**The Psychology Threshold of Market capitalization for Biotechnology IPOs:**

Smadar Siev and Tiran Rothman

**Abstract**

We examine stock return behavior post IPO events in the biotechnology sector and investigate the factors that may influence this behavior.

The results indicate positive Cumulative Average Abnormal return (CAAR) of 3.03% in 20 days after the IPO until the end of the quiet period for all firms under scrutiny, and a decline of tens of percent in the 18 months post IPO. When the sample is divided into two subsamples by firm size, we find a market value (MV) of $500 million as a threshold for positive or negative post IPO yields. Companies with a MV below this threshold present a positive but not significant CAAR in the first 20 days and a significant negative CAAR from day 31 onwards. In contrast, companies above this threshold shows a significant positive CAAR 20 days post IPO, followed by a consistent increase in CAAR for the next few months. We also found that MV, IPO proceeds, shareholders dilution and clinical phases are critical factors determining post IPO returns. In conclusion, we suggest that investors perceive firms' market value of $500 million as a confidence threshold when investing in newly issued biotechnology firms. We postulate that firms above this size attract more attention and gain investor confidence. firms below this size presents might perceive as lottery stocks as IPO ignites a period of enthusiasm until quiet period ends and then investors’ attention to small size firms diminish gradually, as they seek their next 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. It is one of the world’s top five industries by revenues and capitalization, with total annual revenues of more than US$700 billion, the vast majority of the revenues being produced by multinational pharmaceutical giants that have been dominating the industry for decades. The development of a new drug can take on average 12 to 14 years and costs 1.3 to 1.6 Billion of dollars. Of 10,000+ drug discovery attempts, only one will eventually lead to a new drug coming to the market. Over the last decade the industry has been changing with the rapid development of biotechnology, creating space for smaller pharmaceutical firms. The JOBS act (detailed below) facilitated access to the capital market for small firms. As a result, a growing number of biotech companies are seeking to raise public capital throughout IPOs.

**1.1 Focus of the study**

This paper focuses on biotechnology firms that were issued in United States between January 2013 and December 2018. We aim to understand if and how the new JOBS ACT regulation, enacted in the US in April 2012, had affected returns during the eighteen months post-IPO. In the first part, we analyze the CAAR. In the second part, we analyzed factors that may affect stocks' return. Some of which are well documented like company market value or IPO proceeds, others are specific to biopharmaceutical companies, such as its drug regulatory status, firms' therapeutic area and more.

* 1. **The JOBS act and regulatory Periods surrounding IPO in the U.S**

The Jumpstart our Business Startups (JOBS) Act that was 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). EGC are Characterized by annual gross revenues of less than $1 billion over the year prior the IPO. Dambra et al (2015) documented an increase of twenty-one (25%) new IPOs per year in the two years post IPO compared to the two years pre-law levels. offerings of EGC (non-ECG) firms increased by 53% (10%). Of these, pharmaceutical or biopharmaceutical companies increased activity the most, as they are more likely to take advantage of the act's de-risking provisions, allowing firms to file the IPO confidentially while testing-the-waters with qualified institutional buyers.

IPO regulatory process are characterized by a few periods. The first, the pre-filing period begins when a firm chooses an underwriter and ends when it files a registration statement with the SEC. The second, the waiting period/ 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 that period, laws limit the information a firm and related parties can release to the public, investment bankers and underwriters cannot release any analyst coverage including buy or sell recommendations. Once a quiet period expires, analyst coverage will be released to the public. This quiet period expiration can take place in as little as 10 days, but in many cases investment bankers will still require a quiet period of 25 days to coincide with their obligation 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 after the IPO. Once the lock-up period ends, most trading restrictions are removed.

 **The clinical journey from the lab to the shelf1.3**

In general, there are research project, pre-clinical and clinical stages I, II and III.

