multiplying the number of shares appearing in the firms’ profit and loss statement by the stock price on that day. The result was confirmed with the value appearing on the stockraw.com website.

Table 1 displays IPO statistics in the United States. The proportion of biopharmaceutical firms among all the IPOs increased consistently from 12% in 2013 to 32% in 2018.

**Table 1: IPOs Per Year**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Total No. of IPOs** | **No. of Bio- Pharma IPOs** | **No. of Bio- Pharma IPOs** |
| 2013 | 248 | 30 | 12% |
| 2014 | 312 | 70 | 22% |
| 2015 | 200 | 49 | 24% |
| 2016 | 128 | 29 | 23% |
| 2017 | 210 | 50 | 24% |
| 2018 | 258 | 82 | 32% |
| Total | 1,356 | 310 | 23% |

Table 2 presents descriptive statistics of the market value of the firms in our database. A prominent feature of these firms is their relatively low market capitalization, which averaged $539 million, in comparison to the average market value of other companies issued in those years, which was $1,419 million.[[5]](#footnote-5)

**Table 2: Market Value Statistics as of December of the IPO Year ($M)**

|  |  |
| --- | --- |
| Average | 538.7 |
| Std. Dev. | 931.9 |
| Max | 11,528.2 |
| Min | 1.3 |
| Median | 296.1 |

We calculated CAAR for the 18 months following the IPO and conducted a number of sets of regressions. All calculations were performed for the entire sample and for the subsamples of large and small firms.

**2.3 CAAR Analysis**

The event study approach was employed to examine market reaction to IPO events. The actual date of the IPO was marked as t=0 and the daily stock prices were applied for the period t=0,...,375 (eighteen months post-IPO), to calculate daily logarithmic returns. Two return benchmarks, the IXJ Healthcare Index, and the S&P 500 Market Index were utilized. The Abnormal Return (AR) was calculated by subtracting the benchmark returns from the stock returns. CAAR was calculated by aggregating daily ARs and averaging across all the firms in the database. As no stock prices exist prior to the IPO, conditional returns using the market model were not calculated.

In addition, normalized trading volumes were computed as a proxy for market attention. For each firm in the sample, the natural logarithm of the daily trading volume throughout the period t=0,..,375 was recorded, and each observation was normalized by subtracting the mean and dividing by the standard deviation calculated over the period. Then, the average across all firms for each day relative to the IPO date was calculated.

2**.4 CAAR Results and Discussion**

The CAAR results for the entire sample and the two subsamples are displayed in Table 3. Panel A displays CAAR for selected time periods during the eighteen months post-IPO, Panel B contains a display of the CAAR and the normalized trading volumes, and Panel C presents the trading volumes for the entire sample and for the two subsamples. CAARs were calculated for the two benchmarks of market and sector indices. As the CAAR results relative to these two benchmarks are similar, only the results for the sector index are displayed.

**Table 3: Post-IPO CAARs, From One to 375 Days**

**Panel A: CAAR Results for Selected Time Periods Post-IPO**

|  |  |  |  |
| --- | --- | --- | --- |
| **Days Relative to Event** | **The Entire Sample** | **Market Value<$500M** | **Market** **Value >$500M** |
| CAAR, % | t-statistic | CAAR, % | t-statistic | CAAR, % | t-statistic |
| 1 to 10 | 0.77% | 0.84 | -0.11% | -0.12 | 2.70% | 1.5 |
| 1 to 20 | 3.03% | 2.54 | 1.31% | 1.23 | 6.81% | 2.9 |
| 1 to 50 | -1.63% | -0.73 | -7.01% | -2.79 | 10.17% | 2.81 |
| 1 to 100 | -7.01% | -2.08 | -16.81% | -4.4 | 14.53% | 2.82 |
| 1 to 150 | -15.53% | -3.71 | -27.70% | -5.57 | 11.19% | 1.81 |
| 1 to 200 | -21.84% | -4.56 | -37.53% | -6.68 | 12.64% | 1.74 |
| 1 to 250 | -25.80% | -5.05 | -40.88% | -6.64 | 7.34% | 0.92 |
| 1 to 375 | -43.94% | -6.91 | -62.26% | -7.98 | -3.49% | -0.36 |