***The research project stage*** is the stage of choosing a molecule; such as gene or protein that has pharmacological or biological activity likely to be therapeutically useful. ***The pre-clinical stage*** aimed at determining the safe dosage that can be given to people in the clinical phases. **The clinical stage** involves testing in humans to make sure the drug is effective and safe to use and lasts an average of 6 to 7 years. A drug must meet success criteria at each phase before moving on to the next one. This stage consists of 3 phases. **Phase I:** main goals are to assess safety and tolerability, and explore how the drug behaves in the body. **Phase II:** main goals are to evaluate effectiveness in patients, to further explore its safety, and to determine the best dose. It is usually done in hospitals and involves a small number of patients that are already in serious illness or have already exhausted existing treatments. **Phase III:**  is the final step before regulatory approval by the FDA and it is the most expensive. Large studies are conducted involving 500 to 5,000 or more patients, to determine its added value and sufficiently effectiveness and safety. If the drug candidates show clear benefits and acceptable risks in phase 3, the company can file an NDA (New Drug Application), requesting regulatory approval to market the drug. After the approval, the company moves to the market stage in which it will manufacture and market the drug.

**1.4 Common causes of US mortality**

Ten factors are responsible to about 74% of deaths in the United States, and the major causes have remained fairly consistent over the past five years.
According to the Centers for Disease Control and Prevention (CDC), in 2017 heart disease is the leading cause of death for both men and women and it accounts for 23.5% of all deaths. The second cause is cancer, accounting for about 21.3% of all deaths in this year.

**1.5 Biotechnology firms shares as lottery type stocks?**

Lottery stocks have been characterized in the literature as stocks that exhibit features similar to a lottery ticket purchase, in which there are great chances of small loss but little chance of big profit (Markowitz 1952). These shares were quantitatively characterized in the Kumar (2009) study as having low price, high idiosyncratic bias and high idiosyncratic volatility.
Buying a share of a pharmaceutical firm in its initial stages can be viewed as having similar characteristics of buying a lottery ticket: there is a small chance of great success. (less than one to 10000 of a drug discovery profile leads to 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) Find 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." (pg. 1899)

**1.6 Stocks returns post IPO and the factors affecting this return**

While numerous issues involving IPOs have been widely studied, those most relevant to this study address share performance up to three years following the IPOs. Jain and Kini (1994) showed low performance of IPOs for up to three years after the offering, 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. 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 technological 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 periods expirations. The research of Ofek (2000), conducted in the United States from 1996 through 1998, found an abnormal negative return during this period as well as a 1% to 3% drop in the stock price, and a 40% increase in volume 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]) all observed negative abnormal returns of approximately 2% near the time of the lock-up period’s expiration. Komenkul, & Kiranand (2017) found to have positive and significant CAAR of 5.57%, 36 months post IPO in ASEAN (Association of Southeast Asian Nations) countries between 1986 and 2014. Malaysia (Singapore) presents the highest (lowest) CAAR of 57.25% (-39.4%) 3 years post IPO. Thakoret at. al.(2017). distinguish between pharma and biopharmaceutical companies. Their findings indicate that, for the period 2015 - 1980, the biotech (pharma) sector produced the lowest (highest) average annual returns of 6% (14%) per year. The biotech sector was also characterized by the highest volatility and the lowest Sharp index during this period. They confirm that almost all biotech companies are loss making enterprises.

Previous research analyzes a wide range of factors to explain IPOs long term performance: initial return, underwriter reputation, the existence of venture capital (VC) backing, financial ratios, size and many more. Others focusing the biopharma sector also analyzed factors like R&D expenses and the number of patents. We hereby refer to studies that were analyzing factors relevant to this paper such as: firm size, IPO proceeds, dilution percentage and the number of products the firm has in its of clinical testing for whom former findings were mixed. A study conducted by Durukan, M. B. (2002) analyzed stocks performance for 3 years post IPOs in Istanbul stock exchange between 1990 and 1997. Privatization, Firm size and gross proceeds was found to have positive effect on returns. Dilution was found to have negative effect. Gao et al (2006) suggested that a greater divergence of opinion among investors and investor sentiment are sources of long-term performance". F**irm 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), who used a UK dataset of IPOs issued between 1991 to 1995, found **Firms' size** at the time of the IPO, and multi nationality to have positive impact on long term performance. Higher issuing costs, firms' profitability prior to the IPO ang **higher shareholders dilution was found to have negative** effect on returns. The age of the firm and the reputation of the underwriter were found as irrelevant. Chan, & Lo (2011) suggest that firms with credit rating present significantly less initial underpricing in compare to firms without credit rating and these firms do not have abnormal long-term performance. These results indicate that an increased disclosure helps price corrections in the short term. Thomadakis, et. al. (2012) explored Greek IPOs between 1994 to 2002 and found that the factors effecting long-run performance were the ownership concentration, the board classification and issuing during a pronounced 'hot period' IPO wave. Firm **market Size was found as irrelevant factor.**

Regarding biopharma firms IPO, Higgins, et al (2011). explored the factors effecting the IPO proceeds in two time periods 1989 to 1992 and 1996 to 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". Nobel Prize lost its shine as a signal of value in the second period. The effect of dilution was negative in the two time periods, but falls by about half between the two periods. The number of products in clinical phases has positive significant effect only in the first period. More recent studies such of Gorry, & Useche (2017) suggested that additional Orphan drug designation is related with an increase in the proceed collected by a firm at the IPO date and its affect is stronger than patent applications or later stage drugs compound. Higher valuations were also related to VC role, underwriter's reputation, R&S expenses. The number of drugs in at least phase II and the number of patents applied in a four-year window before the IPO was not statistically significant.

**2. Data and analysis**

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

2.1. **Research Goals and Hypotheses**

As described above, the quiet period 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. Our goal was to investigate CAAR behavior from the IPO date to the end of the quiet period and thereafter.

Thus, it can be expected to see an upward trend in CAAR during the quiet period and a downward trend when it expires. An increase in CAAR is expected due to the natural hype immediately following the IPO. The later downward trend can be explained, in part, to the publishing of numerous reports about the company or its sector and future forecasts by affiliated analysts. Dividing the sample into two subsamples according to firm size, we expect to observe better performance among large-sized firms because large-sized firms are likely to have more experience, more available resources and a bigger product portfolio. The presence of these factors is likely to enhance a large firm’s potential for future success as well as to attract greater attention from investors. We formulated the following hypotheses to reflect these expectations:

***H1: Quiet Period and* Stock’s return**: The natural hype from the new IPO will yield positive CAAR from the IPO date until the end of the quiet period. At the end of this period, when coverage initiates by underwriters and their affiliated analysts, the initial hype diminishes, as a result the stock will experience a negative CAAR.

***H2:* Sock returns and market capitalization:**

Large-sized firms shares will show higher yield than small-sized firms, due to higher investors' attention and certainty in their future success. Large-sized firms.

We will now turn to examine the factors that may affect return and abnormal return (hereafter AR). Multiple factors are known to explain stock returns. Risk, firm size and Book to Market Ratio are all known (Fama & French (1992)). In the context of IPO, other possible factors might be relevant and some of them will be examined here. Due to the long time required to develop a drug, financial resources are critical. Naturally, the larger the firm, the more resources it has and greater likelihood of reaching the market with a product. Accordingly, we assume that (i) market value will have a positive impact on returns. In particular, the impact will be greater for large companies. (ii) The IPO proceeds. This variable may affect in opposite directions. First, the larger the proceeds, the more diluted the existing shareholders are, and therefore we expect a negative impact on return. On the other hand, the larger the proceeds, in percentage of firms' value after the money, the better firms' ability to continue its operations, that would effect positively on returns. Accordingly, we formulated the following hypotheses:

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

**H4: IPO proceeds**: the IPO proceeds will affect in opposite directions. The sheer amount will have a negative impact on returns. In percentage of firms, market value, the impact 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 is closer to sales or is already selling. Whereas the earlier stages will have a negative impact 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 the company can have several products in different therapeutic areas and in different regulatory stages. We also hypothesized that the total number of products and the number of products at each regulatory stage would have a positive impact on the return due to the higher future sales potential. As described above in paragraph 1.4, the area of ​​cardiovascular disease and cancer are responsible for approximately 45% of deaths in the United States in recent years. We assume that engaging in these areas and the number of products in them will have a positive impact on returns.
We respectively formulated the following hypotheses:

**H5: Regulatory phase**: Advanced drug development stages: phase III or market stage will have a positive impact on returns. The earlier stages will have a negative effect.

**H6: Number of products**: The total number of products and the number of products at each regulatory stage will 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 will have a positive impact on return.