**Panel B: CAAR Graphic Display**



P**anel C: Trading Volumes**



Note: Table 3 presents CAAR and trading volume results for selected time periods following the IPO. The entire sample contains 310 firms. The subsample of small firms with a market value (MV)<$500 million contains 213 firms (69%) and the subsample of large firms with a MV>$500 million contains 97 firms (31%).

As shown in Panel A of Table 3, the CAAR for the entire sample over the first 20 trading days post-IPO was positive, significant, and equals 3.03% (t = 2.54). Twenty trading days following the IPO, performance began diminishing quickly. One hundred trading days post-IPO, CAAR = -7.01% (t = -2.08); and 375 trading days post-IPO, CAAR = -43.94% (t = -6.91). These results are consistent with previous literature and support hypothesis ***H1***.

When analyzing the subsamples, the overall picture changes dramatically.With respect to small companies, CAAR for the first 20 trading days post-IPO was positive yet not significant, with CAAR = 1.31% (t = 1.23). Fifty trading days post-IPO, CAAR was negative and significant, at -7.01%, (t = -2.79). One hundred trading days post-IPO, CAAR was -16.81%, (t = -4.4). Finally, 375 trading days post-IPO CAAR was -62. 2% (t = -7.98). The results for large firms reveal a completely different picture. After 20 trading days, CAAR was positive and significant, with CAAR = 6.81%, (t = 2. 9). After 50 trading days, CAAR = 10.17%, (t = 2.81); CAAR reached its peak of 15.93% on day 105 post-IPO and began to decline from that point onward. After one year, the CAAR was 7.34% (t=0.92) until it disappeared completely 315 days post-IPO. As ***H2*** posited, large firms performed better than did small ones. However 18 months after the IPO, both small and large firms presented negative CAARs. Therefore, hypothesis ***H2*** proved correct only with respect to the first year post-IPO.

Panel B shows that the CAAR decline was consistent from day 20 onward for small firms but much more volatile for large ones. In terms of trading volume, the IPO day was characterized by the highest trading volume, which was 15 times higher than the average trading during the entire measuring period, reflecting the great excitement immediately after the IPO. Trading volume declined significantly after this day.

As shown in Panel C, the trading volume of large companies was on average 2.6 times greater than the trading volume of small ones throughout the 18 month post-IPO period.

**2.5 Regressions Equations**

According to the hypotheses in section 2.1, the extended regression equations were:[[6]](#footnote-6)

$$Return(time\\_period)/AR\left(time\\_period\right)=β\_{0}+β\_{1}Ln\left(MV\right)+β\_{2}Ln\left(Prcds\right)+β\_{3}Prcds\left(\%\right)+β\_{4}Year2013+..+β\_{8}Year2017+β\_{9}Is RP+β\_{10}Is PC+β\_{11}Is I+β\_{12}Is II+β\_{13}Is III+β\_{14}Is Mrkt+β\_{15}Prd RP+β\_{16}Prd PC+β\_{17}PrdI+β\_{18}Prd II+β\_{19}Prd III+β\_{20}Prd Mrkt+β\_{21}TPrd+β\_{22}Is Onco+β\_{23}Is Crdio+β\_{24}Prd Onco+β\_{25}PrdCrdio$$

The explained variable was return or AR. AR was calculated for two benchmarks: the S&P5 00 Market Index and the Pharma Sector Index IXJ.
The explanatory variables were:

* MV (Ln) represents the natural logarithm of a firms’ market value;
* Ln (Prcds) represents the natural logarithm of the amount of money raised in the IPO;
* Prcds (%) represents the amount raised as a percentage of the firm’s market value;
* Years 2013 to Year2017 are dummy variables for the issued years. Year 2013 receives 1 for 2013 and 0 otherwise and so on;
* RP represents Research Project;
* PC represents Pre-Clinical;
* I, II and III refers to Phases I through III respectively;
* Mrkt represents for the market stage.