In our database, the majority of the firms are in the early stages of drugs development and therefore are characterized by a lot of 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 (moving to the next stage) and a large probability of small losses (failure to pass the next stage). If the profit potential is not realized after a short holding period, the investor will get rid of this share. We assume that small firms' shares are more likely to be perceived as lottery shares. As reflected in lower trading volume and lower share price[[1]](#footnote-1). We respectively formulated the following research hypothesis:
**H8: Lottery type stocks**: Small firms' shares are perceived as lottery stocks and therefore will underperform and will demonstrate lower trading volume and lower stock price

**2.2 Data and Method**

Our initial database consisted of all biotech companies that issued IPOs in the U.S. from January 2013 to December 2018. In our database, 96% of the firms were issued on NASDAQ and the rest in 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.

Evaluate Pharma[[2]](#footnote-2) database was used to extract the issue date products count by therapeutic area and by regulatory stage. We extract issue date, price and the 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 is for December of the IPO year. It was calculated 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 IPOs statistics in the U.S. The part of biopharmaceutical firms from all the IPOs is increasing 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 is their relatively low market capitalization. The average market value of $539 million is relatively low in compared to the average market value of companies issued in those years, which was $1,419 million.[[5]](#footnote-5)

**Table 2: Market Value statistic at 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 after the IPO and conducted a few 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 were utilized: the IXJ Healthcare Index, and the S&P 500 Market Index. The Abnormal Return (AR) was calculated by subtracting the benchmark returns from the stock return. And CAAR was calculated by aggregating daily AR and averaging across all the firms in the database. As no stock prices exist prior to the IPO, conditional return using the market model was 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 sub samples are displayed in Table 3. Panel A display CAAR for selected time periods during the eighteen months post-IPO, Panel B contains graphical display of the CAAR and the normalized trading volumes. Panel C presents the sheer trading volumes for the entire sample and for the two sub samples. CAAR were calculated for the two benchmarks of market and sector indices. As the CAAR results relative to the two benchmarks are similar, only the results for the sector index are displayed

**Table 3: Post-IPO CAARs, 1 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



Panel C



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

As shown in Panel A of Table 3, for the entire sample, CAAR of the first 20 trading days post-IPO is positive, significant, and equals 3.03% (t = 2.54), After 20 trading days, performance began to decrease, diminishing quickly. In the 100th trading day, CAAR = -7.01% (t = -2.08); 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 sub-samples, 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); 100 trading days post- IPO, CAAR was -16.81%, (t = -4.4); until -62. 2% (t = -7.98) 375 trading days post IPO. 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 reaches its peak of 15.93% on day 105 post-IPO and begins to decline from that point onward. After a year the CAAR is 7.34% (t=0.92) until it disappears completely 315 days post-IPO. As was claimed in H2 large firms perform better than small ones, however 18 months after the IPO, both small and large firms present negative CAAR. Therefore, hypothesis H2 proved to be right only for 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. It was 15 times higher than the average trading during the whole measuring period, indicating the great hype immediately after the IPO. Trading volume declines significantly after this day.
As shown in Panel C, the trading volume of large companies was greater on average 2.6 times than the trading volume of small ones throughout the 18 months period .

**2.5 Regressions Equation**

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 & P500 market index and the Pharma Sector Index IXJ.
The explanatory variables were:
MV (Ln) - the natural logarithm of a firms' market value. Ln (Prcds) is the natural logarithm of the amount of money raised in the IPO, Prcds(%) the amount raised as a percentage of the firm's market value. Year2013 to Year2017 are dummy variables for the issued years, Year2013 gets 1 for 2013 and 0 otherwise and so on. RP stands for Research Project, PC stands for Pre-Clinical, I, II and III are for phases I through III respectively, and Mrkt stands for the market stage. The next set of variables beginning with "Is" are a set of dummy variables for the firm's drug regulatory stages. The dummy variable gets 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 - is the total number of products for a firm. Is Onco (Is Crdio) is a dummy variable that receives 1 if the company has oncology (cardiologic) 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, due to the partial availability of data.
We performed 3 sets of OLS regressions that differed within the time period of the explained variable that was 6, 12, and 18 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**we will present results only for the sector index, due to 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 are for the six, twelve and eighteen months 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 return.