The next set of variables beginning with “Is” is a set of dummy variables for the firm’s drug regulatory stages. The dummy variable receives 1 if the firm has products at this stage and 0 otherwise.

The next set of variables from Prd RP to Prd Mrkt are the number of products at each regulatory stage. It should be noted a firm can have several products in different regulatory stages.

* T Prd represents the total number of products for a firm;
* Is Onco/Is Crdio is a dummy variable that receives 1 if the company has oncology or cardiology products and 0 otherwise;
* PrdOnco/PrdCrdio are the number of products in the field of oncology and cardiology respectively. These variables were measured on the day of issue.

The number of observations in this section is lower than in the previous one, due to the partial availability of data.

We performed three sets of OLS regressions that differed within the time period of the explained variable at the points of six, twelve and eighteen months post-IPO date. We conducted these regressions for the entire sample and for the subsamples of large and small firms.

**2.6 Regression Results and Discussion**Results for the sector index only are being presented due to a great similarity in results for AR for the two benchmark indices. The results of the reduced models are presented in Table 4. Panels A, B and C of Table 4 present data for the six, twelve and eighteen months points after the IPO respectively. We will refer below to the results of the return variable because of the similarity of results for the AR and the return.

**Table 4: Regressions Results**

**Panel A: Six Months Post-IPO**

|  |  |  |  |
| --- | --- | --- | --- |
|   | **The Entire Sample** | **Market Value < $500M** | **Market Value > $500M** |
|   | Return  | AR to Sector | Return | AR to Sector | Return | AR to Sector |
| Intercept | -0.13 (0.63) | -0.19 (0.48) | -0.2 (0.48) | -0.27 (0.35) | 0.46 (0.66) | 0.36 (0.73) |
| Ln(MV) | 0.42 (0.00) | 0.41 (0.00) | 0.23 (0.00) | 0.24 (0.00) | 0.70 (0.00) | 0.68 (0.00) |
| Ln(Prcds) | -0.49 (0.00) | -0.48 (0.00) | -0.26 (0.00) | -0.25 (0.00) | -0.92 (0.00) | -0.89 (0.00) |
| Prcds(%) | 0.07 (0.04) | 0.07 (0.04) |   |   |   |   |
| Year 2013 | 0.25 (0.05) | 0.14 (0.25) | 0.41 (0.00) | 0.31 (0.02) | -0.11 (0.68) | -0.21 (0.42) |
| Year 2014 | 0.18 (0.08) | 0.1 (0.33) | 0.12 (0.24) | 0.04 (0.69) | 0.06 (0.81) | -0.01 (0.98) |
| Year 2015 | -0.14 (0.21) | -0.09 (0.41) | -0.01 (0.92) | 0.03 (0.77) | -0.58 (0.02) | -0.50 (0.04) |
| Year 2016 | 0.27 (0.18) | 0.23 (0.25) | 0.43 (0.04) | 0.40 (0.05) | 0.09 (0.85) | -0.02 (0.97) |
| Year 2017 | 0.1 (0.47) | 0.07 (0.60) | 0.22 (0.19) | 0.18 (0.27) | -0.11 (0.65) | -0.13 (0.60) |
| Is Rsrc | -0.25 (0.00) | -0.25 (0.00) | -0.17 (0.03) | -0.17 (0.03) | -0.46 (0.00) | -0.45 (0.00) |
| Is I |   |   |   |   | -0.27 (0.08) | -0.25 (0.10) |
| Is Mrkt |   |   | 0.55 (0.01) | 0.57 (0.01) |   |   |
| Adj R Sqr. | 0.28 | 0.26 | 0.24 | 0.22 | 0.37 | 0.34 |
| Obs. | 212 | 212 | 145 | 145 | 67 | 67 |

**Panel B: Twelve Months Post-IPO**

|  |  |  |  |
| --- | --- | --- | --- |
|   | **The Entire Sample** | **Market Value < $500M** | **Market Value > $500M** |
|   | Return  | AR to Sector | Return | AR to Sector | Return | AR to Sector |
| Intercept | -0.77 (0.06) | -0.84 (0.04) | -1.23 (0.00) | -1.28 (0.00) | 1.01 (0.54) | 0.82 (0.62) |
| Ln(MV) | 0.40 (0.00) | 0.40 (0.00) | 0.16 (0.01) | 0.16 (0.01) | 0.61 (0.03) | 0.62 (0.03) |
| Ln(Prcds) | -0.42 (0.00) | -0.41 (0.00) |   |   | -1.04 (0.00) | -1.02 (0.00) |
| Prcds(%) | 0.09 (0.08) | 0.09 (0.08) |   |   |   |   |
| Year 2013 | 0.45 (0.01) | 0.27 (0.14) | 0.73 (0.00) | 0.55 (0.00) | -0.12 (0.76) | -0.28 (0.46) |
| Year 2014 | 0.43 (0.00) | 0.33 (0.03) | 0.35 (0.02) | 0.25 (0.09) | 0.57 (0.1) | 0.48 (0.17) |
| Year 2015 | -0.15 (0.38) | -0.05 (0.77) | -0.07 (0.69) | 0.03 (0.85) | -0.34 (0.33) | -0.24 (0.50) |
| Year 2016 | 0.50 (0.09) | 0.49 (0.09) | 0.72 (0.01) | 0.7 (0.02) | -0.05 (0.94) | -0.01 (0.99) |
| Year 2017 | 0.46 (0.02) | 0.43 (0.03) | 0.22 (0.34) | 0.2 (0.4) | 0.73 (0.05) | 0.71 (0.06) |
| Is Mrkt | 0.33 (0.15) | 0.33 (0.15) | 1.1 (0.00) | 1.12 (0.00) |   |   |
| Prdc cnt II | 0.10 (0.05) | 0.10 (0.04) | 0.11 (0.03) | 0.11 (0.03) |   |   |
| Prdc cnt III | 0.13 (0.13) | 0.14 (0.12) |   |   |   |   |
| Adj R Sqr | **0.23** | **0.19** | **0.27** | **0.21** | **0.27** | **0.24** |
| Obs. | 208 | 208 | 144 | 144 | 64 | 64 |

**Panel C: Eighteen Months Post-IPO**

|  |  |  |  |
| --- | --- | --- | --- |
|   | **The Entire Sample** | **Market Value < $500M** | **Market Value > $500M** |
|   | Return  | AR to Sector | Return | AR to Sector | Return | AR to Sector |
| Intercept | -1.72 (0.00) | -1.82 (0.00) | -2.09 (0.00) | -2.19 (0.00) | -12.98 (0.01) | -12.92 (0.01) |
| Ln(MV) | 0.22 (0.00) | 0.22 (0.00) | 0.27 (0.01) | 0.27 (0.01) | 5.47 (0.00) | 5.32 (0.00) |
| Ln(Prcds) |   |   |   |   | -6.22 (0.00) | -6.00 (0.00) |
| Prcds(%) |   |   | 0.1 (0.08) | 0.1 (0.06) | 37.53 (0.01) | 36.33 (0.01) |
| Year 2013 | 1.08 (0.00) | 0.82 (0.02) | 1.15 (0.00) | 0.89 (0.01) | 1.03 (0.19) | 0.79 (0.30) |
| Year 2014 | 0.61 (0.06) | 0.57 (0.07) | 0.46 (0.11) | 0.41 (0.14) | 0.63 (0.4) | 0.67 (0.37) |
| Year 2015 | 0.07 (0.83) | 0.2 (0.55) | -0.1 (0.75) | 0.03 (0.92) | 0.19 (0.81) | 0.34 (0.66) |
| Year 2016 | 0.8 (0.08) | 0.73 (0.11) | 0.77 (0.07) | 0.69 (0.09) | 1.28 (0.23) | 1.21 (0.25) |
| Year 2017 | 0.41 (0.28) | 0.4 (0.28) | 0.05 (0.88) | 0.07 (0.86) | 0.93 (0.23) | 0.95 (0.21) |
| Is I |   |   | 0.32 (0.04) | 0.29 (0.06) |   |   |
| Is Mrkt | 0.61 (0.06) | 0.65 (0.04) | 2.25 (0.00) | 2.31 (0.00) | -0.92 (0.08) | -0.88 (0.08) |
| Prdc cnt III | 0.3 (0.04) | 0.3 (0.04) |   |   |   |   |
| Adj R Sqr | 0.19 | 0.15 | 0.42 | 0.38 | 0.15 | 0.13 |
| Obs. | 173 | 173 | 119 | 119 | 54 | 54 |