**Table 4: Regressions Results**

**Panel A: Six months following the 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 following the 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 following the 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 return over time. The coefficient for large firms is larger than for small ones and its effect increases over time. Coefficient values ​​were 0.7 versus 0.23, 0.61 versus 0.16 and 5.47 to 0.27 at 6, 12, and 18 months after the IPO, respectively. These results validate H3.

The **IPO proceeds** as was measured by Ln(Prcds) adversely affects returns, in the first six months after the IPO. its effect on large companies is 3.5 times higher than on small ones -0.92 versus -0.26. Subsequently, it was found to be mainly affecting the large firms, and its influence increased with time -1.04 and -6.22 in the twelve and eighteen months after the IPO respectively. Prcds(%) , the amount raised as a percentage of the company's MV has a positive impact. Up to one year after the IPO, the coefficient appears significant only for the entire sample, at 18 months after the IPO, it is 375 times higher for large firms than for the small ones 37.53 versus 0.1.
If we look at the aggregate effect of the IPO proceeds, In the first year the effect is negative for the entire sample. However, after 18 months, the direction is reversed and the effect is positive for the large firms' sub-sample. We suggest that the negative effect in the year after the IPO is mainly due 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 large firms sub sample. This proves **hypothesis H4**.

The coefficients of the years were tested as a group, some of them significant so we left them in the limited model.

Being in the **research phase** 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 18 months after the IPO, a positive effect was found for small firms. We suggest that firms that are in Phase I at the time of the IPO may reach more advanced stages after a year and a half. Being at the **market stage**, in the first six months after the IPO seems relevant only for small firms and have a positive effect, after a year it stay positive and becomes significant for the entire sample, probably because of the small firms. eighteen months from IPO it still has positive effect on small firms, but surprisingly negative effect for the large ones. For small companies, the effect increased over the years from 0.55 to 1.1 and 2.25 at 6, 12 and 18 months after the IPO respectively. Probably due to increasing sales over time. These results prove **hypothesis H5.**

The **total number of products** was found to be irrelevant in explaining (abnormal) return and therefore is not included in the reduced model. Hereby the first half of Hypothesis **H6** was rejected. 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 twelve- and eighteen-months post IPO. In view of the time passed from the IPO day, it is likely that some of these products reached the market stage and therefore a positive effect is observed. Therefore, the second part of Hypothesis **H6** was proved. Next, it has been found that engaging to the therapeutic areas of **cancer and heart** disease, has no effect on the (abnormal) return. Hereby Hypothesis **H7** was rejected**.**

Lastly, to examine hypothesis H8, we compared the average share price for each subsample at different time points 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 in table 5 indicate that, at any given point in time, small firms' stocks are characterized by lower stock prices than large firms' stocks. In addition, as was presented in table 3, small firms underperform and have lower trading volume. We will conclude therefore that small firms may perceive as lottery stocks. And with that we proved the hypothesis **H9**.

**3. Summary and conclusions**

In this paper we analyzed the CAAR behavior for biotechnology firms, that went public after the JOBS act was enacted and investigate the factors that may influence returns. In general, the JOBS ACT aimed to ease small firm to access the capital market and boost job creation.

Market Value has been shown to be a critical predictor in the success of a biotechnology firm for 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 gain investors' confidence as reflected in their higher trading volumes and positive CAAR in the year following the IPO, those below this threshold might perceived as lottery stocks that investors sell them in loss short time after their purchase and hence exhibits negative CAAR few months after the IPO. The IPO ignites a period of enthusiasm which rises until the end of quiet period and then investors’ attention to small size firms diminish gradually, as they see their next lottery like opportunity. In spite of the success of the JOBS Act in increasing the share of biopharmaceutical companies from all new offerings. in the short term, the consequences 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), 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 end.

 Regarding other factors effecting returns, we find that shareholder dilution had negative effect in the post IPO year but reversed its direction 18 months post IPO date. 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, dealing with the areas of oncology and cardiology found to be irrelevant for stocks return.

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1. Due to the fact that we deal with new issues, and 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, UF Warrington Faculty https://site.warrington.ufl.edu/ritter/ipo-data/ [↑](#footnote-ref-5)
6. As trading starts at the IPO date, parameters such as risk, book to market, volatility and more could not be measured in a time period before the event and therefore are not included. [↑](#footnote-ref-6)