Market value was found to have a positive impact on returns over time. The coefficient for large firms is larger than for small ones and its effect increased over time. Coefficient values ​​were 0.7 for large firms versus 0.23 for small firms six months post-IPO, 0.61 for large firms versus 0.16 for small firms 12 months post-IPO, and 5.47 for large firms versus 0.27 for small firms 18 months post-IPO. These results validate hypothesis ***H3***.

The IPO proceeds as measured by Ln(Prcds) adversely affected returns in the first six months after the IPO. Its effect on large companies was 3.5 times greater than on small ones: -0.92 versus -0.26. Following this period, the effect of the IPO proceeds primarily affected the large firms, and its impact increased with time, from -1.04 twelve months post-IPO and -6.22 eighteen months post-IPO. Prcds(%), the amount raised as a percentage of the company’s MV, had a positive impact on returns. Up to one year after the IPO, the coefficient appeared significant for the entire sample. However, 18 months after the IPO, the coefficient was 375 times higher for large firms than for the small ones: 37.53 versus 0.1.

Examining the aggregate effect of the IPO proceeds, in the first year, it was negative for the entire sample. However, after 18 months, the direction reversed and the effect was positive for the subsample of large firms. We suggest that the negative effect in the first year after the IPO is attributable mainly to shareholder dilution. Over time, if the money raised is used in a way that contributes to the prosperity of the firm, the effect becomes positive, as reflected in the subsample of large firms. This finding supports hypothesis ***H4***.

The coefficients of the years were tested as a group. Because some of them were significant, they remained in the limited model.

If a firm was in the research phase, this was found to have a negative effect on the returns, but only in the first six months post-IPO. Being in Phase I had a negative impact on large firms in the first six months after the IPO, but a positive impact on small firms 18 months after the IPO. We suggest that firms that are in Phase I at the time of the IPO may achieve greater advances after a year and a half. Being at the market stage during the first six months after the IPO seems relevant only for small firms, and has a positive effect. One year post-IPO this effect remains positive and becomes significant for the entire sample, probably because of the impact of the increased returns for the small firms. Eighteen months post-IPO, being in the market stage still has a positive effect on small firms, but has a surprisingly negative effect for the large ones. For small companies, the effect increased over the years from 0.55 six months post-IPO to 1.1 twelve months post-IPO and 2.25 18 months post-IPO. This rise in the effect of being in the market stage can most likely be attributed to increasing sales over time. These results validate **hypothesis *H5*.**

The total number of products was found to be irrelevant in explaining abnormal returns and therefore is not included in the reduced model. Consequently, the first half of hypothesis ***H6***, positing that the total number of products can have a positive effect on returns, was invalidated. The number of products in Phase II was found to have a positive effect on the one-year return after the IPO for the entire sample and for the small firms. The number of products in Phase III was found to have a positive effect on the entire sample at twelve and eighteen-months post-IPO. In view of the time that passed from the date of the IPO, it is likely that some of these products ultimately reached the market stage, which would account for the positive effect observed. Therefore, the second half of hypothesis ***H6***,positing that the number of products at each regulatory stage would have a positive effect on returns, was confirmed. Next, it was found that engaging in the therapeutic areas of cancer and heart disease had no effect on the (abnormal) return. Consequently, hypothesis ***H7*** was rejected**.**

Lastly, to examine hypothesis ***H8***, we compared the average share price for each subsample at different points in time after the IPO. The results are shown in Table 5**.**

**Table 5: Average Share Price**

|  |  |  |  |
| --- | --- | --- | --- |
|   | MV< $500M | MV>$500M | P-value of Diff |
| Day 0 | 15.3 | 21.7 | <0.01 |
| Day 100 | 15.1 | 24.7 | <0.01 |
| Day 200 | 13.9 | 26.0 | <0.01 |
| Day 250 | 13.4 | 26.3 | <0.01 |
| Day 375 | 13.7 | 27.6 | <0.01 |

The results displayed in Table 5 indicate that, at any given point in time, small firms’ stocks are characterized by lower stock prices than are large firms’ stocks. In addition, as was presented in Table 3, small firms underperform and have lower trading volumes than do large firms. We therefore conclude that small firms can be perceived as lottery stocks, thus confirming hypothesis ***H9***.

**3. Summary and Conclusions**

This paper analyzed the CAAR behavior of biotechnology firms that went public after the JOBS Act was enacted, and investigated the factors that could influence returns. In general, the JOBS Act aimed to facilitate small firms’ access to the capital market and boost job creation.

Market Value has been shown to be a critical predictor of the success of a biotechnology firm in the short term after the issuance. A value of $500 million was found to be a confidence threshold in investors’ willingness to buy and hold a share. Companies above this threshold gained investors’ confidence as reflected in their higher trading volumes and positive CAARs in the year following the IPO. Firms valued below this threshold might be perceived as lottery stocks that investors sell at a loss a short time after their purchase, and thus exhibit negative CAARs a few months after the IPO. The IPO ignites an initial period of enthusiasm which rises until the end of quiet period, whereupon investors’ attention to small-sized firms gradually diminishes, as they seek their next lottery-like opportunity. In spite of the success of the JOBS Act in increasing the proportion of biopharmaceutical companies among all new offerings, in the short term, the consequences of IPOs for small pharma firms was a substantial loss to their shareholders. As suggested by Zingales (1995), Mello and Parsons (1998) and Dambra et al. (2015), an IPO can be a first step towards a future sale. This seems particularly relevant to small pharma firms whose acquisition by an established, asset-rich firm is likely to be the best option to support the drug development process until its successful completion.

Regarding other factors effecting returns, it was found that shareholder dilution had a negative effect in the post-IPO year, but reversed its direction 18 months post-IPO. The negative effect of being in its early stages of research is likely to be due to the inherent uncertainty in the process of developing a drug. Lastly, a firm’s research in the areas of oncology and cardiology was found to be irrelevant for its stocks’ returns.

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1. Due to the fact that new issues are being addressed in this paper, and given the short period after the IPO that is being examined, volatility and idiosyncratic bias cannot be examined. [↑](#footnote-ref-1)
2. EvaluatePharma database is one of the top global pharma databases: http://www.evaluate.com/ [↑](#footnote-ref-2)
3. <https://www.nasdaq.com/market-activity/ipos> [↑](#footnote-ref-3)
4. <https://finance.yahoo.com/> [↑](#footnote-ref-4)
5. According to Jay R. Ritter, University of Florida, Warrington, Department of Finance https://site.warrington.ufl.edu/ritter/ipo-data/ [↑](#footnote-ref-5)
6. As trading starts on the IPO date, parameters such as risk, Book-to-Market Ratio, value, volatility, and more could not be measured over a time period before the event and therefore are not included. [↑](#footnote-ref-6)